U.S. ARMY CORPS OF ENGINEERS

DRAFT

GROUNDWATER REMEDIAL ACTION WORK PLAN
FOR THE
FORMER RARITAN ARSENAL
EDISON, NEW JERSEY

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TABLE OF CONTENTS

Section **Title** **Page**

TABLE OF CONTENTS
(CONTINUED)

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDIXES

Appendix	**Title**
A	NJDEP Correspondence
	Comment Letter for the Draft Final Groundwater Natural Attenuation Report (July 2002) to USACE, dated 12 March 2003 (5 pages)
	Attachment A from USACE Response to 06 May 2006 Comment Letter on the Draft Supplemental Groundwater Data Report, dated 29 September 2006 (10 pages)
	Notice of Deficiency Letter for Draft Indoor Air Quality Semi-Annual Report #2, dated 12 January 2007 (7 pages)
	USACE Response to 06 NJDEP Comment #3, regarding AOC 7, MW-59 (3 pages plus laboratory package)
B	Trend Charts – Selected VOCs (Weston, 2006)
	AOC 4A: MW-EPA-2A, MW-46A, MW-120
	AOC 6A: MW-47A
	AOC 8C: MW-87A, MW-125
	AOC 8D: MW-8
	AOC 10: MW-129, MW-131
C	Groundwater CEA Calculations (abridged Table 3-8, Weston, 2002)
	AOC 4
	AOC 6
	AOC 8
	AOC 9
	AOC 10
D	Predicted Extent of Site-Wide CEA [electronic version only – CD ROM]
E	Ground Water Classification Exception Area Fact Sheet (7:26E, Appendix F)
F	Copies of Certified Notification Letters
	Edison Township Municipal Clerk
	Edison Township Planning Board
	Edison Township Department of Health and Human Resources
	Middlesex County Clerk
	Middlesex County Planning Department
	Middlesex County Department of Public Health
	NJDEP Bureau of Safe Drinking Water
	NJDEP Bureau of Water Allocation
	Property Owners
G	Copy of NJDEP CEA Biennial Certification Form, Rev. 1.0, 11/18/03 (8 pages)

LIST OF APPENDIXES
(CONTINUED)

LIST OF ABBREVIATIONS

AOC	area of concern
bgs	below ground surface
cis-1,2-DCE	cis-1,2-dichloroethene
CEA	Classification Exception Area
1,2-DCA	1,2-dichloroethane
DNT	dinitrotoluene
DO	dissolved oxygen
DOD	Department of Defense
Eh	redox potential
EPA	United States Environmental Protection Agency
EPA Table 2C-GW	EPA Generic Screening Benchmarks for Target Indoor Air Concentrations – Groundwater
EPA Table 2C-SSG	EPA Generic Screening Benchmarks for Target Indoor Air Concentrations – Shallow Soil Gas
FEMA	Federal Emergency Management Agency
former Arsenal	Former Raritan Arsenal
ft	feet
GMRAWP	Groundwater Monitoring Remedial Action Work Plan
GSA	General Services Administration
GW	groundwater
GWRAWP	Groundwater Remedial Action Work Plan
GWQS	Groundwater Quality Standard(s)
IAQ	indoor air quality
IAQ Approach	Approach for Evaluating Potential Indoor Air Quality Impacts (USACE, 2001)
LS	lower sand
MCC	Middlesex County College
MM	meadowmat
MNA	Monitored Natural Attenuation
MNT	mononitrotoluene
MSL	mean sea level
NJDEP	New Jersey Department of Environmental Protection

LIST OF ABBREVIATIONS
(CONTINUED)

PAL - Palisades Sill
PAS - Passaic formation
PCBs - polychlorinated biphenols
PCE - tetrachloroethylene
PQL - practical quantitation level

QA - Quality Assurance
QC - Quality Control

RA - remedial action
RAWP - Remedial Action Work Plan
RWRPA - Regional Water Resource Planning Area

SLERA - Screening Level Ecological Risk Assessment
SVOCs - semi-volatile organic compounds

TCE - trichloroethylene
TDS - total dissolved solids
TNT - trinitrotoluene
Trans-1,2-DCE - trans-1,2-dichloroethylene

ug/L - micrograms per liter
ug/m^3 - micrograms per cubic meter
US - upper sand
USACE - United States Army Corps of Engineers
USEPA - United States Environmental Protection Agency
USDA, SCS - United States Department of Agriculture, Soil Conservation Service
UST - underground storage tank

VIG - Vapor Intrusion Guidance
VOC - volatile organic compound
WBK - weathered bedrock group
WRA - well restriction area
Weston® - Weston Solutions, Inc.

EXECUTIVE SUMMARY

This Groundwater Remedial Action Work Plan (GWRAWP) has been prepared in accordance with the NJDEP Technical Requirements for Site Remediation (N.J.A.C. 7:26E) and provides a monitored natural attenuation (MNA) remedial action strategy and site-wide Classification Exception Area (CEA) proposal for existing shallow volatile organic compound (VOC) groundwater plumes at for the former Raritan Arsenal.

In 2003, the NJDEP conditionally approved monitored natural attenuation (MNA) as a remedial action strategy for groundwater plumes subject to the condition that there are no vapor intrusion issues. A remedial strategy for Groundwater AOCs 2 and 8A/8B is not included in this GWRAWP because of outstanding vapor intrusion issues. Furthermore, a remedial strategy for Groundwater AOCs 3, 4B, 6B, and 7 is not included in this GWRAWP because USACE does not consider these plumes to be the result of DOD sources. Supporting data and a recommendation for no further action for Groundwater AOC 7 is included in this GWRAWP. Within this GWRAWP a monitored natural attenuation (MNA) strategy is provided for specific groundwater areas of concern (AOCs) 4A, 6A, 6C, 8C, 8D, 9, and 10.

All groundwater AOCs (i.e., plumes with vapor intrusion issues, non-DOD sources, and those with MNA proposed) are within the boundaries of the site-wide CEA. The proposed CEA includes the following contaminants within the lower sand (LS) geologic unit: tetrachloroethylene (PCE), trichloroethene (TCE), cis-1,2-dichloroethylene (cis-1,2-DCE), trans-1,2,dichloroethylene (trans-1,2-DCE), vinyl chloride, 1,2-dichloroethane (1,2-DCA), benzene, and 2,4-dinitotoluene/2,6-dinitrotoluene mix. The thickness of the CEA (saturated thickness of LS) ranges from approximately 5 to 20 feet and extends to the top of the Raritan Fire Clay or weathered bedrock. The CEA will remain in effect until groundwater contaminant concentrations no longer exceed the NJDEP Groundwater Quality Standards (GWQS). The duration of the CEA is estimated to be 40 years beginning from 1999; with the CEA expiration date estimated to be 2041.

Throughout the life of the CEA periodic site-wide groundwater monitoring of 22 existing monitoring wells, 9 proposed new monitoring wells, and 3 surface water locations will be conducted to monitor the ability of MNA to achieve the remedial objective and protectiveness of the remedy. Two types of groundwater monitoring events are proposed:

- Eight *MNA groundwater monitoring* events are proposed to evaluate the contaminant trends and distribution over time; and
- Two *CEA groundwater quality* events to confirm contaminant concentrations have decreased below applicable standards.

During groundwater monitoring events, fifty-seven site-wide monitoring wells (existing and proposed) will be used to monitor the general groundwater flow direction and horizontal gradients.

SECTION 1.0
INTRODUCTION

1.1 PROJECT OBJECTIVE

The objective of this Groundwater Remedial Action Work Plan (GWRAWP) is to provide a proposed remedial strategy for those existing shallow volatile groundwater plumes at the former Raritan Arsenal (former Arsenal) which were evaluated for vapor intrusion and do not have any remaining vapor intrusion issues. Areas of Concern (AOCs) 4A, 6A, 6C, 8C, 8D, 9, and 10 are included in this GWRAWP. This GWRAWP was prepared in accordance with N.J.A.C. 7:26E and appropriate guidance.

1.2 BACKGROUND

1.2.1 Project Overview

The former Arsenal covers approximately 3,200 acres. The majority of the site is located in Edison Township, with a portion of the site located in Woodbridge Township, in Middlesex County, New Jersey, on the north bank of the Raritan River, approximately 20 miles southwest of lower Manhattan (Figure 1-1). It is bordered to the north and northwest by Woodbridge Avenue, to the southwest by Mill Road and the Industrial Land Reclamation (ILR) Landfill, and to the east by vacant and industrial properties.

During 1917 and 1918 the former Arsenal was acquired and developed by the U.S. Army as a depot for the storage and shipment of various classes or ordinances and general supplies to armed forces based in Europe. The former Arsenal was used by the U.S. Army as a storage, shipment, and maintenance facility until the grounds were decontaminated between 1962 and 1963; and the divestiture of property took place in 1964 (Weston, January 2007). The former Arsenal property is currently owned or occupied by Middlesex County College (MCC), Thomas A. Edison County Park, the United States General Services Administration (GSA), the United States Environmental Protection Agency (USEPA), Raritan Center Industrial Park, and several privately-owned light industrial, warehousing, and hotel operations (Weston, January 2007).

The former Arsenal has been the subject of various United States Army Corp of Engineers (USACE) investigations and remedial/cleanup activities since 1985. The significant groundwater investigations were presented in:

- Final Site-Wide Hydrogeological Report (Weston, June 1996);
- Final Aquifer Reclassification Report (Weston, December 1997)
- Final Groundwater Natural Attenuation Report (Weston, May 2003); and
- Final Supplemental Groundwater Data Report; Groundwater AOCS 2, 3, 4, 6, 7, 8, & 10 (Weston, September 2006)

A summary of each of the abovementioned reports is presented in the Groundwater Remediation Report Summary section of this GWRAWP.

In a letter dated March 12, 2003 (Appendix A), the New Jersey Department of Environmental Protection (NJDEP) conditionally approved monitored natural attenuation (MNA) for groundwater plumes subject to the condition that there are no vapor intrusion issues. At present, potential vapor intrusion issues are unresolved for AOCs 2, 6A, and 8A/8B. This GWRAWP therefore provides a strategy for MNA for the remaining shallow groundwater plumes at which there are no vapor intrusion issues. However, AOCs 3, 6B, and 7 are not included in this GWRAWP because they are not considered by USACE to be the result of DOD sources. Groundwater AOC 4B is a non-DOD plume, and is therefore not included in this GWRAWP. However, the USACE has agreed to provide long-term monitoring of existing monitoring well MW-122 for AOC 4B. Groundwater AOC 6A is included in this GWRAWP because recent indoor air data (Weston, November 2007) indicate no further action is required. Therefore, included in this GWRAWP are shallow groundwater AOCs 4A, 6A, 6C, 8C, 8D, 9, and 10.

1.2.2 Physical Characteristics of the Study Area

Most of the southern two thirds of the former Arsenal consist of an estuarine marsh, while most portions of the northern third of the site are either developed or palustrine (freshwater) forested and emergent wetlands. The site topography slopes gently east-southeast toward the Raritan River. Ground surface elevations range from 6 feet mean sea level (MSL) to approximately 100 feet MSL.

1.2.2.1 Soil Conditions

The soils present at the former Arsenal reflect extensive human activity in the northern sections. Cut and fill activities, clay pits, and fluvial alterations within the study area have led to inconsistent subsurface profiles. Soils identified within the study area are mapped into three general groups by the United States Department of Agriculture, Soil Conservation Service (USDA, SCS).

1. Urban land-Boonton-Haledon: Urban land and nearly level to strongly sloping, deep, well drained to somewhat poorly drained soils that have a firm or very firm, loamy subsoil; on uplands.

2. Klej-Atsion-Evesboro: Nearly level to strongly sloping, deep, excessively well drained and moderately well drained to poorly drained soils with a sandy subsoil and substratum; on terraces and uplands.

3. Sulfaquents-Sulfihemists-Psamments: Nearly level, deep, excessively drained to very poorly drained mineral and organic soils with a grayish or black subsoil; on tidal flats.

1.2.2.2 Topography and Drainage

The former Arsenal is located in the northernmost portion of the Atlantic Coastal Plain Physiographic Province of New Jersey, near its convergence with the Piedmont Physiographic Province. Consequently, the topography is quite flat to gently sloping. Elevations for the study area range from approximately 100 feet MSL (National Geodetic Vertical Datum of 1929) in the northwestern portion of the site (MW-74B/C at Middlesex County College), to approximately 4 feet MSL along the southern boundary of the site (near MW-28B and the banks of the Raritan River). The general slope of the topography is from the northwest to the south-southeast.

The former Arsenal site is located on the northern side of the Raritan River, which discharges to Raritan Bay approximately 5 miles to the east. Much of the former Arsenal site lies within the 100-year floodplain calculated by the Federal Emergency Management Agency (FEMA). The 100-year floodplain is between 10.1 and 12.1 feet MSL. The FEMA 500-year floodplain line is located slightly north of the FEMA 100-year line, with a portion of the two lines being shared. Both lines follow site topography. North of these lines, site elevation rises abruptly.

Seven major surface water drainage areas were identified within the former Arsenal during the Phase 2 RI surface water/sediment investigation:

- East Ditch Drainage;
- Black Ditch Drainage;
- Red Root Creek Drainage;
- Central Ditch Drainage;
- Area 12 Drainage;
- Old Red Root Creek Drainage; and
- County Park Area Drainage.

Except for the Area 12 (100% estuarine) and County Park (100% freshwater) drainage, the drainage areas originate within freshwater areas, but are estuarine in their lower sections, due to the influence of the Raritan River. For more specific discussions relating to each surface water feature is presented in the Final Site-Wide Surface Water and Sediment Report dated June 1996.

1.2.2.3 Arsenal-Wide Geology and Hydrogeology

As described in detail in prior reports (Weston June 1996, May 2003, September 2006), the site geology is characterized by an overburden layer, approximately 10 to 80 feet thick, composed of unconsolidated sediments underlain by bedrock composed of shales, metamorphosed shales and an igneous diabase sill. Groundwater within the overburden aquifer flows southeastward across the site toward the Raritan River.

Groundwater levels in the overburden aquifer are generally not influenced by tidal fluctuations. As a result, water level fluctuations due to tidal influence do not have a significant effect on overall groundwater flow direction in the overburden aquifer.

The interrelationship between surface water and groundwater is limited to the overburden aquifer and varies between recharge and discharge modes according to locale and site conditions such as tidal cycle and precipitation events. Overall, both surface water and overburden groundwater ultimately discharge to the Raritan River.

The region containing the site is characterized by Triassic and Jurassic Rocks of the Passaic and Palisades Formations, overlain by unconsolidated sediments (cyclic beds of clays, silts, sands and gravels) that are Cretaceous in age. To assist in characterizing the Arsenal-wide geology, a conceptual model was developed based on the stratigraphical investigation. The model has subdivided and consolidated the overburden and bedrock geology at the former Arsenal into six distinct stratigraphic units. There are two bedrock and four overburden stratigraphic units. From oldest to most recent, the stratigraphic units are:

- Passaic Formation (PAS) - Triassic age rock, which consists of red, red-brown and gray interbedded shales, siltstones, mudstones, conglomerates and some slightly metamorphosed rocks. This formation is characterized by numerous fractures, easily-weathered zones and layers of interbedded siltstone, shales and sandstones.

- Palisades Sill (PAL) - Late Triassic age rock, which consists of gray to dark gray igneous diabase intrusive material. The PAL has, in some cases, affected locally adjacent shale beds and metamorphosed the shale to a slate material (Barksdale, 1943). The PAL is found at depth in the southern portions of the Arsenal and could be a potential boundary unit (geologic and hydrologic).

- The Weathered Bedrock Group (WBK) - This grouping consists of the Raritan Fire Clay (lower Cretaceous) and the weathered Passaic and saprolite units. These units were consolidated into one group because the areal distribution and properties of each are similar.

- The Raritan Fire Clay is described as a fat clay, and ranges in color from blue, brown, gray to red. The clay is not present in the southwestern portion of the Arsenal (near MW-49C), as well as in the region near the PAL Formation. The weathered Passaic unit is highly decomposed red-brown, red and gray siltstone, mudstone, shales and conglomerates. The weathered Passaic unit is usually highly fractured and friable. This unit is consistent across the Arsenal in areal extent except in the southwestern portions of the Arsenal (near monitoring wells MW-49C, MW-55B, MW-60C and MW-96C).

- Lower Sand (LS) - This formation is believed to be the remains of the Farrington Sand and includes some clayey and silty interbeds. These clayey and silty units may act as localized leaky-confining or semi-confining units. Overall, the LS is a coarse, medium to fine-grained sand, with some gravel and finer-grained material. The color varies based on some localized iron staining, but is usually brown, yellow-brown or red brown. The LS unit is the main overburden aquifer at the former Arsenal.

- Meadowmat (MM) - This formation (formerly called Peat in the 1993 Work Plan) is an organic-rich, black or brown clayey or silty material with some interbedded sands. This material consists primarily of silt and clay which has gradational contacts with abundant organic matter (ranging up to 90 percent). Overall, the unit has a thickness that ranges from 0 feet (in the north-central portions of the former Arsenal) to approximately 10 feet. In some areas of the site (primarily at the southern end of the site), it appeared that natural vegetation was interbedded (in a "layer cake" fashion) with suspected dredge material. In certain cases this material was logged as MM, and in others it was logged as Upper Sand (US) (i.e., fill, or relocated natural sediments). The MM unit acts as a confining or semiconfining layer immediately beneath the US.

- Upper Sand (US) - This formation includes fill material, including dredge spoils, construction debris and reworked natural material. The US water-bearing zones are discontinuous, perched zones of groundwater of limited saturated thickness and areal extent. These zones primarily exist in the southern one-third of the former Arsenal and are believed to be recharging by precipitation and interaction with surface water bodies.

The heterogeneous nature of the soil and rock formations at the site required that similar groups of soils and rock be consolidated in order to present the data in a clear and concise manner. In certain situations, clay and silt material were consolidated into the classification of LS, even though the material is not sand-like. The clay and silt were grouped together and classified as LS because they have been determined to be local units of limited areal extent (within the LS unit) and, from an Arsenal-wide perspective, are not considered to be significant. The Weathered Bedrock Group is a combination of the Raritan Fire Clay unit and weathered bedrock unit of the PAS Formation. The US is a grouping of fill material, reworked native soils, and dredge spoils.

The groundwater flow in the overburden and bedrock aquifers is in a south-southeasterly direction and all overburden groundwater will eventually discharge to the Raritan River.

This GWRAWP is prepared for shallow VOC plumes within the LS in AOCs 4A, 6A, 6C, 8C, 8D, 9, and 10. All site AOCs, remediation areas, and monitoring wells are depicted on the Site Map (Figure 1-2). The groundwater flow direction within the LS is towards the south-southeast (Figure 1-3).

1.2.3 Groundwater Remedial Investigation Report Summary

A summary of the pertinent groundwater remedial investigations performed to date are provided below.

1.2.3.1 Final Site-Wide Hydrogeological Report, June 1996

This report presents the results of the site-wide hydrogeologic investigation performed at the former Raritan Arsenal from June 1993 through March 1995 as part of the WESTON Phase II RI. The objectives of this report were to: (1) summarize the results of the physical site characterization investigation, which included a supplemental geologic/hydrogeologic investigation and surrounding well use survey; (2) present the results of background and site-wide groundwater sampling conducted during November and December 1994; and (3) identify potential contaminants of concern, as well as their potential sources and migration pathways in groundwater. Results of surficial and subsurficial soil sampling and surface water and sediment investigations are presented related to specific groundwater areas of concern.

The analytical results from two rounds of monitoring well sampling indicate that organic and inorganic contamination exceeding NJDEP Groundwater Quality Standards is present within the overburden aquifer. Organic contaminants of potential concern include benzene and the chlorinated VOCs TCE, PCE, 1,2-DCA, total 1,2-DCE, chlorobenzene and vinyl chloride. The VOCs are generally found in seven plumes in the overburden aquifer within the north and north central portions of the site. Inorganic contaminants of potential concern include arsenic and aluminum, which are predominantly found in the southern portion of the site. SVOCs, pesticides/PCBs, thiodiglycol, cyanide, dioxin and furans are not considered contaminants of potential concern. Explosive compounds (2,4-dinitrotoluene, 2-6-dinitrotoluene, and amino-DNT's) are considered a potential concern within the groundwater downgradient of Area 4.

1.2.3.2 Final Aquifer Reclassification Report, February 1999

Based on historical information and the results of field screening tests during the Phase II RI, it was believed that groundwater quality in the southern portion of the former Arsenal near the Raritan River satisfied the criteria for Class IIIB Aquifer classification. Class III groundwaters are not suitable for potable water due to poor natural water quality. As part of the Weston (1997) Groundwater Monitoring Remedial Action Work Plans (GMRAWP), Weston collected groundwater samples in the southern portion of the site to confirm that Class IIIB aquifer conditions existed. Specific GWQS for organic contaminants and metals have not been developed for Class IIIB aquifers as it is unsuitable for conversion to potable water. As documented in the February 1999 *Final Aquifer Reclassification Report*, groundwater in the southern portion of the site was successfully reclassified from aquifer Class IIA to aquifer Class IIIB (non-potable).

1.2.3.3 Final Groundwater Natural Attenuation Report, May 2003

This report was based on the findings associated with the implementation of Weston's December 1997 and June 1999 Groundwater Monitoring Remedial Action Work Plans (GMRAWP), which occurred over a period of 2 years and 8 months, and provides evidence that natural attenuation of groundwater volatile organic compounds (VOCs) (primarily trichloroethylene [TCE] and tetrachloroethylene [PCE]) and trinitrotoluene (TNT) contamination at the former Raritan Arsenal is a feasible remedial alternative.

The site data show that natural attenuation has occurred and is occurring at the site and that conditions in some portions of the site are favorable for continued reductive dechlorination. Although decreasing concentration trends are not evident in each well, there is evidence of an overall decrease in TCE concentrations and the presence of degradation products (including vinyl chloride and ethane) on a site-wide basis; and that the extent of the plumes have remained stable (i.e., have not expanded or migrated with time), suggesting that plumes have attained a steady-state condition.

Based on USACE's understanding of the site, groundwater contaminant plumes that are flowing toward or may be currently discharging to streams and the wetland area present unique remediation problems because of the hydrologic connections between groundwater and surface water and the potential sensitive habitats in wetlands. Currently available engineered cleanup methods would likely seriously impact the viability of these ecosystems, and do not appear to be necessary, because the screening level ecological risk assessment (SLERA) found no evidence of groundwater contaminants entering surface water at concentrations potentially harmful to aquatic biota (Weston, May 2002; Weston, March 2004). Moreover, some remediation methods like pump-and-treat would likely dewater wetland areas and adversely affect the ecosystem. Pump-and-treat remediation technology would also be highly inefficient and prohibitively expensive based on the size of the groundwater Areas of Concern (AOC) and because there is a high potential to pump surface water along with impacted groundwater in some of the groundwater AOCs.

In contrast, natural attenuation is a cost-effective *in-situ* remediation method for groundwater contaminants that has the ability to keep sensitive ecosystems largely undisturbed as long as contaminants associated with groundwater discharge are not resulting in elevated risk to receptors in streams/drainageways. Natural attenuation would be a feasible groundwater remediation method at the former Raritan Arsenal because migration of significant levels of VOC contaminants would not adversely impact human or ecological receptors. It should be noted that groundwater is not being used for potable use at the site and groundwater in the southern portion of the former Raritan Arsenal has been reclassified by USACE and approved by NJDEP as a Class III-B aquifer due to elevated levels of total dissolved solids (TDS) and chlorides.

As part of the ongoing monitoring of groundwater at the site, WESTON has evaluated the potential for natural attenuation as a remediation method using hydrogeological, chemical, and biological characterization. Based on this evaluation, WESTON has determined that contaminants are being attenuated.

1.2.3.4 Final Supplemental Groundwater Data Report, Groundwater AOCs 2, 3, 4, 6, 7, 8, and 10, September 2006

This report presented the results of the groundwater field investigation performed at the former Raritan Arsenal used to develop groundwater Remedial Action Work Plan(s) (RAWP) for eight distinct AOCs. Results of this investigation indicated:

1. No anomalies requiring further investigation or action or the presence of UXO were found; (2) Monitoring well gauging event data indicated a consistent south-southeasterly groundwater flow direction;

2. Benzene, cis-1,2-dichlorethene, chlorobenzene, chloroform. 1,2-dichloroethane, 1,1-dichloroethene, tetrachloroethylene, 1,1,1-tirichloroethane, trichloroethene, and vinyl chloride were detected in groundwater, each at a minimum of one location, exceeding the NJDEP Class IIA Groundwater Quality Standards (GWQS);

3. The compounds (VOCs, BNs, and/or lead) analyzed for each outside area (Area 12, Area 18B, and former MCC UST) were not detected or were detected below the NJDEP Class IIA GWQS; and

4. All seven groundwater AOC boundaries were redefined based on the VOC groundwater data. Groundwater AOCs 3 and 7 were reduced in size, Groundwater AOCs 4 (Groundwater AOC 4A and 4B), 6 (Groundwater AOC 6A, 6B, and 6C), and 8 (Groundwater AOC 8A, 8B, 8C, and 8D) have been subdivided, Groundwater AOC 2 changed shape but not size and Groundwater AOC 10 encompasses a larger area.

Based on the analytical results, no further action was requested for Groundwater AOCs 3, 4B, 6B, and 7 because the sources for contamination associated with these groundwater AOCs are not related to U.S. Department of Defense (DOD) activities. Additionally, no further action for groundwater was requested for VOCs and BN compounds in Area 12, for lead in Area 18B, and for VOCs in the area of the former MCC UST.

Based on the Supplemental Groundwater Investigation, in combination with the IAQ results, this GWRAWP includes the proposal of MNA as the remedial action in the specific groundwater AOCs as described below.

<u>Groundwater AOC 4A</u>

USACE proposed MNA as the remedial action for AOC 4A based on the following:

- Remediation was conducted in the former DOD source Area 18A (former pond and buried drum area).

- Groundwater analytical results since remediation indicate that the remediation was successful; a decreasing trend for VOCs is observed.

- TCE is no longer detected in the source area well MW-EPA-2A.

MNA for AOC 4A was conditionally approved by the NJDEP in its 12 March 2003 letter pending evaluation of vapor intrusion pathways. Since low concentrations of VOCs were detected in groundwater above the Table 2C-GW screening levels, buildings within 100 feet of the plume were evaluated for vapor intrusion in accordance with the NJDEP approved IAQ Approach. These buildings (90/100-112 Northfield Avenue, 95-97 Northfield Avenue, 105-115 Northfield Avenue, 114 Northfield Avenue, 86/90-94/98-102 Mayfield Avenue, 5 Fernwood Avenue) were subsequently evaluated by sampling and analysis of indoor air and subslab soil gas and no evidence of a complete vapor intrusion pathway was evident (Weston, September 2006a). In a January 12, 2007 letter the NJDEP (NJDEP, January 2007) concurred with the USACE no further recommendation regarding indoor air for all buildings except 90/100-112 Northfield Avenue. (Appendix A).

<u>Groundwater AOC 6A</u>

USACE proposed MNA as the remedial action for AOC 6A based on documented decreasing VOC trends and the most recent indoor air quality data which indicate there are no outstanding vapor intrusion issues.

MNA for AOC 6A was conditionally approved by the NJDEP in its 12 March 2003 letter pending evaluation of vapor intrusion pathways. Groundwater analytical results from the most recent sampling event indicate TCE as the only contaminant detected above regulatory standards for monitoring wells located within this plume. Monitoring wells MW-146 and MW-47A had TCE results of 7.4 ug/L and 13 ug/L respectively. Furthermore, monitoring well MW-47A shows a decreasing trend with a maximum concentration of 99 ug/L in August 1999 to 13 ug/L in March 2005.

Since low concentrations of TCE were detected above the Table 2C-GW screening levels, four buildings located within 100 feet of this plume were evaluated for vapor intrusion in accordance with the NJDEP-approved IAQ approach. These buildings are 102-168 Fernwood Avenue, 45 Fernwood, 110 Newfield Avenue, and Building 467.

The presence of TCE in both the subslab soil gas and nearby groundwater sampling suggested the potential for a vapor intrusion pathway into 102-168 Fernwood Avenue. However, two consecutive rounds of data (September 2006 and April 2007) indicate no detections of TCE in indoor air (Weston, November 2007). Indoor air exceedances of NJDEP VIG screening levels appear to be associated with tenant operations within the building. A confirmatory round of subslab soil gas and indoor air sampling is recommended upon completion of construction/remodeling in the building.

During two consecutive rounds (September 2006 and April 2007), neither PCE nor TCE have been detected in soil gas beneath 110 Newfield Avenue in exceedance of the NJDEP screening levels (Weston, November 2007). Exceedances of 1,2–dichloroethane and TCE have been observed in indoor air during the last two rounds, however, since neither of these compounds were detected in the subslab soil gas during any of the three sampling events conducted at this building, the detections of these chemicals are believed to be attributed to tenant-related activities and not originating from soil gas, therefore no further action was recommended for 110 Newfield Avenue (Weston, November 2007).

At 45 Fernwood Avenue PCE has not been detected in subslab soil gas during the two most recent (September 2006 and April 2007) sampling rounds (Weston, November 2007). Furthermore, while PCE has been identified as a historic COPC in the Groundwater AOC 6 plume, it was not detected in nearby groundwater sampling locations (MW-146 and SGWS222) in the vicinity of 45 Fernwood Avenue at concentrations exceeding the NJDEP VIG screening level during recent sampling events. While PCE, TCE, and methylene chloride were detected in subslab soil gas during the September 2006 sampling event and methylene chloride was detected in subslab soil gas during the April 2007 sampling event at concentrations greater than their respective NJDEP VIG screening levels in subslab soil gas, these compounds were either not detected or were detected at concentrations lower than those detected in the corresponding indoor air samples. The findings of the three sampling events conducted at 45 Fernwood Avenue would suggest an incomplete vapor intrusion pathway from groundwater into the building; therefore, no further action was recommended (Weston, November 2007).

The constituent of concern at Building 467 is TCE (as PCE has not been detected in groundwater near this building from 1994 to present). Although TCE has been detected in indoor air above the NJDEP VIG screening levels, TCE has been undetected in soil gas for three consecutive sampling rounds, suggesting that a source other than vapor intrusion is responsible for the exceedances detected in indoor air. This is entirely possible given the ongoing vehicle maintenance at this building. Vinyl chloride was also detected in nearby groundwater at concentrations greater than its NJDEP VIG groundwater screening level. Vinyl chloride has not been detected in either subslab soil gas or in indoor air since the inception of the vapor intrusion investigation at Building 467. The additional VOC exceedances observed in the indoor air samples collected in Building 467 (methylene chloride, MTBE, benzene, 1,4-dichlorobenzene) suggest that tenant activities are the source of the VOC exceedances in indoor air since there were not corresponding soil gas exceedances for these compounds. As noted on the Indoor Air Building Survey & Sampling Form, several chemical compounds, solvents, adhesives, paints and degreasers are stored in the Building 467 warehouse (Weston, November 2007). It was also noted that vehicles are regularly operated in the building, including during the sample collection activities. These observations, along with the lack of TCE exceedances in soil gas, indicate that the VOCs detected in indoor air are attributable to activities within the Building 467 warehouse and not to vapor intrusion. Per the VIG Remediation Decision Matrix, no further action was recommended for Building 467 (Weston, November 2007).

Groundwater AOC 6C

Monitoring well MW-144 and sample location SGWS233 are located within 100 feet of an existing building (Expo Center, 97 Sunfield Avenue). VOCs were detected at concentrations greater than 50 times the EPA Table 2C-GW screening levels. Evaluation of the need for active remediation for this groundwater AOC was based on IAQ results.

At the Expo Center the only VOCs detected in indoor air at concentrations exceeding the NJDEP VIG screening levels were 1,4-dichlorobenzene, benzene and methyl tert-butyl ether (MTBE), which are considered to be non-DOD-related compounds. No exceedances of the NJDEP VIG screening levels for VOCs were reported in subslab soil gas during the January 2006 subslab soil gas sampling event; collected concurrently with indoor air samples (Weston, September 2006a). After two rounds of subslab soil gas data which did not indicate a threat to indoor air, coupled with one round of indoor air data which did not reveal DOD-related contaminants, the NJDEP (NJDEP, January 2007) agreed no further action is warranted (Appendix A).

Groundwater AOC 8C

USACE proposed MNA as the remedial action for groundwater AOC 8C due to the documented decreasing trends for VOCs for this groundwater AOC. Additionally, the area that this plume encompasses is located in an undeveloped area.

MNA was conditionally approved by the NJDEP in its 12 March 2003 letter pending evaluation of vapor intrusion pathways. No buildings exist; therefore, no evaluation of vapor intrusion pathways is warranted at this time.

Groundwater AOC 8D

USACE proposed MNA as the remedial action for groundwater AOC 8D.

The TCE detected at monitoring well MW-8 may be related to a source/residual source associated with Area 1 (former excavation adjacent to well MW-8) or Groundwater AOC 8A and Groundwater 8B. The TCE concentrations in groundwater have been fluctuating between 99 ug/L and 140 ug/L since July 1998; a trend cannot be established. The area that this plume encompasses is located in an undeveloped area with no existing buildings. Therefore, no evaluation of vapor intrusion pathways is warranted at this time.

Because the water quality at MW-8 has fluctuated greatly over time, USACE will decommission MW-8 and replace it with an equivalent well proximate to that location. The proposed replacement for MW-8 was approved by the NJDEP (NJDEP, May 2006). USACE will use the replacement well to evaluate the groundwater quality in AOC 8D.

Groundwater AOC 9

USACE proposed MNA as the remedial action for groundwater AOC 9. The source area for Groundwater AOC 9 (TNT and breakdown products) has previously been identified as Area 4. No other compounds were detected in groundwater at concentrations exceeding NJDEP criteria. A no further action letter for PCB and benzo(a)pyrene (BaP) contamination in soil was requested by the USACE in a letter to the NJDEP.

A soil RAWP was recommended to address the TNT contamination identified in the soil in Area 4, while considering the proposed future use of the site by FBC. Prior to proceeding with the RAWP, a pre-remedial soil-sampling plan was prepared and implemented in 1998 to generate more detailed data on the distribution of TNT contamination throughout the fenced portion of Area 4. Early in the remedial action planning process, the USACE evaluated the option of treating TNT-contaminated soil via a bioremediation technology. As part of this evaluation, the USACE conducted bench-scale and pilot-scale tests of the Grace Bioremediation Technology DARAMEND® bioremediation process in 1998-1999. The USACE authorized Weston to conduct a pilot test of the bioremediation process on 60 cubic yards of TNT-contaminated soil removed from the most contaminated portions of Area 4. The results of the pilot test showed that the bioremediation technology could successfully reduce the levels of TNT and its breakdown products in Area 4 soils to concentrations below NJDEP target cleanup levels, as reported in the April 2000 Draft Pilot Study Report TNT Soil Remediation.

As of January 2008 the FBC’s planned future use for the fenced portion of Area 4 is trucks weigh station and/or parking lot (site expected to be fully paved). Based upon this proposed future use, lack of substantial groundwater contamination, and the high cost of full-scale soil treatment, the USACE could not justify the implementation of full-scale bioremediation of the fenced portion of Area 4. The USACE initiated an effort to prepare a draft RAWP that included construction of an engineered asphalt cap for the site, with continued groundwater monitoring. Effort to finalize the soil RAWP was suspended pending resolution of the proposed future use of the site by FBC.

In the meantime, it appears that the explosives present in groundwater are continuing to degrade. Evidence for contaminant degradation in AOC 9 includes the presence of TNT breakdown products in the plume; decreasing explosive compound concentrations downgradient; and the fact that no explosive compounds are present in sentinel wells (Weston, May 2003).

Because the contaminants of concern in Groundwater AOC 9 are not VOCs, no vapor intrusion concerns exist.

Groundwater AOC 10

USACE proposed MNA as the remedial action for groundwater AOC 10.

The source area (Area W) associated with Groundwater AOC 10 was remediated via soil excavation in 1998. A MIP investigation conducted in October 2004 concluded that most of the remaining contamination at this site is situated below the water table. Groundwater analytical data for monitoring well MW-129 indicate a consistent downward trend of TCE contamination (the only contaminant detected above regulatory standards at this well) over 14 rounds with a maximum concentration of 160 ug/L in 1998 to the most recent TCE concentration of 13 ug/L in April 2005. Similarly, TCE concentrations in samples collected from monitoring well MW-131 have shown a steady decrease from 1,500 ug/L in 1999 to 210 ug/L in 2005.

Due to the fact that concentrations of some VOCs in groundwater exceed the Table 2C screening levels, the one building (Middlesex County training facility) located within Groundwater AOC 10 was investigated to evaluate the vapor intrusion pathway. Based on these exceedances, an indoor air evaluation was expedited for this groundwater AOC.

Subslab soil gas and indoor air results from November 2004 indicate a complete vapor intrusion pathway does not exist at this building. There were no detections of TCE in the indoor air and only one exceedance for PCE in subslab soil gas at 60 micrograms per cubic meter (ug/m^3). PCE was not detected in groundwater monitoring wells above the EPA Table 2C-GW screening levels. A follow-up round of sampling and analysis undertaken in December 2005 confirmed this finding (Weston, January, 2006a).

Dichlorodifluoromethane was detected in subslab soil gas at a concentration exceeding its NJDEP VIG screening level in one of two samples. This compound was also detected in one of four indoor air samples in exceedance of its NJDEP VIG screening level. This compound (a refrigerant also known as Freon 12) is not considered to be DOD-related. Other VOCs detected in indoor air were not related to DOD activities (Weston, January 2006a).

After two rounds of indoor air and subslab soil gas data the NJDEP (NJDEP, January 2007) agreed that the primary vapor intrusion concern is the non-DOD-related Freon 12 which should be further evaluated by the building owner/tenant (Appendix A).

SECTION 2.0
PROPOSED REMEDIAL ACTION

2.1 APPLICABLE REMEDIATION STANDARDS

The remediation standards for individual contaminants of concern resulting from historical DOD activities in groundwater AOCs will be the Higher of the Practical Quantitation Limit (PQL) and Ground Water Quality Criterion provided in the NJDEP GWQS for Class IIA aquifers (N.J.A.C. 7:9C). These applicable remediation standards are provided below:

Applicable Remediation Standards for Groundwater for Class IIA Aquifers (N.J.A.C. 7:9C)
Former Raritan Arsenal
Edison, New Jersey

Constituent	Higher of PQL and Ground Water Quality Criterion (ug/L)
Tetrachloroethylene (PCE)	1
Trichloroethene (TCE)	1
cis-1,2-Dichloroethylene (cis-1,2-DCE)	70
trans-1,2-Dichloroethylene (trans-1,2-DCE)	100
Vinyl Chloride	1
1,2-Dichloroethane (1,2-DCA)	2
Benzene	1
2,4-Dinitrotoluene/2/6-Dinitrotoluene mix	10

As stated in the 12 March 2003 NJDEP comment letter (Appendix A), chlorobenzene does not appear to be related to former DOD operations.

2.2 REMEDIAL APPROACH

The remedial approach for groundwater at the former Arsenal, was presented in both the *Final Groundwater Monitoring Remedial Action Work Plan* [GMRAWP (WESTON, December 1997)] and the Revised GMRAWP (Weston, June 1999) and included additional DOD contamination source investigation and removal, and monitoring of natural attenuation of the groundwater AOCs. After completing the eight rounds of groundwater monitoring from July 1998 through March 2001, the sampling data were evaluated to determine if there are decreasing trends in the primary contaminants (TCE, PCE, and TNT) and their natural breakdown products within each groundwater AOC at the former Arsenal. MNA was conditionally approved by NJDEP in the comment letter dated 12 March 2003 (Appendix A); barring the potential for a vapor intrusion pathway from groundwater and/or soil to subslab soil gas to indoor air in a given AOC. In areas where a potential vapor intrusion pathway originating from groundwater and/or soil is proven, further investigation and/or active remediation may be warranted. The Final Draft Groundwater Natural Attenuation Report was provided to the NJDEP in May 2003 (Weston, May 2003).

Concurrent and subsequent investigations of vapor intrusion from groundwater into site buildings have been documented in semi-annual indoor air quality reports (Weston November 2005, September 2006a, August 2007). Groundwater AOCs with vapor intrusion issues have been identified as 2, 8A, and 8B and are not considered in the RAWP. Because most recent sampling (Weston, November 2007) indicates that either an incomplete vapor intrusion pathway exists (45 Fernwood Avenue) or tenant operations are responsible for indoor air exceedances (102-168 Fernwood, 110 Newfield, Building 467), AOC 6A is included in this RAWP.

A site-wide Classification Exception Area (CEA) and a Well Restriction Area (WRA), which encompass all plumes remaining on the former Arsenal (Figure 3-1), and not just those proposed for MNA, have been delineated and are being proposed by USACE for the former Arsenal. The site-wide CEA/WRA is based upon predicted contaminant concentration degradation rates, fate and transport calculations, and area-specific hydraulic conductivity values [NJAC 7:26E-6.3(e)(2)]. For each monitoring well that contained contaminants at concentrations that exceeded applicable GWQS, a series of calculations were completed to predict the additional time required for each contaminant of concern to attenuate to a concentration equal to the GWQS, and the additional plume travel distance anticipated during that time. The CEA/WRA will remain in effect until groundwater contaminants no longer exceed GWQS. The CEA distance and duration were calculated using the equations presented in NJDEP's *Final CEA Guidance Document* (NJDEP, November 1998).

Based on additional data, conducted during the supplemental groundwater RI in 2005, some Groundwater AOCs were subdivided into smaller AOCs. For example, original Groundwater AOC 4 was subdivided into Groundwater AOC 4A and Groundwater AOC 4B. A discussion of each individual Groundwater AOC is provided below. The following table outlines the original 1994 Groundwater AOC designations, the Groundwater AOC designations as of 2005, the non-DOD Groundwater AOCs, the Groundwater AOCs with outstanding indoor air issues, and the selected Groundwater AOCs addressed in this GWRAWP.

1994 Groundwater AOC	2005 Groundwater AOC	Proposed Non-DOD Groundwater AOC	Groundwater AOCs with Outstanding Indoor Air Issues	Selected Groundwater AOCs in GWRAWP
2	2		X	
3	3	X		
4	4A			X
	4B	X		
6	6A		X	X
	6B	X		
	6C			X
7	7	X		
8	8A/8B		X	
	8C			X
	8D			X
9	9			X
10	10			X

Although USACE has proposed AOCs 3, 4B, 6B, and 7 as non-DOD Groundwater AOCs, they will be included in the proposed site-wide Classification Exception Area (CEA) boundary. In the USACE September 2006 responses to the 6 May 2006 NJDEP Comments (Appendix A) USACE proposed groundwater AOC 4B will to be included in the proposed long-term monitoring. Although unresolved indoor air issues remain in Groundwater AOCs 2, 6A, and 8A/8B, they are also included within the proposed site-wide CEA.

In response to the 6 May 2006 NJDEP comment letter (Appendix A) USACE agreed to collect a groundwater sample from MW-59 to confirm the downward VOC concentration trend in non-DOD Groundwater AOC 7. The results of this October 2006 sampling of MW-59 were below the NJDEP GWQS and demonstrate a decreasing TCE trend over time (Appendix A). A request for no further action for Groundwater AOC 7 is provided in Appendix A.

The Groundwater AOCs selected for this GWRAWP do not indicate the potential for vapor intrusion. A discussion of the selected Groundwater AOCs is provided below.

2.2.1 Groundwater AOC 4A

Groundwater AOC 4 underlies a portion of Raritan Center in the central portion of the former Arsenal (Figure 1-2). Previous investigations confirmed that the source of contamination for Groundwater AOC 4 was the Area 18A former pond and buried drum area. The confirmed source area (the Area 18A former pond and buried drums) was remediated by USACE (*Final Remedial Action Report, Remedial Construction at Areas 11, 12, 18A, 18C, and W*, Weston, March 2002). A total of almost 2,500 cubic yards of soil were excavated from this area in April and May 1998. Post-excavation sampling indicated that residual soil contamination remained at the water table. NJDEP and USACE concurred that the residual contamination would be addressed as part of the site-wide groundwater investigation.

Based on the 2004/2005 groundwater VOC analytical data, the following VOCs were detected within Groundwater AOC 4: acetone, benzene, cis-1,2-DCE, 1,1-DCA, 1,1-DCE, 4-methyl-2-pentanone, PCE, 1,1,1-TCA, TCE, toluene, and vinyl chloride. Of these VOCs, four (benzene, PCE, TCE, and vinyl chloride) had detected concentrations exceeding the NJDEP Class IIA GWQS. TCE was the predominant constituent exceeding the NJDEP Class IIA GWQS during this investigation.

Groundwater AOC 4 (as of 2005) has been subdivided into Groundwater AOC 4A and Groundwater AOC 4B (Figure 2-1) based on the distribution of TCE and benzene and the presence of 4-methyl-2-pentanone. In combination, Groundwater AOCs 4A and 4B cover an area less than the original Groundwater AOC 4 plume. The subdivided plumes underlie the same Soil Investigation Areas.

The Groundwater AOC 4A plume extends in a southeasterly and easterly direction, encompassing portions of Areas 18B and 18C, and extends across the Raritan Center portion of Area 10. However, Groundwater AOC 4A does not extend across the northeastern portions of Area 19, and Area 20, as the 2001 footprint of Groundwater AOC 4 did (Figure 2-1). Rather, Groundwater AOC 4A is now delineated within the northeastern portion of Area 19. Groundwater AOC 4A is bounded to the north, west, south, and east by the following sample locations where TCE was either not detected or was detected below the NJDEP Class IIA GWQS of 1 ug/L: SGWS287, OB-6A, MW-EPA-2A, SGWS206, SGWS208, SGWS295, SGWS26, SGWS278, SGWS139, MW-147, MW-128, SGWS88, SGWS87, SGWS263, SGWS266, and SGWS82. The April 2005 generalized TCE isopleths for groundwater AOC 4 are depicted in Figure 2-2.

Groundwater AOC 4A contains groundwater historically impacted by Area 18A; well MW-EPA2A was purportedly the source well (as defined in the July 2002 *Draft Final Natural Attenuation Report for the Former Arsenal*). The new plume boundary delineated by TCE isopleths does not encompass the source area well MW-EPA-2A since TCE has not been detected in that well since August 1999 following soil remediation.

When monitoring well MW-EPA-2A was sampled in March 2001, cis-1,2 DCE and vinyl chloride (breakdown constituents) were the only VOCs detected, with vinyl chloride detected at a concentration exceeding the NJDEP GWQS (Figure 2-1). Groundwater analytical data for vinyl chloride within this well suggests a decreasing trend since remediation in 1998 (Appendix B). These results indicate that the source area remediation was successful.

Monitoring well MW-46A is located downgradient of well MW-EPA-2A. A decreasing trend for VOCs was also documented at this well. Groundwater analytical results from this investigation indicated that benzene (1.6 ug/L) and TCE (12 ug/L) are still present at concentrations exceeding their NJDEP Class IIA GWQS of 1 ug/L. It should be noted that benzene was detected four of the eight sampling quarters at the source area well MW-EPA-2A at concentrations ranging from 0.8J ug/L to 1.1 ug/L. Groundwater analytical results where more than one round of groundwater data exists for Groundwater AOC 4A (confirmed former source area) indicates an overall decreasing trend of TCE. Breakdown constituents are increasing or have historically increased and now are decreasing. These trends in VOC concentrations are indicators that natural attenuation is occurring at this plume (Appendix B).

This GWRAWP proposes MNA as the remedial action for Groundwater AOC 4A based on the following:

- Remediation was conducted in the former DOD source Area 18A (former pond and buried drum area).

- Groundwater analytical results since remediation indicate that the remediation was successful; a decreasing trend for VOCs is observed. Additionally, TCE is no longer detected in the source area well MW-EPA-2A.

- There are no current vapor intrusion issues.

2.2.2 Groundwater AOCs 6A and 6C

Groundwater AOC 6 is located in the west-central portion of the site (Figure 1-2). The source(s) of the AOC 6 plume is (are) unknown. Potential sources may be related to possible DOD-related storage activities (Historical Archival Report [D&M, July 1993] indicates oil and grease waste storage associated with Building 520), or other more recent site activities not related to previous DOD activities (light manufacturing or industrial processes) identified during a previously conducted DOD review of NJDEP case files.

Based on the 2004/2005 groundwater VOC analytical data, the following VOCs were detected within Groundwater AOC 6: benzene, chlorobenzene, 1,1-DCA, 1,1-DCE, cis-1,2-DCE, trans-1,2-DCE, PCE, 1,1,1-TCA, TCE, toluene, and vinyl chloride. In general, the constituents detected were similar across Groundwater AOC 6. Of these VOCs, six (benzene, cis-1,2-DCE, 1,1-DCE, PCE, TCE, and vinyl chloride) were detected at concentrations exceeding the NJDEP Class IIA GWQS. TCE was the predominant constituent exceeding the NJDEP Class IIA GWQS during this investigation. The highest historical concentration of VOCs detected was at shallow groundwater screening location SGWS110 (completed in 1994) with total VOCs (PCE, TCE, total DCE, and vinyl chloride) at 4,280 ug/L. Monitoring wells MW-6, MW-47A, MW-48A, MW-48B, and MW-80A are plume wells (as designated in the July 2002 *Draft Final Natural Attenuation Report for the Former Raritan Arsenal*) in AOC 6 and the historic compounds of concern are TCE, PCE, and total-DCE.

The *Final Supplemental Groundwater Data Report* (Weston, September 2006) investigation provided sufficient data (distribution of TCE in groundwater in combination with the lack of a source area) to support the subdivision of the original Groundwater AOC 6 plume into Groundwater AOCs 6A, 6B, and 6C (Figure 2-3). In combination, Groundwater AOCs 6A, 6B, and 6C cover an area less than that of the original Groundwater AOC 6 plume, but generally underlie the same Soil Investigation Areas: the physical boundaries of Area 9, a portion of Area 19 in Raritan Center, and a portion of Area 8. The Groundwater AOC 6A, 6B, and 6C footprints extend in the direction of groundwater flow.

AOC 6A:

The northern extent of Groundwater AOC 6A lies north of the building located at 110 Fernwood Avenue and underlies portion of Area 10 within Raritan Center and a portion of Area 9. This plume extends into the wetland area just south of the building located at 45 Fernwood Avenue (Figure 2). Groundwater AOC 6A is bounded by the following sample locations where TCE was either not detected or was detected below the NJDEP Class IIA GWQS of 1 ug/L: SGSW113, SGWS33, SGWS219, SGWS220, SGWS221, SGWS223, SGWS40, SGWS49, SGWS50, SGWS227, SGWS41, and SGWS138.

The maximum concentration of TCE detected during the current investigation in association with Groundwater AOC 6A was 37 ug/L at sample location SGWS229. The center of this plume encompasses monitoring well MW-47A which was referenced in the July 2002 *Draft Final Natural Attenuation Report for the Former Raritan Arsenal* as being located in the source area of former Groundwater AOC 6. This well was sampled as part of the March/April 2005 sampling program and groundwater results indicated that TCE was the only VOC exceeding the NJDEP Class IIA GWQS. TCE was detected at a concentration of 13 ug/L, providing further evidence for a decreasing trend of TCE for this well and occurrence of natural attenuation. The April 2005 generalized TCE isopleths for groundwater AOC 6 are depicted in Figure 2-4.

AOC 6C:

The Groundwater AOC 6C boundary begins just south of the southeastern side of the Expo Center (portion of Area 19 within Raritan Center) and encompasses a portion of a parking lot, a landscaped area, a portion of a wetland area, and an undeveloped area in Area 8. The center of this plume encompasses sample locations SGWS233 and monitoring well MW-144. The TCE result for SGWS233 was used in part to determine the placement of well MW-144 collected for the *Final Supplemental Groundwater Data Report* (Weston, September 2006). The TCE concentrations detected at these locations (320 ug/L and 310 ug/L, respectively) were the maximum TCE concentrations detected at former Groundwater AOC 6 in 2004/2005. Historic data for these locations do not exist; therefore, a trend in TCE concentrations over time can not be established.

During the Supplemental Groundwater Data Investigation, sample locations SGWS232 and SGWS233 were completed to verify current VOC concentrations adjacent to and downgradient, respectively of historic sample location SGWS110 (completed in 1994). Sample location SGWS110 was considered a “hot spot” location due to the detected concentrations of TCE (390 ug/L), PCE (1,800 ug/L), total 1,2-DCE (1,800 ug/L), and vinyl chloride (190 ug/L). Groundwater analytical results from this investigation indicated that VOCs were not detected at sample location SGWS232, while TCE (320 ug/L), PCE (14 ug/L), cis-1,2-DCE (1,200 ug/L), and vinyl chloride (54 ug/L) were detected at sample location SGWS233. The TCE concentration detected at sample location SGWS233 is similar to the TCE concentration detected at sample location SGWS110 in 1994. There is a potential that the contamination detected at sample location SGWS110 has migrated in a downgradient direction. Based on sample location SGWS234 (completed adjacent to sample location SGWS233, but at a greater depth), the TCE concentration extends to 24 feet bgs and decreases vertically in this area. The April 2005 generalized TCE isopleths for groundwater AOC 6 are depicted in Figure 2-4.

In order to monitor natural attenuation in accordance with N.J.A.C. 7:26E-6.3(e), USACE proposes the installation of two additional monitoring wells Groundwater AOC 6C. Both monitoring wells will be installed downgradient of existing monitoring well MW-144. One well will be located within the plume well; and the other well will be a sentinel well located outside of the plume. The locations of these proposed wells are shown in Figure 2-4. Anticipated construction details for these proposed monitoring wells are summarized in Table 4-1.

The data collected during the Supplemental Groundwater Investigation did not allow for a better determination of whether the source(s) of the AOC 6 plumes is (are) related to possible DOD-related storage activities (e.g., oil and grease waste storage associated with Building 520), or other more recent site activities (light manufacturing or industrial processes) not related to DOD activities.

Monitoring well MW-144 and sample location SGWS233 are located within 100 feet of an existing building (Expo Center). Although an exceedance of the NJDE VIG for PCE was reported in soil gas during the first sampling event in April 2005, no exceedances of the NJDEP VIG screening levels were reported in the subslab soil gas beneath the Expo Center for VOCs in the January 2006 samples (Weston, August 2007). As a result, no further investigation should be necessary for this building.

This GWRAWP proposes MNA as the remedial action for Groundwater AOCs 6A and 6C because no current vapor issues were found to exist and the NJDEP has conditionally approved MNA as a remedial method.

2.2.3 Groundwater AOC 8C/8D

Groundwater AOC 8 is located near the northern boundary of the former Arsenal in the central portion of the site, starting in the vicinity of Area 18E (Figure 1-2). Previously identified potential DOD sources or potential sources of the contamination for Groundwater AOC 8 include:

- Former TCE degreasing operations and associated piping located within and near former Buildings 14, 15, and 19 in Area 18E in the northern portion of this AOC. A separate investigation was conducted concurrently in 2004/2005 to address Area 18E and future study of this area is planned.

- Former motor pool (Building 238 area) near wells MW-EPA-6A and MW-121. Building 238 was operated by GSA until the early 1980s as a motor pool maintenance garage.

- Former dump near the heliport in Area 18G and the former trench of shells.

Other potential DOD and non-DOD source areas exist in Area 18G and are associated with or in the vicinity of Building 241:

- Building 241 (former automotive shop) was located in the northeast corner of Area 18G. A review of historical records indicated that Building 241 was used as a DOD engine rebuild shop and/or motor repair shop. A 300-gallon alkali tank, a 300-gallon rinse tank, and an acid tank were located in Building 241. The building also contained numerous transformers and three USTs. Tanks A1 and A2 contained gasoline and diesel fuel, respectively, and the third tank was a 500-gallon heating oil UST. All three tanks were closed under supervision of the EPA and two monitoring wells were installed as part of the tank abandonment. The analytical post-excavation soil results indicated no constituents of concern and the groundwater samples did not exhibit contaminants related to the fuel stored in the tanks. The groundwater samples obtained by EPA contained 1,2-DCE, TCE, and PCE.

- GSA owned Building 241 from 1963 to 1988 and, according to EPA, stored paint, asbestos roofing tar, and drums of paint and oil.

Based on the 2004/2005 groundwater VOC analytical data, the following VOCs were detected within Groundwater AOC 8: benzene, chloroform, 1,1-DCE, cis-1,2-DCE, trans-1,2-DCE, PCE, and TCE. Of these VOCs, three (benzene, PCE, and TCE) had detected concentrations exceeding the NJDEP Class IIA GWQS. TCE was the predominant constituent exceeding the NJDEP Class IIA GWQS during this investigation.

The groundwater analytical data from the 2004/2005 investigation suggest a strong potential for multiple plume sources of contamination for Groundwater AOC 8. Based on this investigation, The original Groundwater AOC 8 (as of 2005) has been subdivided into Groundwater AOC 8A/8B, Groundwater AOC 8C, and Groundwater AOC 8D (Figure 2-5). In combination, Groundwater AOCs 8A/8B, 8C, and 8D cover an area approximately the same size as the original Groundwater AOC 8 plume and generally underlie the same Investigation Areas: the physical boundaries of Area 18E (former degreasing operation area); Area 18G and Area 1; portions of Areas 18C, 18D, and 18F (Buildings 202, 203, and 205) in EPA's Woodbridge Avenue complex; a portion of the Owens-Illinois property; and an area offsite to the north of Woodbridge Avenue(Figure 2-5).

The center of the Groundwater AOC 8C plume is roughly parallel to Pershing Avenue along the southern investigation boundary for Area 18G, former dump area. Area 18G was used for storage in the 1940s and for a dump by Columbia Salvage; the area is currently owned by EPA. This area was targeted for investigation in 1996 where chlorinated VOCs were detected in the groundwater. Monitoring wells MW-87A and MW-125 are located along Pershing Avenue and were sampled as part of the Supplemental Groundwater Investigation; historic groundwater analytical data exist for these wells. TCE was detected at concentrations exceeding the NJDEP Class IIA GWQS at both of these wells. The April 2005 generalized TCE isopleths for groundwater AOC 8C are depicted in Figure 2-6. The concentration at which TCE was detected at well MW-125 supports the documented decreasing trend of TCE. TCE was detected at well MW-87A at a concentration greater than the concentration detected in 2001; however, an overall decreasing trend (linear trend) of TCE is documented (Appendix B). Additionally, PCE was detected at well MW-87A at a concentration less than the NJDEP Class IIA GWQS in 2005; in 2001 PCE exceeded the NJDEP Class IIA GWQS.

Groundwater AOC 8D is located in the vicinity of Area 1. The maximum concentration of TCE detected during the 2005 investigation was 140 ug/L at sample location MW-8. This well is located in the northwestern portion of Area 1. The TCE concentration detected in 2005 is equal to the concentration detected in July 1998 (Figure 2-5). From July 1998 through April 2005, TCE concentrations in well MW-8 have been fluctuating between 99 ug/L and 140 ug/L (Appendix B). The downgradient edge of this plume is delineated by sample locations SGWS260, SGWS261, and MW-89A. TCE was not detected at sample location SGWS260 (screened below the meadowmat) and detected at a concentration of 0.6 ug/L at sample location SGWS261 (screened above the meadowmat). TCE was not detected at sample location MW-89A (screened across the meadowmat), a result which is consistent with historic groundwater data. In this area, the groundwater and surface water interact, as previously reported by Weston. The TCE detected at monitoring well MW-8 may be related to a source/residual source associated with Area 1 or Groundwater AOC 8A/AOC 8B and Groundwater 8C. The April 2005 generalized TCE isopleths for groundwater AOC 8D are depicted in Figure 2-6.

The TCE detected at monitoring well MW-8 may be related to a source/residual source associated with Area 1 (former excavation adjacent to well MW-8) or Groundwater AOC 8A and Groundwater 8B. The TCE concentrations in groundwater have been fluctuating between 99 ug/L and 140 ug/L since July 1998; a trend cannot be established. The area that this plume encompasses is located in an undeveloped area with no existing buildings. Therefore, a potential vapor intrusion threat does not exist at this time.

Groundwater AOC 8C and Groundwater AOC 8D are located in an undeveloped area of the former Arsenal with no existing buildings.

This GW RAWP proposes MNA as the remedial action for Groundwater AOC 8C and Groundwater AOC 8D based on the following:

- Documented decreasing trends for VOCs for these Groundwater AOCs (Appendix B).
- These plumes encompass undeveloped areas and no current vapor issues exist.

2.2.4 Groundwater AOC 9

Groundwater AOC 9 is located in the central northeast portion of the former Arsenal (Figure 1-2). The AOC 9 groundwater plume underlies Area 4 and trends south. Explosive compound contamination consisting of TNT and its breakdown products is present in both the soils within the fenced portion of Area 4 and the groundwater within and downgradient of the fenced area (see Figure 1-2, Revised GMRAWP, June 1999).

Monitoring wells MW-17, MW-42A, MW-123, and MW-124 are plume and source area wells and the historic compounds of concern are TNT, 2,4-dinitrotoluene and amino-DNTs (Figure 2-7). The explosives analytical results for AOC 9 illustrate the explosives trends for select compounds over the eight sampling rounds (Appendix B). Monitoring wells MW-123 and MW-130 are located in the source area of the explosives groundwater contamination. The groundwater contaminants of concern in MW-130, located in the source area, and their breakdown products include the following:

Compound	Source	Higher of PQL and Ground Water Quality Criterion (ug/L)	Low Detection (µg/L)	High Detection (µg/L)
2,4,6-Trinitrotoluene	Parent Material	No criteria	352	772
2,4/2,6-Dinitrotoluene	Breakdown Product	10	20.9 U	766.5
2-amino-4,6-Dinitrotoluene	Breakdown Product	No criteria	211 U	413
4-amino-2,6-Dinitrotoluene	Breakdown Product	No criteria	247.8	462.8

The groundwater contaminants of concern in MW-123, located in the source area, and their breakdown products include the following:

Compound	Source	Higher of PQL and Ground Water Quality Criterion (ug/L)	Low Detection (µg/L)	High Detection (µg/L)
2,4,6-Trinitrotoluene	Parent Material	No criteria	0.83 U	1.61
2,4/2,6-Dinitrotoluene	Breakdown Product	10	1.2 U	135.3
2-amino-4,6-Dinitrotoluene	Breakdown Product	No criteria	47	133
4-amino-2,6-Dinitrotoluene	Breakdown Product	No criteria	14	37.1

The concentrations of explosive contaminants in MW-123 are much lower than those observed in MW-130. MW-123 is suspected to be near the edge of the plume, while MW-130 is more toward the center.

MW-124 and MW-42A are designated as plume wells. The groundwater contaminants of concern in MW-124, located in the source area, and their breakdown products include the following:

Compound	Source	Higher of PQL and Ground Water Quality Criterion (ug/L)	Low Detection (µg/L)	High Detection (µg/L)
2,4,6-Trinitrotoluene	Parent Material	No criteria	4.27	8.98
2,4/2,6-Dinitrotoluene	Breakdown Product	10	44.46	61.7
2-amino-4,6-Dinitrotoluene	Breakdown Product	No criteria	175.5	314
4-amino-2,6-Dinitrotoluene	Breakdown Product	No criteria	55.9	87

The groundwater contaminants of concern in MW-124, located in the plume downgradient of MW-123, are primarily the breakdown products of 2,4,6-TNT, including 2,4/2,6-DNT and the amino-dinitrotoluenes. The concentrations observed in MW-124 are higher than those observed in the source area well MW-123. The concentrations of the contaminants have been observed to be decreasing since the fifth quarter.

The groundwater contaminants of concern in MW-42A, located in the source area, and their breakdown products include the following:

Compound	Source	Higher of PQL and Ground Water Quality Criterion (ug/L)	Low Detection (µg/L)	High Detection (µg/L)
2,4,6-Trinitrotoluene	Parent Material	No criteria	0.2 U	0.2 U
2,4/2,6-Dinitrotoluene	Breakdown Product	10	26 U	26 U
2-amino-4,6-Dinitrotoluene	Breakdown Product	No criteria	0.43	1.9
4-amino-2,6-Dinitrotoluene	Breakdown Product	No criteria	0.26 U	0.7

The concentrations of the groundwater contaminants of concern in MW-42A are lower than the concentrations observed in the upgradient Source Well MW-130. The location represents the potential extent of the explosives contamination in groundwater. No additional source parent material (2,4,6-TNT) has been observed, and only low concentrations of the breakdown products are present.

The total explosives isopleths for Groundwater AOC 9 are depicted on Figure 2-8.

Because Groundwater AOC 9 is related to explosives and not VOCs, there is not a potential vapor intrusion.

This GW RAWP proposes MNA as the remedial action for Groundwater AOC 9 based on documented decreasing trends for explosives.

2.2.5 Groundwater AOC 10

Groundwater AOC 10 is located in the western portion of the former Arsenal, originating at the former buried drum area associated with Area W (Figure 1-2). The former source area, consisting of buried drums (associated with Area W), was remediated in 1998 by removal and disposal, which included associated grossly contaminated soils. VOCs were detected at concentrations exceeding the NJDEP Soil Cleanup Criteria (SCC) in the 1998 post-excavation soil samples and the 1999 Phase II investigation soil samples.

Groundwater AOC 10 (as of 2005) extends south-southeast from the former buried drum area, underlying portions of the physical boundaries of Area W, Area X, Area 17A, and Area 10 (encompassing the Middlesex County Building). The northern (upgradient) extent of the plume is currently estimated to be somewhere south of monitoring well MW-73A and north of SGWS289 (Figure 2-9). Data from 1993 indicated that VOCs were not detected in monitoring well MW-73A (Weston, May 1994).

The 2004/2005 groundwater VOC analytical data indicate the following VOCs were detected within Groundwater AOC 10: bromodichloromethane, chloroform, 1,1-DCE, cis-1,2-DCE, trans-1,2-DCE, TCE, and vinyl chloride. Of these VOCs, four (chloroform, cis-1,2-DCE, TCE, and vinyl chloride) were detected at concentrations exceeding the NJDEP Class IIA GWQS.

USACE has investigated remedial alternatives for Groundwater AOC 10. In October 2004, Shaw Environmental and Infrastructure, Inc. (Shaw) conducted a MIP and soil conductivity survey within and surrounding the former excavations. During the October 2004 field efforts, the MIP was used to delineate the contamination remaining after the 1998 remediation efforts during which over 2,000 cubic yards of soil was excavated from the site. Soil samples were collected from selected locations to confirm the MIP results. TCE and cis-1,2-DCE were detected exceeding the NJDEP SCC in five of the soil samples collected. The results of the survey were to be used as part of a treatability study evaluation. Groundwater samples were not collected during Shaw's investigation. (Shaw, April 2005).

The source and plume wells (MW-129 and MW-131, respectively), as designated in the July 2002 *Draft Final Natural Attenuation Report for the Former Raritan Arsenal*, were sampled as part of Weston's March/April 2005 groundwater sampling event. TCE results from this event support the documented decreasing trend of TCE at these wells, indicating remediation was successful. TCE was detected at concentrations of 46,000 ug/L at sample location SGWS289 (just north of the former excavation and the area investigated by Shaw) and 1,800 ug/L at sample location SGWS288 (west of the former excavation and the area investigated by Shaw). The concentration detected at sample location SGWS289 is the highest reported TCE concentration in groundwater sampled at the former Arsenal to date.

Based on these data, Groundwater AOC 10 is shown to extend westerly towards SGWS288 and is bounded to the north by monitoring well MW-73A. Groundwater AOC 10 is bounded to the south and east by sample locations SGWS190, monitoring well MW-132, SGWS193, SGWS187, monitoring well MW-150, and SGWS281.

The source area (Area W) associated with Groundwater AOC 10 was remediated via soil excavation in 1998. The MIP investigation conducted in October 2004 concluded that most of the remaining contamination at this site is situated below the water table. Groundwater analytical data for monitoring wells MW-129 indicate a consistent downward trend of TCE contamination (the only contaminant detected above regulatory standards at this well) over 14 rounds with a maximum concentration of 160 ug/L in 1998 to the most recent TCE concentration of 13 ug/L in April 2005 (Appendix B). Similarly, TCE concentrations in samples collected from monitoring well MW-131 have shown a steady decrease from 1,500 ug/L in 1999 to 210 ug/L in 2005. The April 2005 generalized TCE isopleths for groundwater AOC 10 are depicted in Figure 2-10.

In order to continue to monitor natural attenuation in accordance with N.J.A.C. 7:26E-6.3(e), and adequately delineate the extent of Groundwater AOC 10, USACE proposes the installation of two additional monitoring wells. One well will be located at or immediately adjacent to the former sample location SGWS289 (area of highest TCE concentrations); and the other well will be located outside the plume and west-southwest of historic sample location SGWS288. The locations of these proposed wells are shown in Figure 2-4. Anticipated construction details for these proposed monitoring wells are summarized in Table 4-1.

This GWRAWP proposes MNA as the remedial action for Groundwater AOC 10 based on the following:

- The source material has been removed.
- Decreasing trends for VOCs have been documented.
- No indoor air issues currently exist.

2.3 MONITORED NATURAL ATTENTUATION

As discussed in the previously accepted *Final Natural Attenuation Report* (Weston May 2003), natural attenuation of groundwater VOC contamination involves the metabolism of contaminant compounds by naturally occurring bacteria present at the site. The metabolic process for natural PCE and TCE degradation is depicted in Figure 2-1.

Based on *Technical Protocol for Evaluating Natural Attenuation for Chlorinated Solvents in Groundwater* (EPA, 1998), chlorinated solvents (PCE/TCE) may undergo microbial natural attenuation through three different pathways: use as an electron acceptor; use as an electron donor; or through cometabolism, where degradation of the chlorinated organic is fortuitous, and there is no benefit to the microorganism. At a given site, one or all of these processes may be operating, although at many sites the use of chlorinated aliphatic hydrocarbons as electron acceptors appears to be most important under natural conditions. In this case, natural attenuation of chlorinated aliphatic hydrocarbons will be an electron donor-limited process.

In a pristine aquifer, native organic carbon is used as an electron donor, and dissolved oxygen (DO) is used first as the prime electron acceptor. Where anthropogenic carbon (e.g., as fuel hydrocarbons) is present, it also will be used as an electron donor. After the DO is consumed, anaerobic microorganisms typically use additional electron acceptors (as available) in the following order of preference: nitrate, ferric iron oxyhydroxide, sulfate, and finally carbon dioxide. Evaluation of the distribution of these electron acceptors can provide evidence of where and how chlorinated aliphatic hydrocarbon natural attenuation is occurring.

In addition, because chlorinated aliphatic hydrocarbons may be used as electron acceptors or electron donors (in competition with other acceptors or donors), evaluating the distribution of these compounds and their daughter products, as well as field/laboratory results for the natural attenuation parameters DO, redox potential (Eh), nitrate, ferrous iron, sulfate, and carbon dioxide, can provide evidence of the mechanisms of natural attenuation working at a site. Therefore, the sampling and evaluation of these compounds is an important component of a natural attenuation monitoring and evaluation program.

The natural attenuation of TNT involves the breakdown of TNT into 2,4-DNT, 2,6-DNT, and other amino DNT and mononitrotoluene (MNT) compounds by naturally occurring denitrating bacteria. Some of the other nitroaromatic DNT and MNT breakdown products include 2-amino-4,6-dinitrotoluene, 4-amino-2,6-dinitrotoluene, 2,4-diamino-6-nitrotoluene, and 2,6-diamino-4-nitrotoluene (Weston, July 2002). The sampling of conventional natural attenuation monitoring parameters mentioned above for PCE/TCE (DO, Eh, nitrate, etc.) has also provided evidence of natural attenuation of TNT.

Previous evidence of ongoing natural attenuation of groundwater plumes at the former Arsenal is presented in the July 2002 *Draft Final Natural Attenuation Report for the Former Raritan Arsenal*, included:

- Positive preliminary screening results (as defined in EPA, 1998);
- Decreasing concentrations of parent compound(s) in source areas;
- Presence of or increasing concentrations of breakdown product(s) in the source areas;
- Reducing conditions in the source areas: low DO, low nitrate, iron present, and high ethane/methane concentrations;
- Decreasing concentration of contaminants in the plume and fringe wells; and
- No contaminants present in sentinel well.

MNA was conditionally approved by NJDEP in the comment letter dated 12 March 2003, barring the potential for a vapor intrusion pathway from groundwater and/or soil to subslab soil gas to indoor air in a given AOC. In areas where a potential vapor intrusion pathway originating from groundwater and/or soil is proven, further investigation and/or active remediation may be warranted.

Overall, the VOC analytical results indicate decreasing trends and reductions in plume sizes, providing further evidence for natural attenuation (See Appendix B). Most of the decreasing trends are related to USACE source removal actions.

The contaminated groundwater volume estimates are provided in the table below and on the generalized isopleth figures for each individual Groundwater AOC.

Groundwater AOC	Plume Area (ft^2)	Thickness of Lower Sand (ft)	Lower Sand Porosity	Volume of Plume (ft^3)	Volume of Contaminated Groundwater	
					(ft^3)	(gallons)
4A	1,620,219	30	0.30	48,606,583	14,581,975	109,080,755
6A	504,075	20	0.30	10,081,495	3,024,449	22,624,449
6C	161,076	20	0.30	3,221,524	966,457	7,229,602
8C	172,976	30	0.30	5,189,282	1,556,785	11,645,559
8D	53,163	10	0.30	531,626	159,488	1,193,051
9	371,533	15	0.30	5,572,995	1,671,899	12,506,671
10	264,295	30	0.30	7,928,862	2,378,659	17,793,603

No permits are required for the implementation of the MNA remediation of Groundwater AOCs. However, according to the NJDEP Bureau of Water Allocation (BWA), monitoring well permits are required prior to the installation of proposed monitoring wells for site-wide groundwater quality monitoring.

SECTION 3.0
CLASSIFICATION EXCEPTION AREA (CEA)

3.1 CONTAMINANTS, EXTENT, AND DURATION

A site-wide Classification Exception Area (CEA) is proposed as part of the remedial action for the Lower Sand (LS) aquifer at the former Raritan Arsenal (Figure 3-1) encompassing the following DOD plumes and non-DOD plumes:

Groundwater AOC included in CEA	DOD plume	Non-DOD plume
2	X	
3		X
4A	X	
4B		X
6A	X	
6B		X
6C	X	
7		X
8A/8B	X	
8C	X	
8D	X	
9	X	
10	X	

Because the northern portion of the designated aquifer can potentially be used as a potable aquifer, the CEA will be identified as a Well Restriction Area (WRA).

The site-wide CEA will include Groundwater AOCs 4A, 6A, 6C, 8C, 8D, 9, and 10. Although USACE has proposed AOCs 3, 4B, 6B, and 7 as non-DOD Groundwater AOCs, they will be included in the proposed site-wide CEA boundary. Although unresolved indoor air issues remain in Groundwater AOCs 2, and 8A/8B, they are also included within the area of the proposed Site-wide CEA.

Based on the most recently available groundwater data for the following contaminants, the maximum concentrations detected in Groundwater AOCs 4A, 6A, 6C, 8C, 8D, 9, and 10, and applicable NJDEP remediation standards are summarized below. Because there is no NJDEP criterion for TNT, USACE proposes to monitor its breakdown products 2,4-DNT and 2,6-DNT.

Contaminant	Most Recent[1] Maximum Concentrations (ug/L)	Current Applicable NJDEP Remediation Standard (ug/L)
Tetrachloroethylene (PCE)	180	1
Trichloroethene (TCE)	310	1
cis-1,2-Dichloroethylene (cis-1,2-DCE)	830	70
trans-1,2-Dichloroethylene (trans-1,2-DCE)	8.2	100
Vinyl Chloride	35	1
1,2-Dichloroethane (1,2-DCA)	Not-detected	2
Benzene	1.6	1
2,4-Dinitrotoluene/2,6-Dinitrotoluene mix	44	10

Note:

1. Most Recent data for AOCs 4A, 6A, 6C, 8C, 8D, and 10 are from 2005; for AOC 9 most recent data is from 2000-2001

The *Final Groundwater Natural Attenuation Report* (Weston, May 2003) presented the CEA distance and duration calculations (Appendix C). Based on these calculations using data available through 2001, the most persistent contaminant, TCE (MW-8; Groundwater AOC 8C) yielded a CEA duration of approximately 40 years to obtain the remedial goal. Therefore an expiration date for the CEA is proposed for the year 2041. A summary of calculated duration for each plume are presented below

Groundwater AOC	Most Persistent Contaminant	Calculated Duration (years)
4	Vinyl Chloride	12
6	TCE	17
8	TCE	41
9	2-amino-4,6-DNT	24
10	TCE	7

The calculated travel distance for TCE (MW-8) was approximately 1700 feet. The calculated extent of plumes within Groundwater AOC 4A, 6A, 6C, 8C, 8D, 9, and 10 are depicted within the overall boundary of the site-wide CEA (Figure 3-1). The calculated maximum contaminant travel distances (Appendix C) based on the calculated half-life values for each plume are shown as compliance points on Figure 3-1. An electronic version of the map showing the predicted extent of the site-wide CEA and the predicted extent of the Groundwater AOC plumes is provided on the data CD in Appendix D. A map showing the site-wide CEA horizontal boundaries and the predicted extent of Groundwater AOC 4A, 6A, 6C, 8C, 8D, 9, and 10 with respect to tax block and lot boundaries is provided as Figure 3-2.

Within the established horizontal boundaries of the CEA, the vertical extent of the CEA is proposed for the entire saturated thickness of the LS and to the top of the Raritan Fire Clay or weathered bedrock. Additional information regarding the CEA is provided in the attached Groundwater CEA Fact Sheet (Appendix E)

3.2 EVALUATION OF CURRENT AND PROJECTED GROUNDWATER USE

According to Schmid (1987), groundwater was not historically used at Raritan Center. Overpumping of regional aquifers, which are important industrial and public sources in municipalities south of the study area, has caused saltwater intrusion into regional wellfields. At

Raritan Center, groundwater does not meet drinking water standards, primarily because of its natural salinity, iron, manganese, and sulfate concentrations. Adequate public water supplies are available for future development in the study area from the off-site surface and underground supplies tapped by Middlesex Water Company. Water lines at Raritan Center have been constructed in sizes to accommodate full development. Furthermore, based on TDS and chloride results the lower one-third of the former Arsenal has been reclassified to a Class IIIB aquifer. This further limits and discourages future use of this aquifer as a potable water source.

The Weston evaluation of the water usage within the borders of the former Arsenal confirms the information presented in the Schmid report. The review of water use information was based on a NJDEP, Bureau of Water Allocation file search of all wells within a 2- and 5-mile radius of the site (Appendix C, *Final Site-Wide Hydrogeology Report*, June 1996). The search yielded a total of 874 wells that were permitted. The wells were categorized into the following three types:

- Monitoring wells, piezometers, vapor extraction wells, recovery wells, and test borings located within the site boundaries, including any domestic, industrial, or public supply wells identified within a one-quarter-mile radius of the site.

- Monitoring wells, piezometers, vapor extraction wells, recovery wells, and test borings located outside the site boundaries, including any domestic, industrial, or public supply wells identified within a greater than one-quarter-mile radius of the site.

- Any wells located south of the Raritan River.

The results of this evaluation, including conversations with the Edison Health Department and a supplemental field reconnaissance, indicated the following:

- Five potential domestic wells were identified within one-quarter mile of the site. All of these wells have been confirmed to be out of service based on a Weston field inspection. In addition, these five locations are located upgradient of the former Arsenal. Other potential receptors were not identified within the site boundary or within one-quarter mile of the site.

- Nineteen domestic wells, 14 industrial wells, and one public supply well were identified greater than one-quarter mile from the site. Many of these wells are believed to be out of service; however, this has not been confirmed. These wells are located upgradient or crossgradient of the site and are not expected to be impacted by the former Arsenal.

- Although 61 water withdrawal points (permitted for pumping up to 100,000 gallons per day [gpd]) are reported within 5 miles of the approximate center of the site, it is not likely that these wells would impact the former Arsenal overburden aquifer. These off-site water withdrawal points do not appear to be affecting local groundwater flow patterns.

- A significant number of industrial facilities exist in and near the Raritan Arsenal for which monitoring well permits exist. These facilities represent potential sources of groundwater contamination that could impact the former Arsenal.

Based on this information, there are no human receptors for the overburden groundwater at the former Arsenal.

Based on conversations with the Edison Health Department, there are no future use plans for the groundwater (both overburden and bedrock) within the former Arsenal. The past history of salt-water intrusion, TDS, iron, and manganese problems are the principal reasons why the township has not developed these aquifers.

The former Arsenal lies within Middlesex County and the Raritan River Regional Water Resource Planning Area (RWRPA) Number 10. According to the New Jersey Statewide Water Supply Master Plan the RWRPA No. 10 was classified as a planning area approaching overdrafting because despite the total province having a current total balance of available groundwater (56.3 million gallons per day [mgd]), a deficit within an individual physiographic province was considered to be approaching overdraft (CH2M HILL, May 1993). The Inner Coastal Plain province within RWRPA No. 10 has a current available groundwater balance of 7.8 mgd. The population and total water demands (purveyor- and self-supplied) are projected to increase by 31.4% and 41.9%, respectively, by the year 2040.

Middlesex County is classified as a county with a total current groundwater overdraft (-14.4 mgd). The Inner Coastal Plain within Middlesex County has a current available groundwater deficit (-16.4 mgd). The population and total water demands are projected to increase by 27.1% and 34.4%, respectively, by the year 2040.

Copies of the certified notification letters, return receipt requested, are provided in Appendix F. Notification letters were sent to: the Edison Township and Middlesex County clerks, the Edison Department of Health and Human Resources, the Middlesex County Public Health Department, the Edison and Middlesex County Planning Boards, The NJDEP Bureau of Safe Drinking Water, NJDEP Bureau of Water Allocation, and property owners within the groundwater CEA.

The CEA will extend over the entire site of the Former Raritan Arsenal. The CEA is proposed for the following contaminants:

- Tetrachloroethylene (PCE) and its degradation products trichloroethylene (TCE), 1,2-dichloroethylene (cis-1,2-DCE), trans-1,2-DCE, 1,1-DCE, and vinyl chloride (VC).
- Tetrachloroethane (PCA) and its degradation products 1,1,1-trichloroethane (1,1,1-TCA) and cis-1,2-dichloroethane (cis-1,2,DCA).
- Explosives compounds (2,4-DNT and 2,6-DNT).

SECTION 4.0
MONITORING, MAINTENANCE & BIENNIAL CERTIFICATION

The USACE will be responsible for the monitoring, maintenance, and biennial certification of protectiveness of the CEA as provided in the NJDEP N.J.A.C. 7:26E-8.4 and 8.6.

Monitoring data and results will be provided in reports to the NJDEP which include: biennial CEA certifications, remedial action progress reports following each round of MNA sampling, and a remedial action report at the end of all CEA and MNA monitoring. The proposed schedule for these reports is provided in Section 9 of this GWRAWP.

4.1 MONITORING

In order to continue to monitor the ability of natural attenuation processes at the site to achieve remedial objectives for groundwater, periodic groundwater monitoring will be performed. This monitoring will include existing and new sentinel (point-of-compliance) wells at strategic locations based on 5-year travel distance calculations. Pursuant to NJDEP Technical Rule 7:26E-6.3(e)1i4, sentinel wells must be located no further than 5 years travel time from the delineated downgradient extent of the groundwater plume. The proposed well locations are shown on Figure 3-2. Monitoring wells will be installed, developed, and sampled consistent with applicable NJDEP regulations and as per the field investigation procedures originally provided in the *Comprehensive Sampling and Analysis Plan* (CSAP) (Weston, July 2005) as described below.

A list of 22 existing groundwater monitoring wells, 9 proposed new groundwater monitoring wells, and 3 surface water locations proposed for future compliance sampling is presented in Table 4-1, and their locations are shown in Figure 3-1. As shown in the table, the proposed long-term monitoring wells will collectively monitor the entire thickness of the LS geologic unit, which is approximately 5 to 20 feet thick in the vicinity of the proposed sample locations.

USACE will conduct groundwater flow monitoring during each round of future sampling. A list of 48 existing and 9 proposed wells to be used for groundwater flow monitoring is presented in Table 4-2.

4.1.1 Proposed Groundwater Monitoring Wells

The proposed overburden wells will be installed and developed for the primary purpose of collecting groundwater for analysis and static water level data. The proposed wells will be 2-inch in diameter and constructed of schedule 40 PVC. The proposed wells will be installed using the hollow-stem auger method, the preferred choice for shallow (<30 ft.) overburden wells at the former Arsenal.

4.1.1.1 Monitoring Well Installation

Well construction information is included on the Well Construction Form for each well installed. At a minimum, the well construction information will show depth from surface grade, the bottom of the boring, the screened interval, casing material, casing diameter, gravel pack location, grout seal and height of riser pipe above the ground.

The annular space between the well screen and the boring is filled with a uniform gravel/sand pack to serve as a filter media. The depth of the top of the sand shall be determined, thus verifying the thickness of the sand pack. Additional sand shall be added to bring the top of the sand pack to approximately two to three feet above the top of the well screen. Under no circumstances should the sand pack extend into any aquifer other than the one to be monitored. In most cases, the well design can be modified to allow for a sufficient sand pack without threat of crossflow between producing zones through the sand pack.

In materials that will not maintain an open hole using hollow-stem augers, the temporary or outer casing is withdrawn gradually during placement of sand pack/grout. For example, after filling two feet with sand pack, the outer casing should be withdrawn two feet. This step of placing more gravel and withdrawing the outer casing should be repeated until the level of the sand pack is approximately three feet above the top of the well screen. This ensures that there is no locking of the permanent (inner) casing in the outer casing.

A bentonite slurry seal of a minimum 2-foot vertical thickness will be placed in the annular space above the sand pack to separate the sand pack from the cement surface seal and to prevent infiltration of cement into the filter pack and the well screen. The slurry will be prepared by mixing powdered or granular bentonite with potable water. The slurry must be of sufficiently high specific gravity and viscosity to prevent its displacement by the grout to be emplaced above it. The bentonite slurry will be pumped through a tremie pipe and emplaced directly above the sand pack. This seal will be allowed to "set up" (or begin to solidify) for approximately 30 to 60 minutes prior to grouting up the remaining annular space.

For wells installed in the LS located beneath the extensive peat unit at the site, the bentonite seal shall extend to the top of the peat unit. This construction will eliminate the potential for migration of contaminants between the upper water-bearing zone and lower water-bearing zone.

A cement/bentonite grout will be placed from the top of the bentonite seal to the ground surface. Grout is pumped through a tremie pipe until undiluted grout flows from the annulus at the ground surface. In materials that will not maintain an open hole, the temporary steel casing should be withdrawn in a manner that prevents the level of grout from dropping below the bottom of the casing. Additional grout may be added to compensate for the removal of the temporary casing and the tremie pipe to ensure that the top of the grout is at or above ground surface. After the grout has set (about 24 hours), any depression due to settlement is filled with a grout mixture similar to that described above.

A protective steel casing will be placed around the exposed PVC well casing and will extend a minimum of 3 feet bgs. The protective casing will be grouted in and a cement pad will be constructed around each protective casing ensuring cement slopes away from the casing. Vent holes will be drilled in the riser pipe and protective casing to vent moisture. In addition, a small hole will be drilled into the base of the protective casing to drain rain water between the casing and well. The protective casing will include a hinged cap which will be padlocked for protection. The padlocks will either have identical keys, or be keyed for opening with one master key. Flush mounted well completions may be used for wells installed within high traffic areas. All wells will be constructed in a manner which prevents damage from thaw/freeze conditions (i.e., frost sleeve installation).

4.1.1.2 Monitoring Well Development

Well development is the process by which fine soil materials are removed from in and around the screen allowing water to flow freely into the well. This process is accomplished by moving water or air through the well screen into and out of the surrounding material. The well development process:

- Removes materials that have built-up in the openings of the screen during the well drilling and installation processes.

- Removes fines from the sides of the borehole that resulted from the drilling procedures, (e.g., drilling mud).

- Increases the hydraulic conductivity of adjacent geologic materials and the filter pack by removing fine materials.

- Stabilizes the fine materials that remain in the vicinity of the well and retards their movement into the well.

The benefits of well development are increased yields, reduced pumping of fines that can damage pumps, decreased corrosion and encrustation, and production of low-turbidity groundwater samples. The results of the development process are a layer of coarse particles adjacent to the screen. The percentage of finer particles increases with distance away from the well. Well development is necessary in any well because clogging can occur regardless of the drilling method used or the formation being penetrated.

Weston will initiate well development as soon as practical after installation, but no sooner than 48 hours after grouting is completed. Existing wells may also require development. This determination will be made following inspection by the field geologist.

There are a variety of methods that can be used in well development. Several are discussed below; however, pumping combined with surge blocking will be the preferred method. If well development goals are not met using this combined method, others will be utilized.

- Bailing - This method involves removing turbid water from a well using a bailer (usually the large type used on drill rigs rather than the type used for sample collection). The process of lowering and raising the bailer helps to move water into and out of the filter pack which flushes finer material into the well for removal. Bailing is a relatively ineffective method of well development; however, Weston may use bailing as a starting method in wells with very turbid water.

- Mechanical Surging - In this method, also called block surging, a surge block or surge plunger is pushed in and pulled out of the well in a plunger-like fashion. The plunger can be solid or valved. Valved plungers allow action on the downstroke and strong action on the upstroke, but care will be taken on the upstroke because screens can be collapsed. As fines are flushed into the well, they will be bailed or pumped.

- Overpumping - This method involves pumping at high rates, then allowing the well to recover before pumping again. This method assumes that the hydrogeologic system will then be stable at normal pumping rates. When the pumps are stopped, backwash helps overcome bridging. While this method is simple and quick, it is also minimally effective. Overpumping may be used as a finishing method.

Criteria used to determine when development is complete are provided below. These criteria will be considered as goals.

- Water appearance (e.g., continue until opaque or translucent water becomes transparent or clear).

- Turbidity (e.g., goal of less than 50 NTU as determined by a nephelometer).

- Flow rate (e.g., continue until maximum flow rate stabilizes).

- Water volume (e.g., remove at least 3 to 5 times the well volume in high yielding wells).

- Field parameters (e.g., continue until temperature, specific conductance, and pH stabilize). Stabilization is defined as less than 10 percent variation.

Specific procedures to be followed during well development are summarized below:

- Open the monitoring well, take initial measurements (i.e., head space air monitor readings, water level, well depth, pH, temperature, and specific conductivity) and record results in the site logbook.

- Develop the well by the appropriate method (i.e., surging and pumping) to accommodate site conditions and project requirements. Dispersing agents, acids, or disinfectants will not be used to enhance development of the well.

- Continue until the development goals above are achieved.

- Containerize discharge water if required.

- All data will be recorded on a Well Development Form.

- Decontaminate equipment as appropriate prior to use in the next well.

4.1.2 Groundwater Quality Monitoring

Groundwater sampling from 22 existing and 9 proposed monitoring wells (Table 4-1) will be performed following the schedule presented in Subsection 4.1.4. Samples will be collected from 3 surface water locations according to the same schedule. Twenty-two existing wells and 9 proposed new wells will be sampled to monitor groundwater quality at each groundwater AOC. Groundwater samples from twenty-seven wells and all surface water samples will be analyzed for VOCs by EPA Method 8260B, and samples from four wells within Groundwater AOC 9 will be analyzed for explosives by EPA Method 8330 (see Section 5, Quality Assurance Plan). Groundwater and surface water sampling, analyses, and associated QA/QC will be performed in accordance with *Comprehensive Sampling and Analysis Plan* (CSAP) (WESTON, July 2005). Figure 3-1 illustrates the locations of the monitoring wells and surface water locations to be sampled.

4.1.3 Groundwater Flow Monitoring

In addition to conducting water quality monitoring, water level data will be collected from groundwater monitoring wells and staff gauges. Water levels from overburden wells will be used to construct groundwater contour maps. These data will be used to evaluate if significant changes in groundwater or surface water flow have occurred over time. Table 4-1 summarizes the AOCs, wells, and former Arsenal area(s) monitored. The rationale for these flow monitoring locations is also provided. Groundwater level monitoring will be performed in conjunction with analytical sampling events.

4.1.4 Groundwater Monitoring Schedule

Two types of groundwater monitoring are proposed:

- *MNA groundwater monitoring* events to evaluate the contaminant trends and distribution over time; and
- *CEA groundwater quality* events to confirm contaminant concentrations have decreased below applicable standards.

USACE proposes that the initial groundwater compliance monitoring program described in Subsection 4.1 be performed on a biennial basis. Based on the calculated pollutant transport rates, the minimum travel time from the delineated downgradient edge of any plume to a sentinel well is approximately 1.52 years (based on data from MW-132 in AOC 10). The calculation represents the estimated minimum amount of time for contaminants to reach any sentinel well. Therefore, an initial monitoring interval of 2 years is proposed.

The CEA calculations for the former Arsenal site indicate durations to reach compliance ranging from less than 1 year to approximately 40 years. However, the extensive data obtained from the eight rounds of groundwater sampling, in addition to previous results, indicate that the plumes are stable and are migrating at a rate less than estimated by the CEA calculations. Therefore, it is proposed that after the first two sampling rounds, the sampling frequency be modified to a 5-year interval, if the results from those first two rounds confirm that contaminants have not migrated to the sentinel wells. USACE would consider such results adequate confirmation of the results presented in this report regarding evidence of stable plumes and decreasing concentrations.

Data will be provided to NJDEP in the first biennial certification report which occurs after the completion of a groundwater sampling event. If groundwater sampling data from any event before the expiration date of the CEA show that natural attenuation has achieved the applicable

GWQS in individual or all of the Groundwater AOCs, USACE will collect a second round within 120 days to confirm the GWQSs have been met. If the confirmatory round of groundwater sampling demonstrates the GWQSs have been met, then USACE will request the NJDEP modify or remove the groundwater CEA accordingly.

A total of 8 MNA groundwater quality monitoring events and 2 CEA groundwater quality events are proposed.

Groundwater Monitoring Type	Round No.	Year
MNA	1	2008
	2	2010
	3	2015
	4	2020
	5	2025
	6	2030
	7	2035
	8	2040
CEA	1	2041
	2	2041

4.2 MONITORING WELL MAINTENANCE

All groundwater monitoring wells used for compliance of the CEA will be inspected to determine physical integrity. A padlock and well identification labels will be maintained; and a maintenance log for each well be kept for the duration of the CEA. Any lost, damaged, or vandalized groundwater monitoring wells used as part of the CEA monitoring will be reported to the NJDEP and replaced, as necessary. A well closure report will be provided to the NJDEP for any decommissioned wells.

4.3 BIENNIAL CERTIFICATION REQUIREMENTS

As per the NJDEP TRSR 7:26E-8.4, the USACE will provide a biennial certification to the NJDEP every two years on the anniversary date of the date that the NJDEP establishes the groundwater CEA. The certification will be submitted to the attention of the former Raritan Arsenal NJDEP current case manager, Anthony Cinque (or future case manager):

New Jersey Department of Environmental Protection
Department of Remediation Management and Response
Bureau of Case Management
P.O. Box 028
401 E. State Street
Trenton, NJ 08625-0028

The biennial certifications will be prepared in accordance with the specific requirements of the groundwater CEA, NJDEP TRSR 7:26E-8.6. The USACE will complete the NJDEP *"Biennial Certification Monitoring Report for a Ground Water Classification Exception Area (CEA)"* (Appendix G)

The evaluation of the groundwater CEA protectiveness will include an evaluation of the laws, NJDEP GWQS, and other regulations applicable at the time CEA was established with any relevant subsequently promulgated laws, standards, or regulations. In addition, it will include a determination of any planned changes within the 25-year water use planning horizon for the former Arsenal's LS aquifer since the NJDEP's establishment of the CEA or most recent biennial review.

Any actual changes within the groundwater use of the LS aquifer within the planning area that are within a 1-mile radius of the CEA boundaries will be identified. Identification will be based on a computer-generated 1-mile NJDEP Bureau of Water Allocation well search and manual search identifying all wells other than groundwater monitoring wells.

Any land disturbances that intercept the groundwater within the CEA and potentially result in a contaminated discharge to surface water will be identified. If potential discharges to surface water are identified, then the USACE will sample the groundwater/surface water downgradient and proximate to the land disturbance. The results of these samples will be compared to New Jersey and Federal Surface Water Quality Criteria.

SECTION 5.0
QUALITY ASSURANCE PROJECT PLAN (QAPP)

The MNA approach with a site-wide CEA is proposed for Groundwater AOCs 4A, 6A, 6C, 8C, 8D, 9, and 10 at the former Arsenal. The MNA approach is not proposed for non-DOD related plumes (i.e. AOCs 3, 4B, 6B, 7) and the plumes that have outstanding vapor intrusion issues (i.e. AOCs 2, and 8A/8B) in this GWRAWP; however the area of these plumes are included within the boundaries of the proposed site-wide CEA. It is anticipated that MNA will ultimately be applied to the site Groundwater AOCs 2, 3, 4B, 6B, 7, and 8A/8B.

The Quality Assurance Project Plan has been documented in the *"Former Raritan Arsenal Comprehensive Sampling and Analysis Plan"* [(CSAP) (Weston, July 2005)]. Table 5-1 shows the Analytical Methods/Quality Assurance Summary table documenting the frequency, number and type of samples to be collected.

5.1 LABORATORY DATA

The data quality objectives of the proposed sampling for this GWRAWP are compliance-based and will be used to demonstrate:

- Natural attenuation is continuing; and
- The natural attenuation remedy remains protective to human health and the environment.

The sample analysis will be performed by a contract laboratory which is validated, accredited, or certified by either the USACE, the National Environmental Laboratory Accreditation Conference (NELAC), or the NJDEP. The laboratory will be selected, and the NJDEP notified, prior to initiation of the first compliance groundwater sampling event.

Mr. Jim Kelly/USACE (978-318-8227) is responsible for the overall project coordination. Mr. Paul Bovitz/Weston (732-417-5800) will be responsible for sampling activities and quality assurance and quality control. Ms. Yunru Yang/Weston (732-417-5800) will be responsible for laboratory activities including quality assurance and quality control.

Analytical methods and quality assurance details are provided in the CSAP (Weston, July 2005). For convenience, copies of the following CSAP tables are provided in Appendix H. The complete CSAP (Weston, July 2005) is provided electronically as Appendix I.

- Table 3-2: Sample Container and Preservation Requirements for Water;
- Table 3-6: Analytical Methods for Water (includes holding times);
- Table 4-1: Volatile Organic Compounds Regulatory Requirements for Water and Soil;
- Table 4-5: Explosive Compounds Regulatory Requirements for Water and Soil;
- Table 4-9: Matrix Spike/Matrix Spike Duplicate Objectives Organic Compounds;
- Table 4-10: QC Objectives for Accuracy in LCS Organic Compounds;
- Table 4-11: QC Objectives for Accuracy for Organic Surrogate Analyses; and
- Table 4-12: GC/MS Calibration Check Compounds and System Performance Check Compounds.

5.2 WATER LEVEL MEASUREMENTS

The following procedures for groundwater level measurements have been previously provided in Section 3.2.7 of the CSAP (Weston, July 2005). The complete CSAP (Weston, July 2005) is provided electronically as Appendix I.

A survey mark will be clearly placed on the casing for use as a reference point for measurement. Generally, the reference point is made at the top of the well casing or "stickup" (not the protective casing). All field personnel will be notified of such reference point in order to ensure comparable data and measurements.

Prior to measurement, water levels in monitoring wells will be allowed to stabilize for a minimum of 24 hours after well construction and development. In low yield situations, recovery may take longer. All measurements will be made to an accuracy of 0.01 ft.

In general, measurements should proceed from least to most contaminated wells. Where many wells are to be sampled (i.e., greater than 10), measurements may be taken in a systematic manner to insure efficiency and accuracy. The well will be opened and headspace monitored with the appropriate monitoring instrument to determine the presence of volatile organic compounds. The total depth of the well will be measured using the survey mark and a depth sounder.

The water level measuring device will be lowered into the well until the water surface is encountered. The distance from the water surface will be measured to the reference point on well casing and recorded in the site logbook and/or a groundwater level data form. All downhole equipment will be removed, decontaminated as necessary, and the casing cap replaced. If floating hydrocarbon product is present, a special dual-phase level indicator will be used. Any physical changes to the protective concrete pad or variation in total depth of the well will also be noted in the logbook and/or form.

5.3 GROUNDWATER SAMPLING PROCEDURES

The following groundwater sampling methods have been previously provided in Section 3.2.8 of the CSAP (Weston, 2005). The complete CSAP (Weston, July 2005) is provided electronically as Appendix I. The groundwater sampling methods are consistent with applicable NJDEP regulations.

Prior to sampling a monitor well, the well will be purged to remove water that may have stagnated in the well, and to introduce fresh groundwater into the well for sampling. This can be achieved with one of a number of instruments. The most common of these are the bailer and/or pump. Weston plans to utilize low-flow rate submersible pumps to purge and sample the monitoring wells. Recent research by the EPA has concluded that this method of purging and sampling results in the collection of samples with low turbidity levels. Studies have confirmed that this method produces greater sample quality, accuracy and reproducibility over samples collected through more conventional methods such as bailing (R. Puls and R. Powell, 1992, Groundwater Monitoring Review). According to these studies, samples collected with this method typically contain turbidity levels less than 5 NTUs, even if fine materials are present in the formation. Since the overburden beneath the former Arsenal consists of primarily fine-grained materials and a majority of the samples are being collected for metals analysis, special consideration to turbidity levels is required.

Low-flow rate pumps may include Well Wizards, submersible Johnson Keck, or Grundfos pumps, or other similar equipment. Weston intends to use a 2-inch Grundfos Redi-Flo submersible pump with the BT1/MP1 converter box to regulate flow rates. These pumps will be used for both purging and sampling, unless a well exhibits such low yield/recharge that pumping becomes impractical. In cases where well yield/recharge is very low, a bailer or WaTerra pump (inertial pump) may be used for development, purging, and sampling in accordance with procedures outlined in the NJDEP's *Field Sampling Procedures Manual (*NJDEP, August 2005*)*. For wells with short water columns above the screens, the pumps will be set immediately above the well screen. For wells with longer water columns, the pump will be initially set at the top of the water column and slowly lowered during purging. The pump will not be lowered into the screened interval. Water level measurements will be taken as appropriate to ensure that the water column does not extend below the top of the well screen, thereby eliminating exposure of the well screen to air.

The wells will be purged until a minimum of three to five well volumes have been removed or field parameters (e.g., temperature, specific conductance, pH, turbidity, D.O., and Eh) stabilize. Stabilization is defined as less than 10 percent variation. Section 5.2.1 discusses how each of these parameters will be measured. Less than three volumes may be removed from low yielding wells. Groundwater samples will be collected immediately following purging using the same adjustable low-flow rate pumping equipment (i.e., within 2 hours if sufficient recharge is available). Flow rates will be approximately 100 ml/min during sampling. The pump will be lowered into the middle of the screened interval during sampling in order to obtain a representative sample. Since flow rates during sampling will be minimal, the potential of exposing the well screen will essentially be eliminated. If water level information obtained during purging indicates otherwise, the pump will be set immediately above the well screen during sampling.

Equipment will be decontaminated prior to use and between monitoring wells. Once purging is completed and the correct laboratory-cleaned sample containers have been prepared, sampling will immediately proceed. The following order of sample fraction collection will generally be followed; however, field conditions and well yield may require field decisions to modify the order on a case by case basis:

1. pH, specific conductance, Eh, and temperature.
2. Volatile organics.
3. Extractable organics including explosives.

The type of analysis for which a sample is being collected determines the type of bottle, preservative, holding time, and filtering requirements. Samples should be collected directly from the sampling device into appropriate laboratory cleaned containers. Further information concerning sample containers is provided in Table 3-2 of Appendix H.

Samples shall be appropriately preserved, labeled, logged, and placed in a cooler to be maintained at 4°C. Samples will be shipped well before the holding time is up and in most cases will be shipped within 24 hours of sample collection. The bottles will be shipped with adequate packing and cooling to ensure that they arrive intact.

5.3.1 Groundwater Physicochemical Measurements

Specific Conductance, Temperature, pH, and Eh Measurements

The specific conductance, temperature, pH, and Eh of all liquid samples will be measured with a YSI Model 600XL flow-through cell instrument (or equivalent) where possible. Temperature measurements will also be verified using a laboratory thermometer. Measurements will be performed as monitoring well purging activities are conducted, as well as during sample collection. The meter will be calibrated at the beginning of each day according the manufacturer's guidelines and checked periodically during the day. The probes and flow-through cell assembly will be rinsed with distilled water before and after each use. The probes will be placed in the flow-through sample cell and measurements will be made as purge/sample water flows through the system. Measurements will be recorded in the field logbook and/or Well Purging Form and will be allowed to stabilize prior to collecting the sample. A field laptop computer may also be used to directly record some of the groundwater physiochemical measurements and water level information.

Dissolved Oxygen Measurements

Dissolved oxygen (DO) will also be measured as part of the flow-through cell system using a YSI Model 600XL instrument (or equivalent). Weston is certified by the NJDEP for collecting water quality data using in-situ instruments. The meter will be calibrated at the beginning of each day according the instruction manual and checked periodically during the day. The probe will be rinsed with distilled water before and after each use. The probe will be placed in the flow-through sample cell and measurements will be made as purge/sample water flows through the system. DO will also be measured within the well using a YSI Model 95 downhole DO probe. In 2-inch-diameter wells, DO levels will be measured in-situ before the pump is placed in the well and after it is removed. Due to space limitations in a 2-inch diameter well, continuous downhole DO measurements can not be collected. In 4-inch-diameter wells, the YSI Model 95 DO probe will also be used to measure DO. The probe will be placed below the pump and DO levels will be monitored during well purging. DO colorimetric test kits will be used to confirm the DO measurements collected using the YSI probes. A glass vial will be filled with groundwater collected from the discharge tubing prior to the entry point of the flow-through cell system. DO measurements will be recorded in the field logbook and/or Well Purging Form and will be allowed to stabilize prior to collecting the sample. A field laptop computer may also be used to directly record DO measurements.

Turbidity Measurements

Groundwater turbidity will be measured during the purging process along with the parameters discussed above. A turbidity meter manufactured by H.F. Scientific (Model DRT-15CE, or equivalent) will be used. Similarly, the meter will be calibrated at the beginning of each day according the instruction manual and checked periodically during the day. The measuring probe and associated glassware will be rinsed with distilled water before and after each use. Measurements will be recorded in the field logbook and/or Well Purging Form and will be allowed to stabilize prior to collecting the sample. A field laptop computer may also be used to directly record turbidity measurements.

5.4 SURFACE WATER SAMPLING

The following surface water sampling methods have been previously provided in Section 3.2.12 of the CSAP (Weston, July 2005). The complete CSAP (Weston, July 2005) is provided electronically as Appendix I.

The sampling of surface water will be conducted as per the Direct Method presented below. Weston anticipates the use of the Direct Method for surface water sampling in all cases where access is not restricted.

For streams, rivers, lakes, and other surface waters, the direct method may be utilized to collect water samples from the surface directly into the sample bottle. The Direct Method will be the preferred method of collection, especially when collecting samples for volatile organic analysis.

Using adequate protective clothing, the sampling station will be accessed by appropriate means. For shallow stream stations, the sample will be collected under the water surface while pointing the sample container upstream; the container must be upstream of the collector. Disturbing the substrate will be avoided. Sample collection will begin in the most downstream portion of the stream. For lakes and other impoundments, the sample will be collected under the water surface avoiding surface debris and turbulence.

When using the direct method, sample bottles without preservation will be used. All samples will then be preserved and checked for proper preservation.

SECTION 6.0
HEALTH AND SAFETY PLAN

The health and safety plan has been documented in the *"Former Raritan Arsenal Accident Prevention Plan"* (WESTON, May 2006). This Health and Safety Plan applies to the remedial action of AOCs 4A, 6A, 6C, 8C, 8D, 9, and 10 at the former Arsenal. An electronic copy of the complete report is submitted on CD-ROM with this GWRAWP (Appendix J).

SECTION 7.0
SITE RESTORATION PLAN

The overall remedial strategy for the former Raritan Arsenal is summarized in the Revised Draft Management Action Plan (MAP) (Weston, January 2007). The site restoration plan for Groundwater AOCs 4A, 6A, 6C, 8C, 8D, 9, and 10 at the former Arsenal includes the establishment of a site-wide Classification Exception Area (CEA) and the collection of periodic compliance sampling. The details of the proposed site-wide CEA and compliance sampling are provided in Section 3 and Section 4, respectively, of this GWRAWP.

Because the remedial action is not intrusive, there are no requirements to restore the site’s topography, hydrology, or vegetation.

At the completion of the remedial action all monitoring wells will be decommissioned in accordance with N.J.A.C. 7:9D.

SECTION 8.0
REMEDIAL ACTION COST ESTIMATE

A Remedial Action Cost estimate to complete the remedial action of Groundwater AOCs 4A, 6A, 6C, 8C, 8D, 9, and 10 at the former Arsenal is provided in Table 8-1. The overall estimated cost of implementing the Classification Exception Area (CEA) and adopting Monitored Natural Attenuation (MNA) as a strategy is $505,600 for the period 2008 and 2041.

The estimated costs include the installation and development of a replacement well for MW-8, nine new monitoring wells, and one contingence monitoring well. Periodic maintenance (as needed) for all wells is included in the estimate. The abandonment MW-8 at the beginning of the remedial action, one contingency well (if needed) and twenty-four monitoring wells at the completion of the remedial action is included in this cost estimate.

Ten rounds (8 MNA and 2 CEA) of groundwater/surface water sampling are included in the estimated costs. During each round 31 monitoring wells and 3 surface water locations will be sampled. For each sampling event, 42 samples and 13 samples (including QA/QC) are assumed or TCL VOC and explosives analysis, respectively. Each sampling event is estimated to require eight field days and two complete sets of low-flow sampling equipment for a two-person team. Costs also include the sampling of one additional contingency monitoring well for TCL VOCs, if needed.

Eight remedial action progress reports, 16 biennial CEA reports, and 1 groundwater Remedial Action Report are included in the estimated remedial action costs.

SECTION 9.0
REMEDIAL ACTION AND MONITORING SCHEDULE

The projected completion for the remedial action (i.e. MNA) of Groundwater AOCs 4A, 6A, 6C, 8C, 8D, 9, and 10 at the former Arsenal is December 2040. The proposed CEA is estimated to expire in January 2041. The project sampling, deliverables, and milestones are summarized in Table 9-1.

Reporting to the NJDEP will include: Biennial CEA certifications, remedial action progress reports following each round of MNA sampling, and a remedial action report at the end of all CEA and MNA monitoring.

Any changes to the proposed remedial action schedule, including a predicted change in duration or sampling frequency, as a result of interim MNA monitoring will be presented in remedial action progress reports.

SECTION 10.0
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Table 4-1
Proposed Monitoring Wells and Surface Water Sampling Locations to Be Used for Long-Term Compliance Sampling
Groundwater AOCs 4C, 6A, 6C, 8C, 8D, 9, 10
Former Raritan Arsenal
Edison, New Jersey

Monitoring Well/SGWS Location	Well Status	Well Location Type	Groundwater AOC Monitored	Stratigraphic Unit	Actual Screened Interval (FT MSL)	LS Unit Thickness (FT MSL)	Analysis
MW-EPA-2A	Existing	Source	4A	LS	TD = 32.14	55 thru 25	WQIP, VOC
MW-46A	Existing	Source	4A	LS	25.07 thru 15.07	32.07 thru 11.07	WQIP, VOC
MW-120	Existing	Fringe	4A	LS	17.40 thru 9.40	18 thru 8	WQIP, VOC
MW-128	Existing	Sentinel	4A	LS	18.69 thru 8.69	18.69 thru 8.19	WQIP, VOC
MW-122**	Existing	Plume	4B**	LS	7.30 thru -2.70	7.37 thru -3.13	WQIP, VOC
MW-47A	Existing	Source	6A	LS	7.68 thru 2.69	14.69 thru 11.50	WQIP, VOC
MW-146	Existing	Plume	6A	LS	-3.59 thru-13.59	7.37 thru -3.13	WQIP, VOC
MW-144	Existing	Source	6C	LS	-11.85 thru -22.85	-6.4 thru -22.85	WQIP, VOC
MW-153	Proposed	Plume	6C	LS	25 thru 20 (approx.)	TBD	WQIP, VOC
MW-154	Proposed	Sentinel	6C	LS	20 thru 15 (approx.)	TBD	WQIP, VOC
MW-87A	Existing	Plume	8C	LS	51.64 thru 41.64	59.64 thru 27.14	WQIP, VOC
MW-125	Existing	Plume	8C	LS	25.3 thru 15.3	44.67 thru 16.17	WQIP, VOC
MW-8	Existing	Fringe	8D	LS	7.69 thru 2.69	10.35 thru 6.75	WQIP, VOC
MW-89A	Existing	Sentinel	8D	US/MM/LS	19.25 thru 13.25	15.25 thru 13.75	WQIP, VOC
MW-130	Existing	Source	9	LS	15.14 thru 5.15	20.15 thru 5.15	WQIP, Explosives
MW-123	Existing	Source	9	LS	4.6 thru -5.4	11.68 thru -3.32	WQIP, Explosives
MW-124	Existing	Plume	9	LS	1.7 thru -8.3	4 thru -1	WQIP, Explosives
MW-42A	Existing	Plume	9	LS	4.02 thru -5.98	7.02 thru -5.98	WQIP, Explosives
MW-129	Existing	Fringe	10	LS	39.43 thru 29.43	62.43 thru 29.43	WQIP, VOC
MW-131	Existing	Plume	10	LS	9.74 thru -5.26	10.44 thru -5.26	WQIP, VOC
MW-132	Existing	Sentinel	10	LS	19.03 thru 9.03	24.00 thru 9.20	WQIP, VOC
MW-155	Proposed	Source	10	LS	45 thru 40 (approx.)	TBD	WQIP, VOC
MW-156	Proposed	Fringe	10	LS	35 thru 30 (approx.)	TBD	WQIP, VOC
MW-90B	Existing	Sentinel	Site-Wide	LS	-12.06 thru -22.06	-6.06 thru -26.06	WQIP, VOC
MW-92B	Existing	Sentinel	Site-Wide	LS	-13.14 thru -23.14	-12.64 thru -26.14	WQIP, VOC
MW-99B	Existing	Sentinel	Site-Wide	LS	-22.3 thru -32.3	-17.7 thru -31.2	WQIP, VOC
MW-CEA-1	Proposed	Sentinel	Site-Wide	LS	0 thru -5 (approx.)	TBD	WQIP, VOC
MW-CEA-2	Proposed	Sentinel	Site-Wide	LS	0 thru -5 (approx.)	TBD	WQIP, VOC
MW-CEA-3	Proposed	Sentinel	Site-Wide	LS	0 thru -5 (approx.)	TBD	WQIP, VOC
MW-CEA-4	Proposed	Sentinel	Site-Wide	LS	0 thru -5 (approx.)	TBD	WQIP, VOC
MW-CEA-5	Proposed	Sentinel	Site-Wide	LS	0 thru -5 (approx.)	TBD	WQIP, VOC
SW-6-01	Existing	Surface Water	6C	N/A	N/A	N/A	WQIP, VOC
SW-8-01	Existing	Surface Water	8C	N/A	N/A	N/A	WQIP, VOC
SW-8-06	Existing	Surface Water	8D	N/A	N/A	N/A	WQIP, VOC

Notes:

1 LS = Lower Sand Stratigraphic Unit
2 MM = Meadow Mat
3 US = Upper Sand
4 TBD = To Be Determined
5 N/A = Not Applicable
6 WQIP - Water Quality Indicator Parameters
7 VOCs - Target Compound List Volatile Organic Compounds
** USACE wiill monitor MW-122 as part of Long-Term sampling; however, Groundwater AOC 4B is non-DOD.

Table 4-2
Proposed Monitoring Wells
to Be Used for Long-Term Compliance Groundwater Flow Monitoring
Groundwater AOCs 4C, 6A, 6C, 8C, 8D, 9, 10
Former Raritan Arsenal
Edison, New Jersey

Groundwater AOC	Monitoring Well Identification	Monitoring Well Will Also Be Sampled	Former Arsenal Area(s) Monitored	Rationale for Water Level Data
4A	MW-46A	X	10	Evaluate LS GW flow in the Plume Area
	MW-57		10	Evaluate LS GW flow on Plume Fringe
	MW-64		1, 18D	Evaluate LS GW flow upgradient of the Plume
	MW-EPA-1A		18B	Evaluate LS GW flow on Plume Fringe
	MW-EPA-2A	X	18A	Evaluate LS GW flow near the Source Area
	MW-117		19	Evaluate LS GW on the Plume Fringe
	MW-119		8,19	Evaluate LS GW flow downgradient of the Plume
	MW-120	X	19	Evaluate LS GW flow on the Plume Fringe
	MW-122***	X	20	Evaluate LS GW Flow in Source Area (AOC 4B)
	MW-128	X	19	Evaluate LS GW flow downgradient of the Plume
	MW-147		19	Evaluate LS GW flow downgradient of the Plume
	MW-148		18B	Evaluate LS GW flow upgradient of the Plume
	OB-6A		10	Evaluate LS flow and SW/GW interaction
	OB-7A		19	Evaluate LS flow on Plume Fringe
6A and 6C	MW-6		9, 19	Evaluate LS GW flow upgradient of the Plume
	MW-47A	X	19	Evaluate LS GW in source (6A)
	MW-54		16	Evaluate LS GW flow
	MW-80A		9	Evaluate LS GW flow upgradient of Plume Area
	MW-144	X	19	Evaluate LS GW flow in Source Area
	MW-145		19	Evaluate LS GW flow
	MW-146	X	19	Evaluate LS GW Flow within Plume Area (6A)
	MW-153**	X	8	Evaluate LS GW Flow within Plume Area (6C)
	MW-154**	X	8	Evaluate LS GW flow downgradient of Plume Area (6C)
8C/8D	MW-125	X	18B	Evaluate LS flow and SW/GW interaction (8C)
	MW-87A	X	18D	Evaluate LS GW flow within the Plume Area (8C)
	MW-106A		18C	Evaluate LS GW Flow
	MW-7		1	Evaluate LS GW flow within a Plume Area (8D)
	MW-8	X	1	Evaluate LS GW flow within Plume Area (8D)
	MW-9		1	Evaluate LS GW flow within Plume Area (8D)
	MW-88A		18C	Evaluate LS GW Flow
	MW-89A	X	1	Evaluate LS GW flow downgradient of Plume Area
	MW-138		18C	Evaluate LS GW Flow
9	MW-76B		4	Evaluate LS GW flow downgradient of Plume/Fringe
	MW-18		4	Evaluate LS GW flow upgradient of Plume Area
	MW-42A	X	4	Evaluate LS GW flow downgradient of Plume/Fringe
	MW-123	X	4	Evaluate LS GW flow near a Source Area
	MW-124	X	4	Evaluate LS GW flow downgradient of Plume/Fringe
	MW-130	X	4	Evaluate LS GW flow within Plume Area
	MW-142		3	Evaluate LS GW flow
10	MW-73A		17	Evaluate LS GW flow upgradient of Plume Area
	MW-72A		17	Evaluate LS GW Flow
	MW-69A		10	Evaluate LS GW flow within Plume Area
	MW-129	X	17	Evaluate LS GW flow within the Plume Area
	MW-131	X	10	Evaluate LS GW flow within Plume Area
	MW-132	X	10	Evaluate LS GW flow downgradient of Plume Area
	MW-149		10	Evaluate LS GW flow downgradient of Plume/Fringe
	MW-150		10	Evaluate LS GW Flow
	MW-155**	X	W	Evaluate LS GW flow in Source Area
	MW-156**	X	17	Evaluate LS GW Flow
Site-Wide	MW-90B*	X	16	Evaluate LS GW flow downgradient of Plumes/Site
	MW-92B*	X	16	Evaluate LS GW flow downgradient of Plumes/Site
	MW-99B*	X	6	Evaluate LS GW flow downgradient of Plumes/Site
	MW-CEA-1**	X	none	Evaluate LS GW flow downgradient of Plumes/Site
	MW-CEA-2**	X	16	Evaluate LS GW flow downgradient of Plumes/Site
	MW-CEA-3**	X	16	Evaluate LS GW flow downgradient of Plumes/Site
	MW-CEA-4**	X	16	Evaluate LS GW flow downgradient of Plumes/Site
	MW-CEA-5**	X	6	Evaluate LS GW flow downgradient of Plumes/Site

NOTES:
LS - Lower Sand Aquifer
GW - Groundwater
SW - Surface Water
* - Existing monitoring well for site-wide CEA monitoring
** - Proposed monitoring well to be installed for MNA and site-wide CEA monitoring

Table 5-1
Analytical Methods/Quality Assurance Summary
to Be Used for Long-Term Compliance Groundwater Sampling
Groundwater AOCs 4C, 6A, 6C, 8C, 8D, 9, 10
Former Raritan Arsenal
Edison, New Jersey

Groundwater AOC	Sample Location	Location Status	Well Location Type	Total Number of Proposed Sample Rounds			Total Proposed Samples		MEDIUM	ANALYTICAL PARAMETERS			SAMPLE METHODOLOGY
				Total MNA Rounds	Total CEA Rounds	Total Sampling Rounds	Proposed Well Samples per Sampling Event	Total Proposed Samples		WQIP	TCL VOCs	Explosives	
4A	MW-EPA-2A	Existing	Source	8	2	10	1	10	GW	10	10	0	LFPS
	MW-46A	Existing	Source	8	2	10	1	10	GW	10	10	0	LFPS
	MW-120	Existing	Fringe	8	2	10	1	10	GW	10	10	0	LFPS
	MW-122**	Existing	Source	8	2	10	1	10	GW	10	10	0	LFPS
	MW-128	Existing	Sentinel	8	2	10	1	10	GW	10	10	0	LFPS
							AOC 4A Totals:	**50**					
6A	MW-47A	Existing	Source	8	2	10	1	10	GW	10	10	0	LFPS
	MW-146	Existing	Plume	8	2	10	1	10	GW	10	10	0	LFPS
							AOC 6A Totals:	**20**					
6C	MW-144	Existing	Source	8	2	10	1	10	GW	10	10	0	LFPS
	MW-153	Proposed	Plume	8	2	10	1	10	GW	10	10	0	LFPS
	MW-154	Proposed	Sentinel	8	2	10	1	10	GW	10	10	0	LFPS
	SW-6-01	Existing	N/A	8	2	10	1	10	SW	0	10	0	direct sample
							AOC 6C Totals:	**40**					
8C	MW-87A	Existing	Plume	8	2	10	1	10	GW	10	10	0	LFPS
	MW-125	Existing	Plume	8	2	10	1	10	GW	10	10	0	LFPS
	SW-8-01	Existing	N/A	8	2	10	1	10	SW	0	10	0	direct sample
							AOC 8C Totals:	**30**					
8D	MW-8	Existing	Fringe	8	2	10	1	10	GW	10	10	0	LFPS
	MW-89A	Existing	Sentinel	8	2	10	1	10	GW	10	10	0	LFPS
	SW-8-06	Existing	N/A	8	2	10	1	10	SW	0	10	0	direct sample
							AOC 8D Totals:	**30**					
9	MW-130	Existing	Source	8	2	10	1	10	GW	10	0	10	LFPS
	MW-123	Existing	Source	8	2	10	1	10	GW	10	0	10	LFPS
	MW-124	Existing	Plume	8	2	10	1	10	GW	10	0	10	LFPS
	MW-42A	Existing	Plume	8	2	10	1	10	GW	10	0	10	LFPS
							AOC 9 Totals:	**40**					
10	MW-129	Existing	Fringe	8	2	10	1	10	GW	10	10	0	LFPS
	MW-131	Existing	Plume	8	2	10	1	10	GW	10	10	0	LFPS
	MW-132	Existing	Sentinel	8	2	10	1	10	GW	10	10	0	LFPS
	MW-155	Proposed	Source	8	2	10	1	10	GW	10	10	0	LFPS
	MW-156	Proposed	Fringe	8	2	10	1	10	GW	10	10	0	LFPS
							AOC 10 Totals:	**50**					
Site-Wide	MW-90B	Existing	Sentinel	8	2	10	1	10	GW	10	10	10	LFPS
	MW-92B	Existing	Sentinel	8	2	10	1	10	GW	10	10	10	LFPS
	MW-99B	Existing	Sentinel	8	2	10	1	10	GW	10	10	10	LFPS
	MW-CEA-1	Proposed	Sentinel	8	2	10	1	10	GW	10	10	10	LFPS
	MW-CEA-2	Proposed	Sentinel	8	2	10	1	10	GW	10	10	10	LFPS
	MW-CEA-3	Proposed	Sentinel	8	2	10	1	10	GW	10	10	10	LFPS
	MW-CEA-4	Proposed	Sentinel	8	2	10	1	10	GW	10	10	10	LFPS
	MW-CEA-5	Proposed	Sentinel	8	2	10	1	10	GW	10	10	10	LFPS
							Site-Wide Totals:	**80**					
Total Samples Collected/Analyzed for Duration of MNA/CEA:								**340**		**310**	**300**	**120**	
Total Samples Collected and Analyzed per Sampling Round:								**34**		**31**	**30**	**12**	

Notes:

SW - Surface water

GW - Groundwater

WQIP - Water Quality Indicator Parameters (pH, dissolved oxygen, specific conductance, temperature, turbidity, Eh)

TCL VOCs - Target Compound List Volatile Organic Compounds

LFPS - Low-Flow Purging and Sampling as per NJDEP Field Sampling Procedures Manual

** - USACE wiill monitor MW-122 as part of Long-Term sampling; however, Groundwater AOC 4B is non-DOD.

Quality Control/Assurance Samples							
	Trip Blanks	Field Rinseate	Ambient Blanks	Field Duplicates			Total No. of QA/QC
				WQIP	TCL VOCs	Explosives	
Proposed No. of Samples per Round:	5	5	0	0	2	1	13
Total Proposed No. of Samples:	50	50	0	0	20	10	130

Notes:

Total of ten sampling rounds assumed

Trip blanks are collected at frequncy of 1 per VOC sample shipment

Field Rinseate Blanks are collected at a frequency of one per day

Ambient Blanks are not required

Field Duplicates, where required, are collected at a frequency approximately 5% per investigation samples

Assumes 5 sample shipments per VOC sampling event

Assumes 5 day sampling events

Table 8-1
Estimated Groundwater Remedial Action Costs
Groundwater AOCs 4C, 6A, 6C, 8C, 8D, 9, 10
Former Raritan Arsenal
Edison, New Jersey

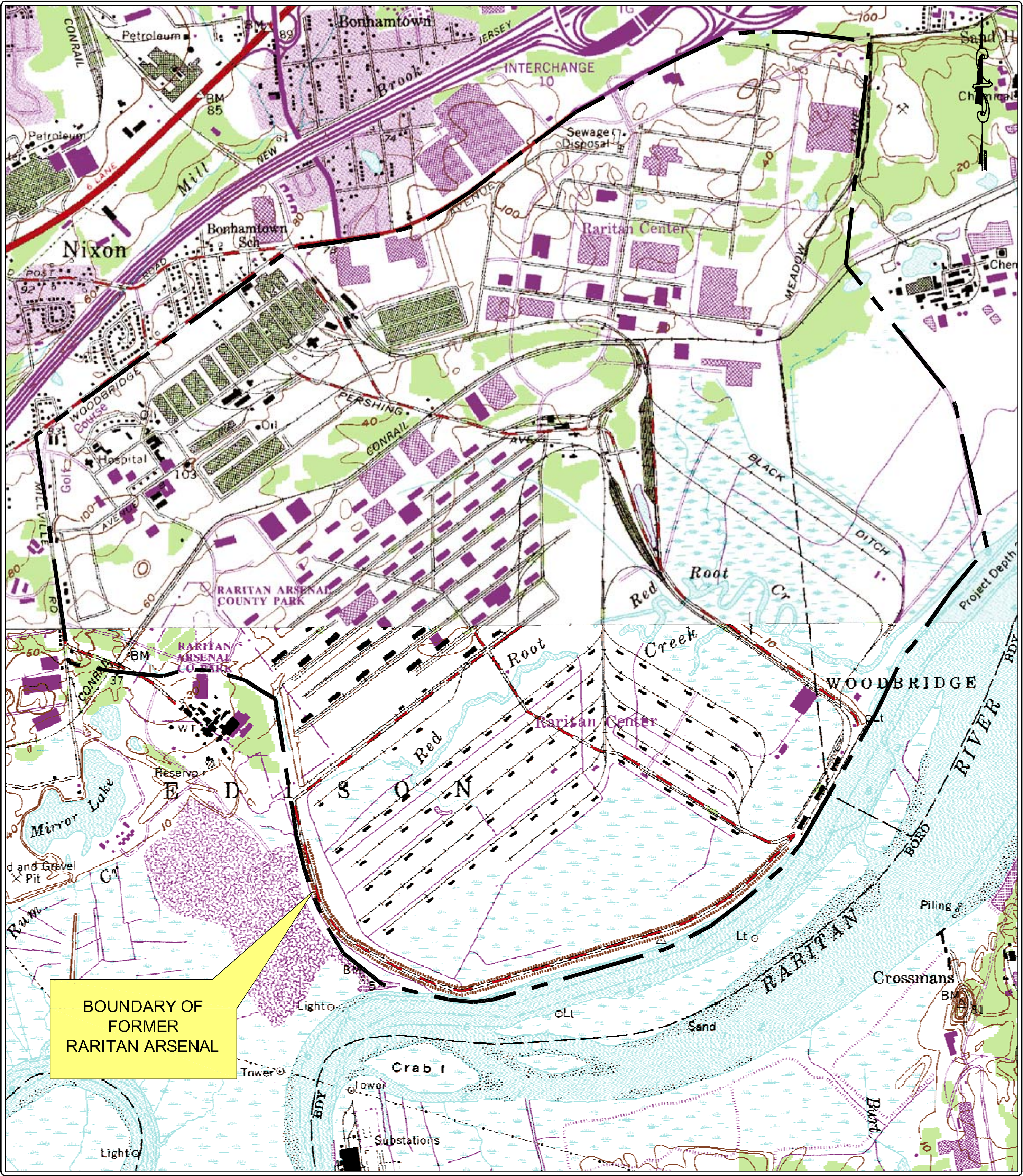
Item	Unit	Estimated Units	Estimated Unit Cost	Estimated Cost
Monitoring Well Installation and Surveying (includes labor and subcontractors)	each	10	$ 6,100	$ 61,000
Monitoring Well Maintenance (periodic, includes labor and subcontractor)	each	10	$ 1,000	$ 10,000
Monitoring Well Abandonment (includes labor and subcontractors)	each	26	$ 500	$ 13,000
Monitoring Well Sampling (includes labor and equipment)	event	10	$ 14,500	$ 145,000
Monitoring Well/Surface Sample Analysis - TCL VOCs (includes QA/QC)	sample	430	$ 125	$ 53,750
Monitoring Well Sample Analysis - Explosives (includes QA/QC)	sample	130	$ 210	$ 27,300
Progress Reports	each	8	$ 4,775	$ 38,200
CEA Biennial Certification	each	16	$ 3,025	$ 48,400
Groundwater Remedial Action Report (Preliminary DRAFT and DRAFT)	each	1	$ 81,950	$ 81,950
Meetings, Coordination, and Misc.	each	10	$ 2,700	$ 27,000
			Total Estimated Cost:	**$ 505,600**

Note:

Installation, sampling, and abandonment for one contingency monitoring well is included in cost estimate

Table 9-1
Proposed Groundwater Remedial Action Schedule
Groundwater AOCs 4C, 6A, 6C, 8C, 8D, 9, 10
Former Raritan Arsenal
Edison, New Jersey

Year	Item no.	Item Description	Start Date	End Date	Work Days
2008	1A	DRAFT GWRAWP submittal to NJDEP	02/08/08	02/11/08	1
	1B	NJDEP Review of GWRAWP	02/11/08	06/16/08	90
	1C	FINAL GWRAWP to NJDEP	06/16/08	08/18/08	45
	1D	NJDEP Approval of GWRAWP	08/18/08	09/29/08	30
	1E	Abandonment of MW-8 and Construction of Replacement Well	09/29/08	10/01/08	2
	1F	NJDEP Establish CEA	10/01/08	10/02/08	1
	2A	MNA Sampling - Round 1	10/13/08	10/20/08	5
	2B	Round 1 Sample Results Pending	10/20/08	12/01/08	30
	2C	Remedial Action Progress Report 1	12/01/08	12/05/08	4
	2D	Remedial Action Progress Report 1 to NJDEP	12/05/08	12/08/08	1
2010	3A	Prepare Biennial CEA Report - 1 (2008 through 2010)	08/16/10	09/27/10	30
	3B	Biennial CEA Report - 1 (2008 through 2010) to NJDEP	09/27/10	09/28/10	1
	4A	MNA Sampling - Round 2	10/11/10	10/18/10	5
	4B	Round 2 Sample Results Pending	10/18/10	11/29/10	30
	4C	Remedial Action Progress Report 2	11/29/10	12/03/10	4
	4D	Remedial Action Progress Report 2 to NJDEP	12/03/10	12/06/10	1
2012	5A	Prepare Biennial CEA Report - 2 (2010 through 2012)	08/16/12	09/27/12	30
	5B	Biennial CEA Report - 2 (2010 through 2012) to NJDEP	09/27/12	09/28/12	1
2014	6A	Prepare Biennial CEA Report - 3 (2012 through 2014)	08/15/14	09/26/14	30
	6B	Biennial CEA Report - 3 (2012 through 2014) to NJDEP	09/26/14	09/29/14	1
2015	7A	MNA Sampling - Round 3	10/12/15	10/19/15	5
	7B	Round 3 Sample Results Pending	10/19/15	11/30/15	30
	7C	Remedial Action Progress Report 3	11/30/15	12/04/15	4
	7D	Remedial Action Progress Report 3 to NJDEP	12/04/15	12/07/15	1
2016	8A	Prepare Biennial CEA Report - 4 (2014 through 2016)	08/15/16	09/26/16	30
	8B	Biennial CEA Report - 4 (2014 through 2016) to NJDEP	09/26/16	09/27/16	1
2018	9A	Prepare Biennial CEA Report - 5 (2016 through 2018)	08/15/18	09/26/18	30
	9B	Biennial CEA Report - 5 (2016 through 2018) to NJDEP	09/26/18	09/27/18	1
2020	10A	Prepare Biennial CEA Report - 6 (2018 through 2020)	08/14/20	09/25/20	30
	10B	Biennial CEA Report - 6 (2018 through 2020) to NJDEP	09/25/20	09/28/20	1
	11A	MNA Sampling - Round 4	10/19/20	10/26/20	5
	11B	Round 4 Sample Results Pending	10/26/20	12/07/20	30
	11C	Remedial Action Progress Report 4	12/07/20	12/11/20	4
	11D	Remedial Action Progress Report 4 to NJDEP	12/11/20	12/14/20	1
2022	12A	Prepare Biennial CEA Report - 7 (2020 through 2022)	08/15/22	09/26/22	30
	12B	Biennial CEA Report - 7 (2020 through 2022) to NJDEP	09/26/22	09/27/22	1
2024	13A	Prepare Biennial CEA Report - 8 (2022 through 2024)	08/15/24	09/26/24	30
	13B	Biennial CEA Report - 8 (2022 through 2024) to NJDEP	09/26/24	09/27/24	1
2025	14A	MNA Sampling - Round 5	10/13/25	10/20/25	5
	14B	Round 5 Sample Results Pending	10/20/25	12/01/25	30
	14C	Remedial Action Progress Report 5	12/01/25	12/05/25	4
	14D	Remedial Action Progress Report 5 to NJDEP	12/05/25	12/08/25	1
2026	15A	Prepare Biennial CEA Report - 9 (2024 through 2026)	08/17/26	09/28/26	30
	15B	Biennial CEA Report - 9 (2024 through 2026) to NJDEP	09/28/26	09/29/26	1
2028	16A	Prepare Biennial CEA Report - 10 (2026 through 2028)	08/15/28	09/26/28	30
	16B	Biennial CEA Report - 10 (2026 through 2028) to NJDEP	09/26/28	09/27/28	1
2030	17A	Prepare Biennial CEA Report - 11 (2028 through 2030)	08/15/30	09/26/30	30
	17B	Biennial CEA Report - 11 (2028 through 2030) to NJDEP	09/26/30	09/27/30	1
	18A	MNA Sampling - Round 6	10/14/30	10/21/30	5
	18B	Round 6 Sample Results Pending	10/21/30	12/02/30	30
	18C	Remedial Action Progress Report 6	12/02/30	12/06/30	4
	18D	Remedial Action Progress Report 6 to NJDEP	12/06/30	12/09/30	1
2032	19A	Prepare Biennial CEA Report - 12 (2030 through 2032)	08/16/32	09/27/32	30
	19B	Biennial CEA Report - 12 (2030 through 2032) to NJDEP	09/27/32	09/28/32	1
2034	20A	Prepare Biennial CEA Report - 13 (2032 through 2034)	08/15/34	09/26/34	30
	20B	Biennial CEA Report - 13 (2032 through 2034) to NJDEP	09/26/34	09/27/34	1
2035	21A	MNA Sampling - Round 7	10/15/35	10/22/35	5
	21B	Round 7 Sample Results Pending	10/22/35	12/03/35	30
	21C	Remedial Action Progress Report 7	12/03/35	12/07/35	4
	21D	Remedial Action Progress Report 7 to NJDEP	12/07/35	12/10/35	1
2036	22A	Prepare Biennial CEA Report - 14 (2034 through 2036)	08/15/36	09/26/36	30
	22B	Biennial CEA Report - 14 (2034 through 2036) to NJDEP	09/26/36	09/29/36	1
2038	23A	Prepare Biennial CEA Report - 15 (2036 through 2038)	08/16/38	09/27/38	30
	23B	Biennial CEA Report - 15 (2036 through 2038) to NJDEP	09/27/38	09/28/38	1
2040	24A	Prepare Biennial CEA Report - 16 (2038 through 2040)	08/15/40	09/26/40	30
	24B	Biennial CEA Report - 16 (2038 through 2040) to NJDEP	09/26/40	09/27/40	1
	25A	MNA Sampling - Round 8	10/15/40	10/22/40	5
	25B	Round 8 Sample Results Pending	10/22/40	12/03/40	30
	25C	Remedial Action Progress Report 8	12/03/40	12/07/40	4
	25D	Remedial Action Progress Report 8 to NJDEP	12/07/40	12/10/40	1
2041	26A	CEA Sampling - Round 1	01/07/41	01/14/41	5
	26B	CEA Sampling - Round 1 Results Pending	01/14/41	02/25/41	30
	27A	CEA Sampling - Round 2 (Confirmatory)	03/11/41	03/18/41	5
	27B	CEA Sampling - Round 2 Results Pending	03/18/41	04/29/41	30
	28A	Prepare DRAFT Groundwater Remedial Action Report (GWRAR)	04/29/41	09/02/41	90
	28B	Submit DRAFT GWRAR to NJDEP	09/02/41	09/03/41	1
	28C	NJDEP review of DRAFT GWRAR	09/03/41	01/07/42	90
2042	28D	FINAL GWRAR to NJDEP	01/07/42	03/11/42	45
	28E	NJDEP Approval of FINAL GWRAR, issuance of NFA	03/11/42	07/15/42	90



LEGEND:

GRAPHIC SCALE

1 inch = 2000 ft.

SOURCE: U.S.G.S. TOPO QUAD - PERTH AMBOY/SOUTH AMBOY NJ

TITLE:

SITE LOCATION MAP
EDISON, NEW JERSEY

PROJECT: FORMER RARITAN ARSENAL

CLIENT NAME: U.S. ARMY CORPS OF ENGINEERS

WESTON SOLUTIONS

DATE: February 2008

FIGURE #: 1-1

K:\Raritan01\RaritanGIS\Cad\0108_RAWP\05438_SiteLoc.dwg

Legend

⊕	Monitoring Well Location[1][2] (Installed 2005 as part of Site-Wide Groundwater Investigation)
⊕	Monitoring/Observation Well Location
●	Shallow Groundwater Screening Location[3] (Completed 2004 as part of Site-Wide Groundwater Investigation)
⬚	Former Groundwater AOC Boundary (as of 2001)
▭	Groundwater AOC Boundary (as of 2005)
🟧	Soil Investigation Area Boundary
🟥	Potential Source Area
🟥	DOD Source Removal Area
▦	Wetlands
┄	Surface Water
426	Building Number
Area4	Soil Investigation Area
AOC3	Former Groundwater AOC (as of 2001)
AOC3	Groundwater AOC (as of 2005)

Notes

1. Monitoring well MW-153 is an EPA well that was adopted as part of the USACE 2004-2005 Site-Wide Groundwater Investigation.
2. Monitoring wells MW-133 through MW-137 were installed in 2004 as part of the 18E Supplemental Investigation.
3. Shallow groundwater screening locations completed in 2004-2005 as part of the 18E Investigation and Groundwater AOC 8-EPA Building Investigation are not depicted on this figure.

AOC - Area of Concern
DOD - Department of Defense
EPA - Environmental Protection Agency
USACE - United States Army Corps of Engineers

450 0 450 900
Graphic Scale In Feet

Weston Solutions, Inc.
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REPORT NAME:	DRAFT - GROUNDWATER REMEDIAL ACTION WORK PLAN FEBRUARY 2008
CLIENT NAME:	UNITED STATES ARMY CORPS OF ENGINEERS
PROJECT NAME:	FORMER RARTIAN ARSENAL
DRAWING TITLE:	SITE MAP
SCALE:	*see scale bar on map
DATE:	8-22-07
FIGURE:	1-2

Legend

- ● Monitoring/Observation Well Location Included in the March 2005 Monitoring Well Gauging Program
- (MW-136) ← Well ID
- (59.91) ← Groundwater Elevation (feet above mean sea level)
- (MW-151) ← Well ID
- (NU) ← Groundwater Elevation Not Used(1)
- ● Monitoring Well Location Not Included in The March 2005 Monitoring Well Gauging Program
- 58 Inferred Groundwater Contour Interval (feet above mean sea level), Dashed where Extrapolated
- → Groundwater Flow Direction
- Former Groundwater AOC Boundary (as of 2001)
- ▭ Groundwater AOC Boundary (as of 2005)
- 🟧 Soil Investigation Area Boundary
- 🟥 Potential Source Area
- ■ DOD Source Removal Area
- ▨ Wetlands
- Surface Water
- 426 Building Number
- **Area4** Soil Investigation Area
- **AOC3** Former Groundwater AOC (as of 2001)
- **AOC3** Groundwater AOC (as of 2005)

Notes

1. Wells screened across the Lower Sand Unit were used to construct this figure. If a well was damaged, the water level measurement was not collected (See Table 4).
2. Monitoring Well Gauging Program was conducted from 24 March through 28 March 2005. Wells measured included those wells included in the approved well list (Table 4).
3. Contours were generated with a surface mapping program, Surfer Version 8.0 (Krieging Method) and further refined by hand to adjust for items not accounted for by the program.
4. Northen American Vertical Datum 1988.

AOC - Area of Concern
DOD - Department of Defense
ID - Identifier

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REPORT TITLE: DRAFT - GROUNDWATER REMEDIAL ACTION WORK PLAN FEBRUARY 2008
CLIENT NAME: U.S. ARMY CORPS OF ENGINEERS
PROJECT NAME: FORMER RARITAN ARSENAL

DRAWING TITLE: SITE-WIDE GROUNDWATER CONTOUR MAP MARCH 2005
DATE: 2-1-08
SCALE: *see scale bar on map
FIGURE: 1-3

Legend

- AOC 4 Monitoring/Observation Well Location,[5] Sampled March/April 2005
- AOC 4 Monitoring/Observation Well Location Not Sampled March/April 2005
- AOC 4 Shallow Groundwater Screening Sample Location - See Figure 12
- Other Monitoring Well Location
- Other Shallow Groundwater Screening Sample Location
- Other Geoprobe Sample Location
- Groundwater AOC 4 Boundary (as of 2005)
- Soil Investigation Area Boundary
- DOD Source Removal Area
- Potential Source Area
- Wetlands
- Surface Water
- 426 Building Number
- Area7 Soil Investigation Area
- AOC4A Groundwater AOC (as of 2005)
- TRICHLOROETHYLENE (TCE) Compound concentration exceeding the NJDEP Class IIA GWQS for the last groundwater sample event the location was sampled.
- 1.8 Concentration exceeds the NJDEP Class IIA GWQS.
- VOC Analytical Results For Monitoring Well Sampled In 2005
- VOC Analytical Results For Monitoring Well Not Sampled In 2005

Notes

1. The criteria listed are the NJDEP Class IIA GWQS.
2. The results and criteria are in micrograms per liter.
3. Data included in the analytical text boxes begin with the July 1998 groundwater sampling event. This event was the first of eight quarterly groundwater sampling events. Text boxes include all groundwater sample events from July 1998 to April 2005. If an event is not listed, the location was not sampled during that event. If a monitoring well is shown and it does not have a text box then that location was sampled prior to the July 1988 groundwater sampling event, sampled for parameters other than VOCs, or was never sampled.
4. The compound list is Groundwater AOC-specific. The compound list includes those compounds detected in at least one groundwater monitoring well sample starting with the July 1998 groundwater sampling event for the associated Groundwater AOC.
5. Monitoring well MW-148 was installed in 2005. This well was only sampled for lead; Area 18B contaminant of concern.
6. Volume of contaminated groundwater in AOC4A = 14,582,000 ft^3

AOC - Area of Concern
DOD - Department of Defense
GWQS - Groundwater Quality Standard
J/J- - Estimated Concentration
MDL - Method Detection Limit
NJDEP - New Jersey Department of Environmental Protection
U - Not detected at MDL listed
VOC - Volatile Organic Compounds

OB-8A

Parameter	[Criteria]	7/15/1998	3/30/2005
1,1,1-TRICHLOROETHANE	[30]	2 U	0.3 U
1,1,2,2-TETRACHLOROETHANE	[1]	2 U	0.5 U
1,1,2-TRICHLOROETHANE	[3]	2 U	0.3 U
1,1-DICHLOROETHANE	[50]	2 U	0.4 U
1,1-DICHLOROETHENE	[2]	2 U	0.3 U
1,2-DICHLOROETHANE	[2]	2 U	0.4 U
2-BUTANONE	[300]	10 U	0.9 U
4-METHYL-2-PENTANONE	[400]	10 U	0.4 U
ACETONE	[700]	10 U	1 U
BENZENE	[1]	2 U	0.3 U
CARBON DISULFIDE	[800]	2 U	0.2 U
CHLOROBENZENE	[50]	2 U	0.3 U
CHLOROETHANE	[100]	4 U	0.4 U
CHLOROFORM	[6]	2 U	0.3 U
CIS-1,2-DICHLOROETHENE	[70]	63	39
ETHYLBENZENE	[700]	2 U	0.3 U
TETRACHLOROETHYLENE	[1]	2 U	0.4 U
TOLUENE	[1000]	2 U	0.3 U
TRANS-1,2-DICHLOROETHENE	[100]	2 U	0.3 U
TRICHLOROETHYLENE (TCE)	[1]	14	8.2
VINYL CHLORIDE	[5]	2 J	0.4 U
XYLENES (TOTAL)	[1000]	2 U	0.2 U

OB-6A

Parameter	[Criteria]	7/15/1998	3/30/2005
1,1,1-TRICHLOROETHANE	[30]	1 U	0.3 U
1,1,2,2-TETRACHLOROETHANE	[1]	1 U	0.5 U
1,1,2-TRICHLOROETHANE	[3]	1 U	0.3 U
1,1-DICHLOROETHANE	[50]	1 U	0.4 U
1,1-DICHLOROETHENE	[2]	1 U	0.3 U
1,2-DICHLOROETHANE	[2]	1 U	0.4 U
2-BUTANONE	[300]	5 U	0.9 U
4-METHYL-2-PENTANONE	[400]	5 U	0.4 U
ACETONE	[700]	5 U	1 U
BENZENE	[1]	1 U	0.3 U
CARBON DISULFIDE	[800]	1 U	0.2 U
CHLOROBENZENE	[50]	1 U	0.3 U
CHLOROETHANE	[100]	2 U	0.4 U
CHLOROFORM	[6]	1 U	0.3 U
CIS-1,2-DICHLOROETHENE	[70]	11	1.1
ETHYLBENZENE	[700]	1 U	0.3 U
TETRACHLOROETHYLENE	[1]	1 U	0.4 U
TOLUENE	[1000]	1 U	0.3 U
TRANS-1,2-DICHLOROETHENE	[100]	1 U	0.3 U
TRICHLOROETHYLENE (TCE)	[1]	2	0.5
VINYL CHLORIDE	[5]	2 U	0.4 U
XYLENES (TOTAL)	[1000]	1 U	0.2 U

OB-7A

Parameter	[Criteria]	7/15/1998
1,1,1-TRICHLOROETHANE	[30]	2 U
1,1,2,2-TETRACHLOROETHANE	[1]	2 U
1,1,2-TRICHLOROETHANE	[3]	2 U
1,1-DICHLOROETHANE	[50]	2 U
1,1-DICHLOROETHENE	[2]	2 U
1,2-DICHLOROETHANE	[2]	2 U
2-BUTANONE	[300]	10 U
4-METHYL-2-PENTANONE	[400]	10 U
ACETONE	[700]	10 U
BENZENE	[1]	2 U
CARBON DISULFIDE	[800]	2 U
CHLOROBENZENE	[50]	2 U
CHLOROETHANE	[100]	4 U
CHLOROFORM	[6]	2 U
CIS-1,2-DICHLOROETHENE	[70]	71
ETHYLBENZENE	[700]	2 U
TETRACHLOROETHYLENE	[1]	2 U
TOLUENE	[1000]	2 U
TRANS-1,2-DICHLOROETHENE	[100]	2 U
TRICHLOROETHYLENE (TCE)	[1]	6
VINYL CHLORIDE	[5]	3 J
XYLENES (TOTAL)	[1000]	2 U

MW-117

Parameter	[Criteria]	7/15/1998	10/14/1998	3/31/2005
1,1,1-TRICHLOROETHANE	[30]	1 U	5 U	0.3 U
1,1,2,2-TETRACHLOROETHANE	[1]	1 U	0.9 J	0.5 U
1,1,2-TRICHLOROETHANE	[3]	1 U	3 U	0.3 U
1,1-DICHLOROETHANE	[50]	1 U	5 U	0.4 U
1,1-DICHLOROETHENE	[2]	1 U	2 U	0.3 U
1,2-DICHLOROETHANE	[2]	1 U	2 U	0.4 U
2-BUTANONE	[300]	5 U	5 U	0.9 U
4-METHYL-2-PENTANONE	[400]	5 U	5 U	0.4 U
ACETONE	[700]	5 U	5 U	1 U
BENZENE	[1]	0.2 J	1 U	0.3 U
CARBON DISULFIDE	[800]	3 U	5 U	0.2 U
CHLOROBENZENE	[50]	1 U	5 U	0.3 U
CHLOROETHANE	[100]	2 U	5 U	0.4 U
CHLOROFORM	[6]	1 U	5 U	0.3 U
CIS-1,2-DICHLOROETHENE	[70]	17	23	15
ETHYLBENZENE	[700]	1 U	4 U	0.3 U
TETRACHLOROETHYLENE	[1]	1 U	1 U	0.4 U
TOLUENE	[1000]	1 U	5 U	0.3 U
TRANS-1,2-DICHLOROETHENE	[100]	1 U	5 U	0.3 U
TRICHLOROETHYLENE (TCE)	[1]	4	4.4	2.6
VINYL CHLORIDE	[5]	2 U	5 U	0.4 U
XYLENES (TOTAL)	[1000]	1 U	5 U	0.2 U

MW-EPA-2A

Parameter	[Criteria]	7/16/1998	10/19/1998	8/25/1999	1/11/2000	4/26/2000	8/9/2000	11/30/2000	3/21/2001
1,1,1-TRICHLOROETHANE	[30]	1 U	5 U	5 U	1 U	1 U	1 U	1 U	1 U
1,1,2,2-TETRACHLOROETHANE	[1]	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,1,2-TRICHLOROETHANE	[3]	1 U	3 U	3 U	1 U	2.9	1 U	1 U	1 U
1,1-DICHLOROETHANE	[50]	1 U	5 U	5 U	1 U	1 U	1 U	1 U	1 U
1,1-DICHLOROETHENE	[2]	1 U	2 U	2 U	1 U	1 U	1 U	1 U	1 U
1,2-DICHLOROETHANE	[2]	1 U	2 U	2 U	1 U	1 U	1 U	1 U	1 U
2-BUTANONE	[300]	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
4-METHYL-2-PENTANONE	[400]	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
ACETONE	[700]	5 U	5 U	5 U	5 U	5 UJ	5 U	5 U	5 U
BENZENE	[1]	1.1	1 U	1 U	0.8 J	1 U	1.09	0.8 J	1 U
CARBON DISULFIDE	[800]	1 U	5 U	5 U	1 U	1 U	1 U	1 U	1 U
CHLOROBENZENE	[50]	1 U	5 U	5 U	1 U	1 U	1 U	1 U	1 U
CHLOROETHANE	[100]	2 U	5 U	2 U	1 U	1 U	1.99	2.94	1 U
CHLOROFORM	[6]	1 U	5 U	5 U	1 U	1 U	1 U	1 U	1 U
CIS-1,2-DICHLOROETHENE	[70]	160 J	8.7	97	46 J	104.5 J-	68 J	58.4	20.7
ETHYLBENZENE	[700]	0.2 J	0.6 J	4 U	1 U	1 U	1 U	1 U	1 U
TETRACHLOROETHYLENE	[1]	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
TOLUENE	[1000]	1 U	5 U	5 U	0.5 J	1 U	1 U	1 U	1 U
TRANS-1,2-DICHLOROETHENE	[100]	1.1	5 U	0.6 J	1	0.7 J	0.67 J	0.64 J	1 U
TRICHLOROETHYLENE (TCE)	[1]	16	0.8 J	1 U	1 U	1 U	1 U	1 U	1 U
VINYL CHLORIDE	[5]	26	5	39	52 J	45.6	63.2 J	37.5	18.8
XYLENES (TOTAL)	[1000]	1.4	5 U	5 U	4	1 U	0.57 J	1 U	1 U

MW-116

Parameter	[Criteria]	7/15/1998	10/14/1998
1,1,1-TRICHLOROETHANE	[30]	1 U	5 U
1,1,2,2-TETRACHLOROETHANE	[1]	1 U	1 U
1,1,2-TRICHLOROETHANE	[3]	1 U	3 U
1,1-DICHLOROETHANE	[50]	1 U	5 U
1,1-DICHLOROETHENE	[2]	1 U	2 U
1,2-DICHLOROETHANE	[2]	1 U	2 U
2-BUTANONE	[300]	5 U	5 U
4-METHYL-2-PENTANONE	[400]	5 U	5 U
ACETONE	[700]	5 U	5 U
BENZENE	[1]	1 U	1 U
CARBON DISULFIDE	[800]	1 U	5 U
CHLOROBENZENE	[50]	1 U	5 U
CHLOROETHANE	[100]	2 U	5 U
CHLOROFORM	[6]	1 U	5 U
CIS-1,2-DICHLOROETHENE	[70]	1 U	5 U
ETHYLBENZENE	[700]	1 U	4 U
TETRACHLOROETHYLENE	[1]	1 U	1 U
TOLUENE	[1000]	1 U	5 U
TRANS-1,2-DICHLOROETHENE	[100]	1 U	5 U
TRICHLOROETHYLENE (TCE)	[1]	1 U	1 U
VINYL CHLORIDE	[5]	2 U	5 U
XYLENES (TOTAL)	[1000]	1 U	5 U

MW-122

Parameter	[Criteria]	7/15/1998	10/20/1998	8/23/1999	1/11/2000	4/26/2000	8/8/2000	11/30/2000	3/21/2001	3/31/2005
1,1,1-TRICHLOROETHANE	[30]	5 U	10 U	5 U	1 U	1 U	1 U	1 U	1 U	0.3 U
1,1,2,2-TETRACHLOROETHANE	[1]	5 U	2 U	1 U	1 U	1 U	1 U	1 U	1 U	0.5 U
1,1,2-TRICHLOROETHANE	[3]	5 U	6 U	3 U	1 U	1 U	1 U	1 U	1 U	0.3 U
1,1-DICHLOROETHANE	[50]	13	9.8 J	5 U	16	13.9	11	12.4	7.96	0.4 U
1,1-DICHLOROETHENE	[2]	5 U	4 U	2 U	1 U	1 U	1 U	1 U	1 U	0.3 U
1,2-DICHLOROETHANE	[2]	5 U	4 U	2 U	1 U	1 U	1 U	1.11	1 U	0.4 U
2-BUTANONE	[300]	25 U	10 U	5 U	5 U	5 U	5 U	5 U	5 U	0.9 U
4-METHYL-2-PENTANONE	[400]	25 U	10 U	5 U	5 U	5 U	5 U	5 U	5 U	2.8
ACETONE	[700]	25 U	10 U	5 U	5 U	5 UJ	5 U	5 U	5 U	17
BENZENE	[1]	55	36	1 U	44	41.8	36.2	30.1	19.4	2.9
CARBON DISULFIDE	[800]	5 U	10 U	5 U	1 U	1 U	1 U	1 U	1 U	0.2 U
CHLOROBENZENE	[50]	5 U	10 U	5 U	0.9 J	1 U	0.82 J	0.78 J	0.57 J	0.3 U
CHLOROETHANE	[100]	10 U	10 U	2 U	1 U	1 U	1 U	1 U	1 U	0.4 U
CHLOROFORM	[6]	5 U	10 U	5 U	1 U	1 U	1 U	1 U	1 U	0.3 U
CIS-1,2-DICHLOROETHENE	[70]	170	210	0.8 J	28	21.4	17.3	26.9	11.7	4.3
ETHYLBENZENE	[700]	5 U	8 U	4 U	1 U	1 U	1 U	1 U	1 U	0.3 U
TETRACHLOROETHYLENE	[1]	0.6 J	2 U	1 U	1 U	1 U	1 U	1 U	1 U	0.4 U
TOLUENE	[1000]	5 U	10 U	5 U	1 U	1 U	1 U	1 U	1 U	0.3 U
TRANS-1,2-DICHLOROETHENE	[100]	3 J	2.4 J	5 U	3	2.4	2.17	2.11	1.79	0.3 U
TRICHLOROETHYLENE (TCE)	[1]	77	80	1 U	4	3.6	3.2	5.58	1.44	1.8
VINYL CHLORIDE	[5]	52	44	2 U	220	103.4 J	109	87.9	58.5	2.4
XYLENES (TOTAL)	[1000]	2.1 J	1.2 J	5 U	2	1	0.87 J	1	1 U	0.2 U

MW-64

Parameter	[Criteria]	7/16/1998	10/14/1998
1,1,1-TRICHLOROETHANE	[30]	8	6.7
1,1,2,2-TETRACHLOROETHANE	[1]	1 U	1 U
1,1,2-TRICHLOROETHANE	[3]	1 U	3 U
1,1-DICHLOROETHANE	[50]	2	1.3 J
1,1-DICHLOROETHENE	[2]	3	1.8 J
1,2-DICHLOROETHANE	[2]	0.3 J	2 U
2-BUTANONE	[300]	5 U	5 U
4-METHYL-2-PENTANONE	[400]	5 U	5 U
ACETONE	[700]	5 U	5 U
BENZENE	[1]	1 U	1 U
CARBON DISULFIDE	[800]	1 U	5 U
CHLOROBENZENE	[50]	1 U	5 U
CHLOROETHANE	[100]	2 U	5 U
CHLOROFORM	[6]	1 U	5 U
CIS-1,2-DICHLOROETHENE	[70]	1 U	5 U
ETHYLBENZENE	[700]	1 U	4 U
TETRACHLOROETHYLENE	[1]	0.2 J	1 U
TOLUENE	[1000]	1 U	5 U
TRANS-1,2-DICHLOROETHENE	[100]	1 U	5 U
TRICHLOROETHYLENE (TCE)	[1]	1 U	1 U
VINYL CHLORIDE	[5]	2 U	5 U
XYLENES (TOTAL)	[1000]	1 U	5 U

MW-118

Parameter	[Criteria]	7/20/1998	10/16/1998	8/23/1999	1/11/2000	4/26/2000	8/8/2000	11/30/2000	3/22/2001
1,1,1-TRICHLOROETHANE	[30]	1 U	5 U	5 U	1 U	1 U	1 U	1 U	1 U
1,1,2,2-TETRACHLOROETHANE	[1]	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,1,2-TRICHLOROETHANE	[3]	1 U	3 U	3 U	1 U	1 U	1 U	1 U	1 U
1,1-DICHLOROETHANE	[50]	0.2 J	5 U	5 U	1 U	1 U	1 U	1 U	1 U
1,1-DICHLOROETHENE	[2]	1 U	2 U	2 U	1 U	1 U	1 U	1 U	1 U
1,2-DICHLOROETHANE	[2]	1 U	2 U	2 U	1 U	1 U	1 U	1 U	1 U
2-BUTANONE	[300]	5 U	5 U	5 U	5 U	5 U	5 U	1.11 J	5 U
4-METHYL-2-PENTANONE	[400]	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
ACETONE	[700]	5 U	5 U	5 U	5 U	5 UJ	5 U	5 U	5 U
BENZENE	[1]	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
CARBON DISULFIDE	[800]	1 U	1.4 J	5 U	1 U	1 U	1 U	1 U	1 U
CHLOROBENZENE	[50]	1 U	5 U	5 U	1 U	1 U	1 U	1 U	1 U
CHLOROETHANE	[100]	2 U	5 U	2 U	1 U	1 U	1 U	1 U	1 U
CHLOROFORM	[6]	1 U	5 U	5 U	1 U	1 U	1 U	1 U	1 U
CIS-1,2-DICHLOROETHENE	[70]	0.2 J	5 U	5 U	1 U	1 U	1 U	1 U	1 U
ETHYLBENZENE	[700]	1 U	4 U	4 U	1 U	1 U	1 U	1 U	1 U
TETRACHLOROETHYLENE	[1]	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
TOLUENE	[1000]	1 U	5 U	5 U	1 U	1 U	1 U	1 U	1 U
TRANS-1,2-DICHLOROETHENE	[100]	1 U	5 U	5 U	1 U	1 U	1 U	1 U	1 U
TRICHLOROETHYLENE (TCE)	[1]	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
VINYL CHLORIDE	[5]	2 U	5 U	2 U	1 U	1 U	1 U	1 U	1 U
XYLENES (TOTAL)	[1000]	1 U	5 U	5 U	1 U	1 U	1 U	1 U	1 U

MW-EPA-1A

Parameter	[Criteria]	7/16/1998	10/15/1998
1,1,1-TRICHLOROETHANE	[30]	1 U	5 U
1,1,2,2-TETRACHLOROETHANE	[1]	1 U	0.9 J
1,1,2-TRICHLOROETHANE	[3]	1 U	3 U
1,1-DICHLOROETHANE	[50]	1 U	5 U
1,1-DICHLOROETHENE	[2]	1 U	2 U
1,2-DICHLOROETHANE	[2]	1 U	2 U
2-BUTANONE	[300]	5 U	5 U
4-METHYL-2-PENTANONE	[400]	5 U	5 U
ACETONE	[700]	5 U	5 U
BENZENE	[1]	1 U	1 U
CARBON DISULFIDE	[800]	1 U	5 U
CHLOROBENZENE	[50]	1 U	5 U
CHLOROETHANE	[100]	2 U	5 U
CHLOROFORM	[6]	1 U	5 U
CIS-1,2-DICHLOROETHENE	[70]	1 U	5 U
ETHYLBENZENE	[700]	1 U	4 U
TETRACHLOROETHYLENE	[1]	1 U	1 U
TOLUENE	[1000]	1 U	5 U
TRANS-1,2-DICHLOROETHENE	[100]	1 U	5 U
TRICHLOROETHYLENE (TCE)	[1]	1 U	1 U
VINYL CHLORIDE	[5]	2 U	5 U
XYLENES (TOTAL)	[1000]	1 U	5 U

MW-147

Parameter	[Criteria]	3/31/2005
1,1,1-TRICHLOROETHANE	[30]	0.3 U
1,1,2,2-TETRACHLOROETHANE	[1]	0.5 U
1,1,2-TRICHLOROETHANE	[3]	0.3 U
1,1-DICHLOROETHANE	[50]	0.4 U
1,1-DICHLOROETHENE	[2]	0.3 U
1,2-DICHLOROETHANE	[2]	0.4 U
2-BUTANONE	[300]	0.9 U
4-METHYL-2-PENTANONE	[400]	0.4 U
ACETONE	[700]	1 U
BENZENE	[1]	0.3 U
CARBON DISULFIDE	[800]	0.2 U
CHLOROBENZENE	[50]	0.3 U
CHLOROETHANE	[100]	0.4 U
CHLOROFORM	[6]	0.3 U
CIS-1,2-DICHLOROETHENE	[70]	0.4 U
ETHYLBENZENE	[700]	0.3 U
TETRACHLOROETHYLENE	[1]	0.4 U
TOLUENE	[1000]	0.3 U
TRANS-1,2-DICHLOROETHENE	[100]	0.3 U
TRICHLOROETHYLENE (TCE)	[1]	0.4 U
VINYL CHLORIDE	[5]	0.4 U
XYLENES (TOTAL)	[1000]	0.2 U

MW-119

Parameter	[Criteria]	7/20/1998	10/20/1998
1,1,1-TRICHLOROETHANE	[30]	1 U	5 U
1,1,2,2-TETRACHLOROETHANE	[1]	1 U	1 U
1,1,2-TRICHLOROETHANE	[3]	1 U	3 U
1,1-DICHLOROETHANE	[50]	1 U	5 U
1,1-DICHLOROETHENE	[2]	1 U	2 U
1,2-DICHLOROETHANE	[2]	1 U	2 U
2-BUTANONE	[300]	5 U	5 U
4-METHYL-2-PENTANONE	[400]	5 U	5 U
ACETONE	[700]	5 U	5 U
BENZENE	[1]	1 U	1 U
CARBON DISULFIDE	[800]	1 U	5 U
CHLOROBENZENE	[50]	1 U	5 U
CHLOROETHANE	[100]	2 U	5 U
CHLOROFORM	[6]	1 U	5 U
CIS-1,2-DICHLOROETHENE	[70]	0.4 J	5 U
ETHYLBENZENE	[700]	1 U	4 U
TETRACHLOROETHYLENE	[1]	1 U	1 U
TOLUENE	[1000]	1 U	5 U
TRANS-1,2-DICHLOROETHENE	[100]	1 U	5 U
TRICHLOROETHYLENE (TCE)	[1]	0.1 J	1 U
VINYL CHLORIDE	[5]	2 U	5 U
XYLENES (TOTAL)	[1000]	1 U	5 U

MW-128

Parameter	[Criteria]	7/20/1998	10/16/1998
1,1,1-TRICHLOROETHANE	[30]	1 U	5 U
1,1,2,2-TETRACHLOROETHANE	[1]	1 U	1 U
1,1,2-TRICHLOROETHANE	[3]	1 U	3 U
1,1-DICHLOROETHANE	[50]	1 U	5 U
1,1-DICHLOROETHENE	[2]	1 U	2 U
1,2-DICHLOROETHANE	[2]	1 U	2 U
2-BUTANONE	[300]	5 U	5 U
4-METHYL-2-PENTANONE	[400]	5 U	5 U
ACETONE	[700]	6 U	5 U
BENZENE	[1]	1 U	1 U
CARBON DISULFIDE	[800]	1 U	5 U
CHLOROBENZENE	[50]	1 U	5 U
CHLOROETHANE	[100]	2 U	5 U
CHLOROFORM	[6]	0.4 J	5 U
CIS-1,2-DICHLOROETHENE	[70]	1 U	5 U
ETHYLBENZENE	[700]	1 U	4 U
TETRACHLOROETHYLENE	[1]	1 U	1 U
TOLUENE	[1000]	1 U	5 U
TRANS-1,2-DICHLOROETHENE	[100]	1 U	5 U
TRICHLOROETHYLENE (TCE)	[1]	1 U	1 U
VINYL CHLORIDE	[5]	2 U	5 U
XYLENES (TOTAL)	[1000]	1 U	5 U

MW-46A

Parameter	[Criteria]	7/15/1998	10/20/1998	8/30/1999	1/11/2000	4/26/2000	8/9/2000	11/30/2000	3/21/2001	3/30/2005
1,1,1-TRICHLOROETHANE	[30]	5 U	5 U	5 U	1 U	1 U	1 U	1 U	1 UJ	0.3 U
1,1,2,2-TETRACHLOROETHANE	[1]	5 U	1 U	1 U	1 U	1 U	1 U	1 U	1 UJ	0.5 U
1,1,2-TRICHLOROETHANE	[3]	5 U	3 U	3 U	1 U	1 U	1 U	1 U	1 UJ	0.3 U
1,1-DICHLOROETHANE	[50]	5 U	5 U	5 U	1 U	1 U	1 U	1 U	1 UJ	0.4 U
1,1-DICHLOROETHENE	[2]	5 U	2 U	2 U	1 U	1 U	1 U	1 U	1 UJ	0.3 U
1,2-DICHLOROETHANE	[2]	5 U	2 U	2 U	1 U	1 U	1 U	1 U	1 UJ	0.4 U
2-BUTANONE	[300]	25 U	5 U	5 U	5 U	5 U	5 U	5 U	5 UJ	0.9 U
4-METHYL-2-PENTANONE	[400]	25 U	5 U	5 U	5 U	5 U	5 U	5 U	5 UJ	0.4 U
ACETONE	[700]	25 U	5 U	5 U	5 U	5 UJ	5 U	5 U	5 UJ	1 U
BENZENE	[1]	1 J	1.8	2.1	3	2.7	2.01	1.28	2.08 J	1.6
CARBON DISULFIDE	[800]	5 U	0.8 J	5 U	1 U	1 U	1 U	1 U	1 UJ	0.2 U
CHLOROBENZENE	[50]	5 U	5 U	5 U	1 U	1 U	1 U	1 U	1 UJ	0.3 U
CHLOROETHANE	[100]	10 U	5 U	2 U	1 U	1 U	1 U	1 U	1 UJ	0.4 U
CHLOROFORM	[6]	5 U	5 U	5 U	1 U	1 U	1 U	1 U	1 UJ	0.3 U
CIS-1,2-DICHLOROETHENE	[70]	80	110	130	200	108.6 J	112	83.6	94.8 J	36
ETHYLBENZENE	[700]	5 U	4 U	4 U	1 U	1 U	1 U	1 U	1 UJ	0.3 U
TETRACHLOROETHYLENE	[1]	5 U	1 U	1 U	1 U	1 U	1 U	1 U	1 UJ	0.4 U
TOLUENE	[1000]	5 U	5 U	5 U	1 U	1 U	1 U	1 U	1 UJ	0.3 U
TRANS-1,2-DICHLOROETHENE	[100]	5 U	5 U	5 U	0.9 J	1 U	0.62 J	1 U	1 UJ	0.3 U
TRICHLOROETHYLENE (TCE)	[1]	18	16	18	17	17	13.2	14.4	12.6 J	12
VINYL CHLORIDE	[5]	11	20	32	54	46.5	29.8	16.6	31.5 J	4.9
XYLENES (TOTAL)	[1000]	5 U	5 U	5 U	1 U	1 U	1 U	1 U	1 UJ	0.2 U

MW-120

Parameter	[Criteria]	7/20/1998	10/16/1998	8/26/1999	4/26/2000	8/9/2000	11/30/2000	3/21/2001	3/31/2005
1,1,1-TRICHLOROETHANE	[30]	0.4 J	5 U	5 U	1 U	1 U	1 U	1 U	0.3 U
1,1,2,2-TETRACHLOROETHANE	[1]	1 U	1 U	1 U	1 U	1 U	1 U	1 U	0.5 U
1,1,2-TRICHLOROETHANE	[3]	1 U	3 U	3 U	1 U	1 U	1 U	1 U	0.3 U
1,1-DICHLOROETHANE	[50]	1.5	1.6 J	1.5 J	1.5	1.25	1.25	1.11	0.6
1,1-DICHLOROETHENE	[2]	0.4 J	2 U	2 U	1 U	1 U	1 U	1 U	0.3 U
1,2-DICHLOROETHANE	[2]	0.4 J	2 U	2 U	0.8 J	1 U	1 U	1 U	0.4 U
2-BUTANONE	[300]	5 U	5 U	5 U	5 U	5 U	5 U	5 U	0.9 U
4-METHYL-2-PENTANONE	[400]	5 U	5 U	5 U	5 U	5 U	5 U	5 U	0.4 U
ACETONE	[700]	5 U	5 U	5 U	5 UJ	5 U	5 U	5 U	1 U
BENZENE	[1]	3	3.5	3.3	3.6	2.8	2.91	2.95	0.7
CARBON DISULFIDE	[800]	1.2 U	5 U	5 U	1 U	1 U	1 U	1 U	0.2 U
CHLOROBENZENE	[50]	1 U	5 U	5 U	1 U	1 U	1 U	1 U	0.3 U
CHLOROETHANE	[100]	2 U	5 U	2 U	1 U	1 U	1 U	1 U	0.4 U
CHLOROFORM	[6]	0.2 J	5 U	5 U	1 U	1 U	1 U	1 U	0.3 U
CIS-1,2-DICHLOROETHENE	[70]	30	36	33	31.7	28.6	30.4	32	15
ETHYLBENZENE	[700]	1 U	4 U	4 U	1 U	1 U	1 U	1 U	0.3 U
TETRACHLOROETHYLENE	[1]	1 U	1 U	1 U	1 U	1 U	1 U	1 U	0.4 U
TOLUENE	[1000]	1 U	5 U	5 U	1 U	1 U	1 U	1 U	0.3 U
TRANS-1,2-DICHLOROETHENE	[100]	0.2 J	5 U	5 U	1 U	1 U	1 U	1 U	0.3 U
TRICHLOROETHYLENE (TCE)	[1]	5	4.6	5.3	4.7	3.79	4.49	3.42	2.4
VINYL CHLORIDE	[5]	32	50	33	40	32.5	27.9	34	7.4
XYLENES (TOTAL)	[1000]	1 U	5 U	5 U	1 U	1 U	1 U	1 U	0.2 U

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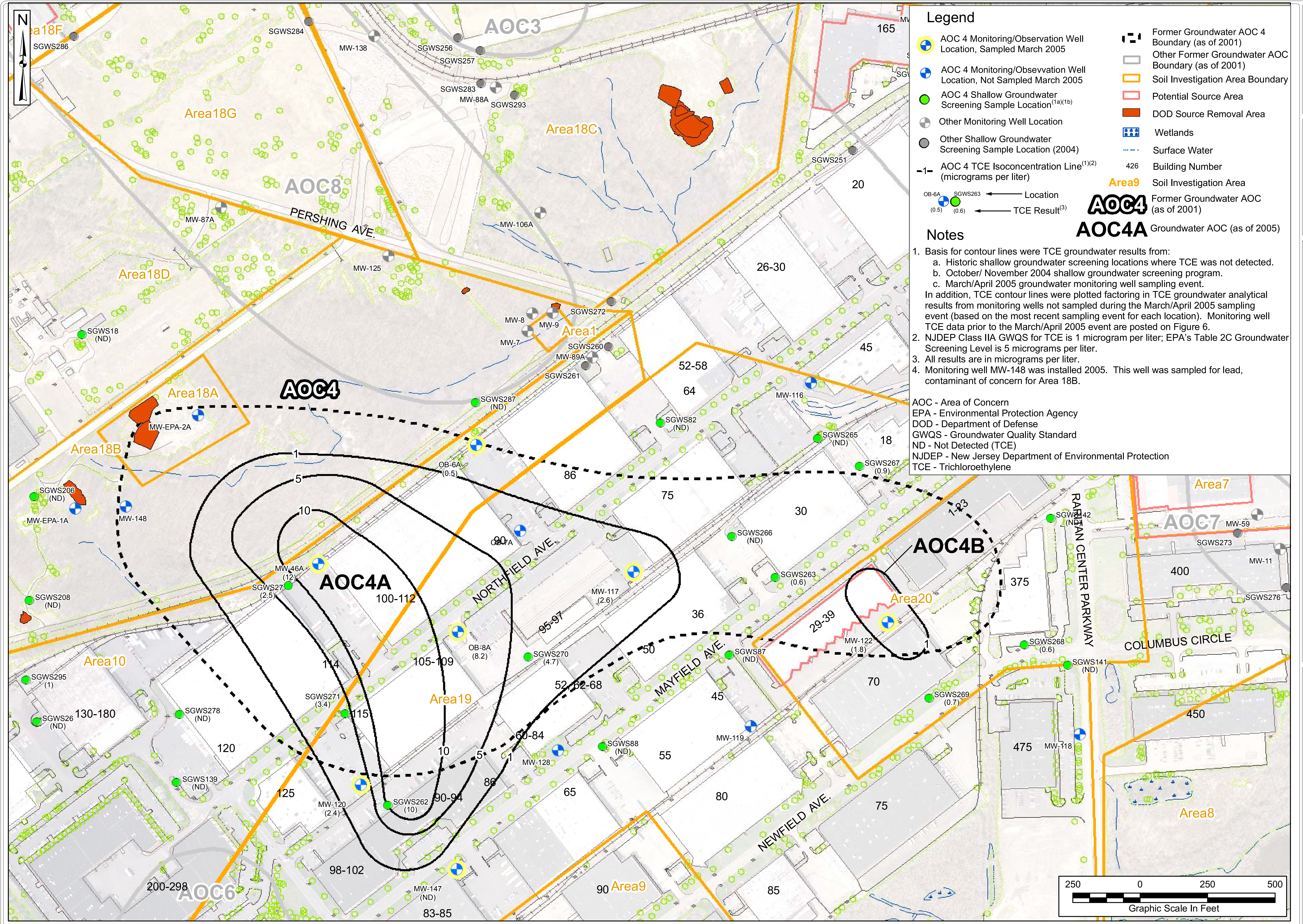
DRAWING: 05441_GW-AOC4.mxd
PATH: K:\Raritan01\RaritanGIS\Mxd\0108_RAWP\
REVISION No.: 0
WORK ORDER No.: 03886.110.027.0005

REPORT NAME: DRAFT - GROUNDWATER REMEDIAL ACTION WORK PLAN FEBRUARY 2008
CLIENT NAME: U.S. ARMY CORPS OF ENGINEERS
PROJECT NAME: FORMER RARITAN ARSENAL

DRAWING TITLE: GROUNDWATER AOC 4: COMPARISON OF THE DETECTED VOC LIST TO THE NJDEP CLASS IIA GWQS JULY 1998 TO APRIL 2005
DATE: 2-1-08
SCALE: See scale bar on map
FIGURE: 2-1



Legend

AOC 4 Monitoring/Observation Well Location, Sampled March 2005	Former Groundwater AOC 4 Boundary (as of 2001)
AOC 4 Monitoring/Obsevvation Well Location, Not Sampled March 2005	Other Former Groundwater AOC Boundary (as of 2001)
AOC 4 Shallow Groundwater Screening Sample Location(1a)(1b)	Soil Investigation Area Boundary
Other Monitoring Well Location	Potential Source Area
Other Shallow Groundwater Screening Sample Location (2004)	DOD Source Removal Area
-1- AOC 4 TCE Isoconcentration Line(1)(2) (micrograms per liter)	Wetlands
OB-6A (0.5) SGWS263 (0.6) ← Location ← TCE Result(3)	Surface Water
	426 Building Number
	Area9 Soil Investigation Area
	AOC4 Former Groundwater AOC (as of 2001)
	AOC4A Groundwater AOC (as of 2005)

Notes

1. Basis for contour lines were TCE groundwater results from:
    a. Historic shallow groundwater screening locations where TCE was not detected.
    b. October/ November 2004 shallow groundwater screening program.
    c. March/April 2005 groundwater monitoring well sampling event.

   In addition, TCE contour lines were plotted factoring in TCE groundwater analytical results from monitoring wells not sampled during the March/April 2005 sampling event (based on the most recent sampling event for each location). Monitoring well TCE data prior to the March/April 2005 event are posted on Figure 6.
2. NJDEP Class IIA GWQS for TCE is 1 microgram per liter; EPA's Table 2C Groundwater Screening Level is 5 micrograms per liter.
3. All results are in micrograms per liter.
4. Monitoring well MW-148 was installed 2005. This well was sampled for lead, contaminant of concern for Area 18B.

AOC - Area of Concern
EPA - Environmental Protection Agency
DOD - Department of Defense
GWQS - Groundwater Quality Standard
ND - Not Detected (TCE)
NJDEP - New Jersey Department of Environmental Protection
TCE - Trichloroethylene

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PROJECT MANAGER: P. BOVITZ
SCALE: *see scale bar on map
DATE: 2/1/2008

TITLE:
GROUNDWATER AOC 4: GENERALIZED TCE ISOPLETH MAP AS OF APRIL 2005

FIGURE #: 2-2
DRAWING NUMBER: 05442_GW-ISO-AOC4.mxd
DRAWING LOCATION: K:\Raritan01\RaritanGIS\Mxd\0108_RAWP\

REPORT: DRAFT - GROUNDWATER REMEDIAL ACTION WORK PLAN FEBRUARY 2008
PROJECT: FORMER RARITAN ARSENAL
CLIENT NAME: U.S. ARMY CORPS OF ENGINEERS

MW-47A

Parameter	[Criteria]	8/27/1999	1/18/2000	5/3/2000	8/9/2000	12/7/2000	3/27/2001	3/31/2005
1,1-DICHLOROETHANE	[50]	3.3 J	2.6	1 U	2.45	3.3	0.78 J	0.4 U
1,1-DICHLOROETHENE	[2]	1.9 J	1.5	1.2 J	1.07	1.28	1 U	0.3 U
1,2-DICHLOROETHANE	[2]	2 U	1 U	1.8 J	1 U	1 U	1 U	0.4 U
BENZENE	[1]	5	6.8	6.1 J	7.3	4.6	1.58	0.8
CARBON DISULFIDE	[800]	5 U	1 U	2 J	1 U	1 U	1 U	0.2 U
CIS-1,2-DICHLOROETHENE	[70]	170	147.1	67.1 J	138	149	37.2	21
TETRACHLOROETHYLENE	[1]	1 U	1 U	1 U	1 U	1 U	1 U	0.4 U
TRANS-1,2-DICHLOROETHENE	[100]	3.3 J	3.8	2.7 J	4.02	2.96	1 J	0.9
TRICHLOROETHYLENE (TCE)	[1]	99	48	38 J	45.2	75	32.3	13
VINYL CHLORIDE	[5]	9.5	5.3	2.4 J	8.6	8.2	1.3	0.4 U

MW-144

Parameter	[Criteria]	3/31/2005
1,1-DICHLOROETHANE	[50]	3.6 U
1,1-DICHLOROETHENE	[2]	3.4 U
1,2-DICHLOROETHANE	[2]	3.6 U
BENZENE	[1]	3.1 U
CARBON DISULFIDE	[800]	2.5 U
CIS-1,2-DICHLOROETHENE	[70]	830
TETRACHLOROETHYLENE	[1]	180
TRANS-1,2-DICHLOROETHENE	[100]	8.2
TRICHLOROETHYLENE (TCE)	[1]	310
VINYL CHLORIDE	[5]	35

MW-146

Parameter	[Criteria]	3/31/2005
1,1-DICHLOROETHANE	[50]	0.4 U
1,1-DICHLOROETHENE	[2]	0.3 U
1,2-DICHLOROETHANE	[2]	0.4 U
BENZENE	[1]	0.3 U
CARBON DISULFIDE	[800]	0.2 U
CIS-1,2-DICHLOROETHENE	[70]	1.9
TETRACHLOROETHYLENE	[1]	0.4 U
TRANS-1,2-DICHLOROETHENE	[100]	0.3 U
TRICHLOROETHYLENE (TCE)	[1]	7.4
VINYL CHLORIDE	[5]	0.4 U

MW-48A

Parameter	[Criteria]	12/7/2000
1,1-DICHLOROETHANE	[50]	1 U
1,1-DICHLOROETHENE	[2]	0.56 J
1,2-DICHLOROETHANE	[2]	1 U
BENZENE	[1]	1 U
CARBON DISULFIDE	[800]	1 U
CIS-1,2-DICHLOROETHENE	[70]	30.9
TETRACHLOROETHYLENE	[1]	1.69
TRANS-1,2-DICHLOROETHENE	[100]	1 U
TRICHLOROETHYLENE (TCE)	[1]	37
VINYL CHLORIDE	[5]	1.67

MW-48B

Parameter	[Criteria]	8/27/1999	1/18/2000	5/3/2000	8/15/2000	3/27/2001
1,1-DICHLOROETHANE	[50]	5 U	1 U	1 U	1 U	0.63 J
1,1-DICHLOROETHENE	[2]	2 U	0.8 J	0.8 J	1 U	0.52 J
1,2-DICHLOROETHANE	[2]	2 U	1 U	1 U	1 U	1 U
BENZENE	[1]	1 U	1 U	1 U	1 U	1 U
CARBON DISULFIDE	[800]	5 U	1 U	1 U	1.18 U	1 U
CIS-1,2-DICHLOROETHENE	[70]	6.6	9	29.2	27	36.6
TETRACHLOROETHYLENE	[1]	2.7	2	1.9	1.49	1.9
TRANS-1,2-DICHLOROETHENE	[100]	5 U	0.6 J	0.8 J	0.51 J	1 U
TRICHLOROETHYLENE (TCE)	[1]	24	29	31.5	20.3	34.8
VINYL CHLORIDE	[5]	2 U	1 U	1.6	2.44	2.63

MW-80A

Parameter	[Criteria]	3/31/2005
1,1-DICHLOROETHANE	[50]	1.9
1,1-DICHLOROETHENE	[2]	1.5
1,2-DICHLOROETHANE	[2]	0.4 U
BENZENE	[1]	0.3 U
CARBON DISULFIDE	[800]	0.2 U
CIS-1,2-DICHLOROETHENE	[70]	1.9
TETRACHLOROETHYLENE	[1]	0.4 U
TRANS-1,2-DICHLOROETHENE	[100]	0.3 U
TRICHLOROETHYLENE (TCE)	[1]	29
VINYL CHLORIDE	[5]	0.4 U

MW-54

Parameter	[Criteria]	9/2/1999	1/18/2000	5/3/2000	8/15/2000	12/7/2000	3/27/2001
1,1-DICHLOROETHANE	[50]	0.7 J	0.7 J	1 U	0.51 J	0.54 J	1 U
1,1-DICHLOROETHENE	[2]	2 U	1 U	1 U	1 U	1 U	1 U
1,2-DICHLOROETHANE	[2]	2 U	1 U	1 U	1 U	1 U	1 U
BENZENE	[1]	1 U	1 U	1 U	1 U	1 U	1 U
CARBON DISULFIDE	[800]	1.1 J	1 U	1 U	1.81 U	1.43	1 U
CIS-1,2-DICHLOROETHENE	[70]	5 U	1 U	1 U	1 U	1 U	1 U
TETRACHLOROETHYLENE	[1]	1 U	1 U	1 U	1 U	1 U	1 U
TRANS-1,2-DICHLOROETHENE	[100]	5 U	1 U	1 U	1 U	1 U	1 U
TRICHLOROETHYLENE (TCE)	[1]	1 U	1 U	1 U	1.45	1 U	0.73 J
VINYL CHLORIDE	[5]	2 U	1 U	1 U	1 U	1 U	1 U

MW-145

Parameter	[Criteria]	4/11/2005
1,1-DICHLOROETHANE	[50]	0.4 U
1,1-DICHLOROETHENE	[2]	0.3 U
1,2-DICHLOROETHANE	[2]	0.4 U
BENZENE	[1]	0.3 U
CARBON DISULFIDE	[800]	0.2 U
CIS-1,2-DICHLOROETHENE	[70]	0.4 U
TETRACHLOROETHYLENE	[1]	0.4 U
TRANS-1,2-DICHLOROETHENE	[100]	0.3 U
TRICHLOROETHYLENE (TCE)	[1]	0.4 U
VINYL CHLORIDE	[5]	0.4 U

Legend

Symbol	Description
●	AOC 6 Monitoring Well Location, Sampled March/April 2005
●	AOC 6 Monitoring Well Location, Not Sampled March/April 2005
●	AOC 6 Shallow Groundwater Screening Sample Location - See Figure 13
●	Other Monitoring Well
●	Other Shallow Groundwater Screening Sample Location
☐	Groundwater AOC 6 Boundary (as of 2005)
☐	Soil Investigation Area Boundary
■	DOD Source Removal Area
☐	Potential Source Area
▨	Wetlands
---	Surface Water
426	Building Number
Area8	Soil Investigation Area
AOC6A	Groundwater AOC (as of 2005)
TRICHLOROETHYLENE (TCE)	Compound concentration exceeding the NJDEP Class IIA GWQS for the last groundwater sample event the location was sampled.
7.4	Concentration exceeds the NJDEP Class IIA GWQS.
☐	VOC Analytical Results For Monitoring Well Sampled In 2005
☐	VOC Analytical Results For Monitoring Well Not Sampled In 2005

Notes

1. The criteria listed are the NJDEP Class IIA GWQS.
2. The results and criteria are in micrograms per liter.
3. Data included in the analytical text boxes begin with the July 1998 groundwater sampling event. This event was the first of eight quarterly groundwater sampling events. Text boxes include all groundwater sample events from July 1998 to April 2005. If an event is not listed, the location was not sampled during that event. If a monitoring well is shown and it does not have a text box then that location was sampled prior to the July 1988 groundwater sampling event, sampled for parameters other than VOCs, or was never sampled.
4. The compound list is Groundwater AOC-specific. The compound list includes those compounds detected in at least one groundwater monitoring well sample starting with the July 1998 groundwater sampling event for the associated Groundwater AOC.
5. Volume of contaminated groundwater in AOC6C = 966,500 ft^3
6. Volume of contaminated groundwater in AOC6A = 3,024,000 ft^3

AOC - Area of Concern
DOD - Department of Defense
GWQS - Groundwater Quality Standard
J - Estimated Concentration
MDL - Method Detection Limit
NJDEP - New Jersey Department of Environmental Protection
U - Not detected at MDL listed
VOC - Volatile Organic Compounds

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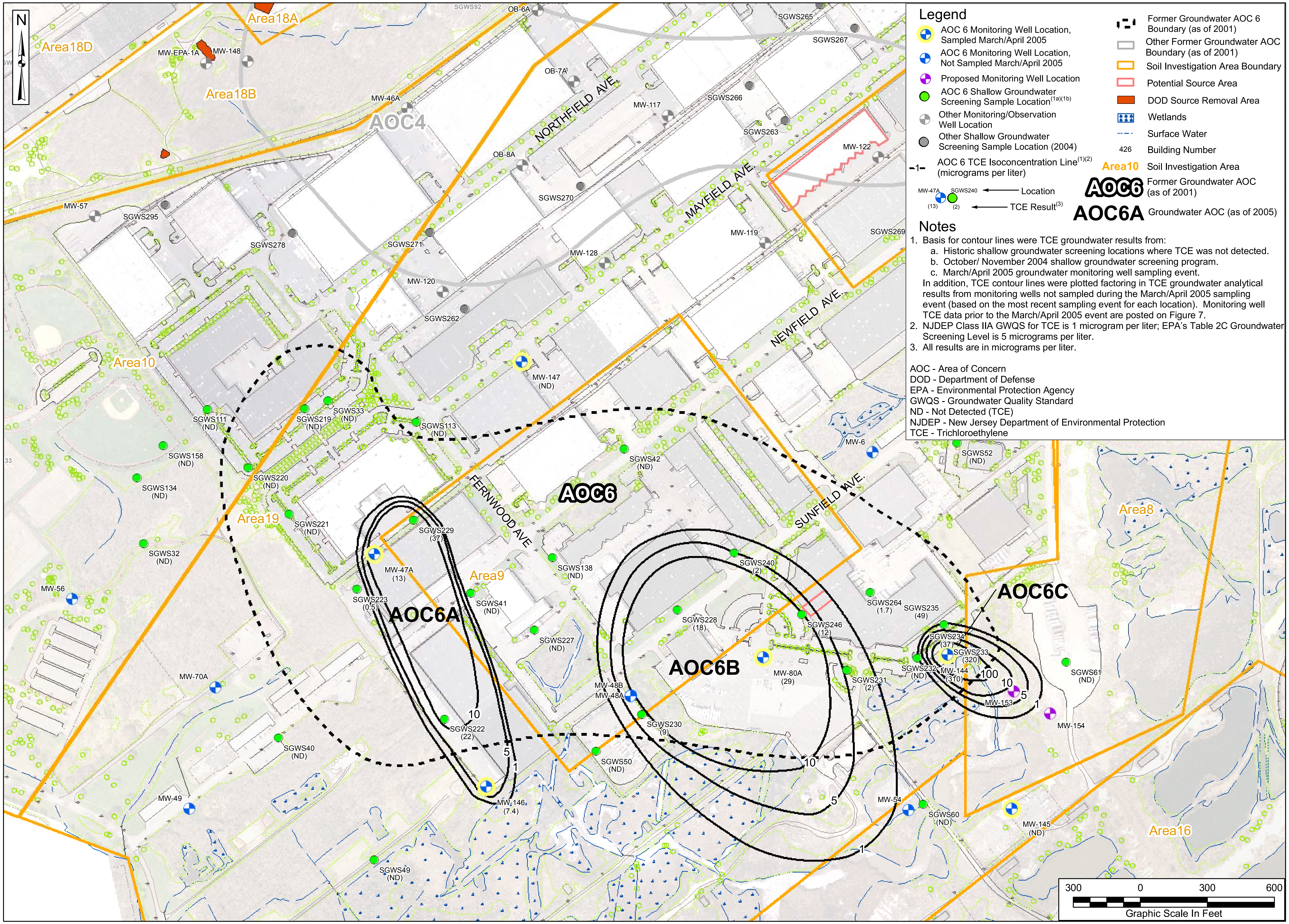
DRAWING: 05443_GW-ISO-AOC6.mxd
PATH: K:\Raritan01\RaritanGIS\Mxd\0108_RAWP\
REVISION No. 0
WORK ORDER No. 03886.110.027.0005

REPORT NAME:
DRAFT - GROUNDWATER
REMEDIAL ACTION WORK PLAN
FEBRUARY 2008

CLIENT NAME: U.S. ARMY CORPS OF ENGINEERS
PROJECT NAME: FORMER RARITAN ARSENAL

DRAWING TITLE:
GROUNDWATER AOC 6:
COMPARISON OF THE DETECTED VOC
LIST TO THE NJDEP CLASS IIA GWQS
JULY 1998 TO APRIL 2005

FIGURE: 2-3
SCALE: *see scale bar
DATE: 1-31-08



Legend

🔵	AOC 6 Monitoring Well Location, Sampled March/April 2005
🔵	AOC 6 Monitoring Well Location, Not Sampled March/April 2005
🟣	Proposed Monitoring Well Location
🟢	AOC 6 Shallow Groundwater Screening Sample Location[(1a)(1b)]
●	Other Monitoring/Observation Well Location
●	Other Shallow Groundwater Screening Sample Location (2004)
-1-	AOC 6 TCE Isoconcentration Line[(1)(2)] (micrograms per liter)
MW-47A (13) SGWS240 (2)	Location TCE Result[(3)]
▭	Former Groundwater AOC 6 Boundary (as of 2001)
▭	Other Former Groundwater AOC Boundary (as of 2001)
▭	Soil Investigation Area Boundary
▭	Potential Source Area
🟥	DOD Source Removal Area
▨	Wetlands
- -	Surface Water
426	Building Number
Area10	Soil Investigation Area
AOC6	Former Groundwater AOC (as of 2001)
AOC6A	Groundwater AOC (as of 2005)

Notes

1. Basis for contour lines were TCE groundwater results from:
   - a. Historic shallow groundwater screening locations where TCE was not detected.
   - b. October/ November 2004 shallow groundwater screening program.
   - c. March/April 2005 groundwater monitoring well sampling event.

   In addition, TCE contour lines were plotted factoring in TCE groundwater analytical results from monitoring wells not sampled during the March/April 2005 sampling event (based on the most recent sampling event for each location). Monitoring well TCE data prior to the March/April 2005 event are posted on Figure 7.
2. NJDEP Class IIA GWQS for TCE is 1 microgram per liter; EPA's Table 2C Groundwater Screening Level is 5 micrograms per liter.
3. All results are in micrograms per liter.

AOC - Area of Concern
DOD - Department of Defense
EPA - Environmental Protection Agency
GWQS - Groundwater Quality Standard
ND - Not Detected (TCE)
NJDEP - New Jersey Department of Environmental Protection
TCE - Trichloroethylene

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DRAWN BY: J. LYNES
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PROJECT MANAGER: P. BOVITZ
SCALE: 1: 3,600
DATE: 2-1-08

TITLE:
GROUNDWATER AOC 6:
GENERALIZED TCE ISOPLETH MAP
AS OF APRIL 2005

FIGURE #: 2-4
DRAWING NUMBER: 05448_GW-ISO-AOC6.mxd
DRAWING LOCATION: K:\Raritan01\RaritanGIS\Mxd\0108_RAWP\

REPORT:
DRAFT - GROUNDWATER
REMEDIAL ACTION WORK PLAN
FEBRUARY 2008

PROJECT: FORMER RARITAN ARSENAL

CLIENT NAME: U.S. ARMY CORPS OF ENGINEERS

Legend

●	AOC 3 And AOC 8 Monitoring Well Location, Sampled March/April 2005
●	AOC 3 And AOC 8 Monitoring Well Location, Not Sampled March/April 2005
🟢	AOC 3 And AOC 8 Shallow Groundwater Screening Sample Location - See Figure 11
▲	AOC 3 And AOC 8 Geoprobe Sample Location
●	Other Monitoring Well Location
●	Other Shallow Groundwater Screening Sample Location
▲	Other Geoprobe Sample Location
☐	Groundwater AOC 3 And AOC 8 Boundary (as of 2005)
☐	Soil Investigation Area Boundary
🟥	DOD Source Removal Area
☐	Potential Source Area
▨	Wetlands
----	Surface Water
426	Building Number
Area4	Soil Investigation Area
AOC3	Groundwater AOC (as of 2005)
TRICHLOROETHYLENE (TCE)	Compound concentration exceeding the NJDEP Class IIA GWQS for the last groundwater sample event the location was sampled.
1.4	Concentration exceeds the NJDEP Class IIA GWQS.
☐	Analytical Text Box For Monitoring Well Sampled In 2005
☐	Analytical Text Box For Monitoring Well Not Sampled In 2005

Notes

1. The criteria listed are the NJDEP Class IIA GWQS.
2. The results and criteria are in micrograms per liter.
3. Data included in the analytical text boxes begin with the July 1998 groundwater sampling event. This event was the first of eight quarterly groundwater sampling events. Text boxes include all groundwater sample events from July 1998 to April 2005. If an event is not listed, the location was not sampled during that event. If a monitoring well is shown and it does not have a text box then that location was sampled prior to the July 1988 groundwater sampling event, sampled for parameters other than VOCs, or was never sampled.
4. The compound list is Groundwater AOC-specific. The compound list includes those compounds detected in at least one groundwater monitoring well sample starting with the July 1998 groundwater sampling event for the associated Groundwater AOC.
5. -- Compound not analyzed for the listed event.
6. Volume of contaminated groundwater in AOC8C = 1,557,000 ft^3
Volume of contaminated groundwater in AOC8D = 159,500 ft^3

AOC - Area of Concern
DOD - Department of Defense
GWQS - Groundwater Quality Standard
J/J- - Estimated Concentration
MDL Method Detection Limit
NJDEP - New Jersey Department of Environmental Protection
U - Not detected at MDL listed
VOC - Volatile Organic Compounds

MW-133

Parameter	[Criteria]	3/28/2005
1,1,1-TRICHLOROETHANE	[30]	0.3 U
1,1,2-TRICHLOROETHANE	[3]	0.3 U
1,1-DICHLOROETHANE	[50]	0.4 U
1,1-DICHLOROETHENE	[2]	0.3 U
1,2-DICHLOROETHANE	[2]	0.4 U
ACETONE	[700]	1 U
BROMODICHLOROMETHANE	[1]	0.3 U
CARBON DISULFIDE	[800]	0.2 U
CHLOROBENZENE	[50]	0.3 U
CHLOROFORM	[6]	0.3 U
CHLOROMETHANE	[30]	0.4 U
CIS-1,2-DICHLOROETHENE	[70]	0.4 U
TETRACHLOROETHYLENE	[1]	0.4 U
TRANS-1,2-DICHLOROETHENE	[100]	0.3 U
TRICHLOROETHYLENE (TCE)	[1]	100
VINYL CHLORIDE	[5]	0.4 U
XYLENES (TOTAL)	[1000]	0.2 U

MW-137

Parameter	[Criteria]	3/28/2005
1,1,1-TRICHLOROETHANE	[30]	0.3 U
1,1,2-TRICHLOROETHANE	[3]	0.3 U
1,1-DICHLOROETHANE	[50]	0.4 U
1,1-DICHLOROETHENE	[2]	0.3 U
1,2-DICHLOROETHANE	[2]	0.4 U
ACETONE	[700]	1 U
BROMODICHLOROMETHANE	[1]	0.3 U
CARBON DISULFIDE	[800]	0.2 U
CHLOROBENZENE	[50]	0.3 U
CHLOROFORM	[6]	0.3 U
CHLOROMETHANE	[30]	0.4 U
CIS-1,2-DICHLOROETHENE	[70]	0.4 U
TETRACHLOROETHYLENE	[1]	0.4 U
TRANS-1,2-DICHLOROETHENE	[100]	0.3 U
TRICHLOROETHYLENE (TCE)	[1]	0.4 U
VINYL CHLORIDE	[5]	0.4 U
XYLENES (TOTAL)	[1000]	0.2 U

MW-104A

Parameter	[Criteria]	7/21/1998
1,1,1-TRICHLOROETHANE	[30]	1 U
1,1,2-TRICHLOROETHANE	[3]	1 U
1,1-DICHLOROETHANE	[50]	1 U
1,1-DICHLOROETHENE	[2]	1 U
1,2-DICHLOROETHANE	[2]	1 U
ACETONE	[700]	5 U
BROMODICHLOROMETHANE	[1]	1 U
CARBON DISULFIDE	[800]	1 U
CHLOROBENZENE	[50]	1 U
CHLOROFORM	[6]	1 U
CHLOROMETHANE	[30]	2 U
CIS-1,2-DICHLOROETHENE	[70]	1 U
TETRACHLOROETHYLENE	[1]	1 U
TRANS-1,2-DICHLOROETHENE	[100]	1 U
TRICHLOROETHYLENE (TCE)	[1]	1 U
VINYL CHLORIDE	[5]	2 U
XYLENES (TOTAL)	[1000]	1 U

MW-153

Parameter	[Criteria]	5/6/2005
1,1,1-TRICHLOROETHANE	[30]	0.3 U
1,1,2-TRICHLOROETHANE	[3]	0.3 U
1,1-DICHLOROETHANE	[50]	0.3 U
1,1-DICHLOROETHENE	[2]	0.4 U
1,2-DICHLOROETHANE	[2]	0.3 U
ACETONE	[700]	1.3 U
BROMODICHLOROMETHANE	[1]	0.3 U
CARBON DISULFIDE	[800]	0.3 U
CHLOROBENZENE	[50]	0.4 U
CHLOROFORM	[6]	0.5 U
CHLOROMETHANE	[30]	0.3 U
CIS-1,2-DICHLOROETHENE	[70]	2.8
TETRACHLOROETHYLENE	[1]	0.4 U
TRANS-1,2-DICHLOROETHENE	[100]	0.4 U
TRICHLOROETHYLENE (TCE)	[1]	27
VINYL CHLORIDE	[5]	0.3 U
XYLENES (TOTAL)	[1000]	0.4 U

MW-136

Parameter	[Criteria]	3/28/2005
1,1,1-TRICHLOROETHANE	[30]	0.3 U
1,1,2-TRICHLOROETHANE	[3]	0.3 U
1,1-DICHLOROETHANE	[50]	0.4 U
1,1-DICHLOROETHENE	[2]	0.3 U
1,2-DICHLOROETHANE	[2]	0.4 U
ACETONE	[700]	1 U
BROMODICHLOROMETHANE	[1]	0.3 U
CARBON DISULFIDE	[800]	0.2 U
CHLOROBENZENE	[50]	0.3 U
CHLOROFORM	[6]	0.3 U
CHLOROMETHANE	[30]	0.4 U
CIS-1,2-DICHLOROETHENE	[70]	0.4 U
TETRACHLOROETHYLENE	[1]	0.4 U
TRANS-1,2-DICHLOROETHENE	[100]	0.3 U
TRICHLOROETHYLENE (TCE)	[1]	19
VINYL CHLORIDE	[5]	0.4 U
XYLENES (TOTAL)	[1000]	0.2 U

MW-135

Parameter	[Criteria]	3/28/2005
1,1,1-TRICHLOROETHANE	[30]	0.3 U
1,1,2-TRICHLOROETHANE	[3]	0.3 U
1,1-DICHLOROETHANE	[50]	0.4 U
1,1-DICHLOROETHENE	[2]	0.3 U
1,2-DICHLOROETHANE	[2]	0.4 U
ACETONE	[700]	1 U
BROMODICHLOROMETHANE	[1]	0.3 U
CARBON DISULFIDE	[800]	0.2 U
CHLOROBENZENE	[50]	0.3 U
CHLOROFORM	[6]	0.6
CHLOROMETHANE	[30]	0.4 U
CIS-1,2-DICHLOROETHENE	[70]	0.4 U
TETRACHLOROETHYLENE	[1]	0.4 U
TRANS-1,2-DICHLOROETHENE	[100]	0.3 U
TRICHLOROETHYLENE (TCE)	[1]	38
VINYL CHLORIDE	[5]	0.4 U
XYLENES (TOTAL)	[1000]	0.2 U

MW-105A

Parameter	[Criteria]	7/17/1998	10/16/1998	8/30/1999	1/14/2000	4/27/2000	8/10/2000	12/1/2000	3/22/2001	3/28/2005
1,1,1-TRICHLOROETHANE	[30]	1 U	5 U	5 U	1 U	1 U	1 U	1 U	1 UJ	0.3 U
1,1,2-TRICHLOROETHANE	[3]	1 U	3 U	3 U	1 U	1 U	1 U	1 U	1 UJ	0.3 U
1,1-DICHLOROETHANE	[50]	1 U	5 U	5 U	1 U	1 U	1 U	1 U	1 UJ	0.4 U
1,1-DICHLOROETHENE	[2]	1 U	2 U	2 U	1 U	1 U	1 U	1 U	1 UJ	0.3 U
1,2-DICHLOROETHANE	[2]	1 U	2 U	2 U	1 U	1 U	1 U	1 U	1 UJ	0.4 U
ACETONE	[700]	5 U	5 U	5 U	5 U	5 UJ	5 U	5 U	5 UJ	1 U
BROMODICHLOROMETHANE	[1]	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 UJ	0.3 U
CARBON DISULFIDE	[800]	1 U	5 U	5 U	1 U	1 U	1 U	1 U	1 UJ	0.2 U
CHLOROBENZENE	[50]	1 U	5 U	5 U	1 U	1 U	1 U	1 U	1 UJ	0.3 U
CHLOROFORM	[6]	10	6.7	11	9.2	5.8 U	11	11 J	4.71 J	2.8
CHLOROMETHANE	[30]	2 U	5 U	2 U	2.1 U	1 U	1 U	1 U	1 UJ	0.4 U
CIS-1,2-DICHLOROETHENE	[70]	1	5 U	5 U	1 U	1 U	1 U	1 U	1 UJ	0.4 U
TETRACHLOROETHYLENE	[1]	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 UJ	0.4 U
TRANS-1,2-DICHLOROETHENE	[100]	1 U	5 U	5 U	1 U	1 U	1 U	1 U	1 UJ	0.3 U
TRICHLOROETHYLENE (TCE)	[1]	2	1.2	2.1	3	6.8	2.52	2.01 J	4.08 J	2.4
VINYL CHLORIDE	[5]	2 U	5 U	2 U	1 U	1 U	1 U	1 U	1 UJ	0.4 U
XYLENES (TOTAL)	[1000]	1 U	5 U	5 U	1 U	1 U	1 U	1 U	1 UJ	0.2 U

MW-108A

Parameter	[Criteria]	7/20/1998	10/14/1998	8/26/1999	1/13/2000	4/27/2000	8/11/2000	12/5/2000	3/22/2001
1,1,1-TRICHLOROETHANE	[30]	1 U	5 U	5 U	1 U	1 U	1 U	1 U	1 U
1,1,2-TRICHLOROETHANE	[3]	1 U	3 U	3 U	1 U	1 U	1 U	1 U	1 U
1,1-DICHLOROETHANE	[50]	1 U	5 U	5 U	1 U	1 U	1 U	1 U	1 U
1,1-DICHLOROETHENE	[2]	1 U	2 U	2 U	1 U	1 U	1 U	1 U	1 U
1,2-DICHLOROETHANE	[2]	1 U	2 U	2 U	1 U	1 U	1 U	1 U	1 U
ACETONE	[700]	5 U	5 U	5 U	5 U	5 UJ	5 U	5 U	5 U
BROMODICHLOROMETHANE	[1]	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
CARBON DISULFIDE	[800]	1 U	5 U	5 U	1 U	1 U	1 U	1 U	1 U
CHLOROBENZENE	[50]	1 U	5 U	5 U	1 U	1 U	1 U	1 U	1 U
CHLOROFORM	[6]	0.2 J	5 U	5 U	1 U	1 U	1 U	1 U	1 U
CHLOROMETHANE	[30]	2 U	5 U	2 U	1 U	1 U	1 U	6.12 U	1 U
CIS-1,2-DICHLOROETHENE	[70]	1 U	5 U	5 U	1 U	1 U	1 U	1 U	1 U
TETRACHLOROETHYLENE	[1]	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
TRANS-1,2-DICHLOROETHENE	[100]	1 U	5 U	5 U	1 U	1 U	1 U	1 U	1 U
TRICHLOROETHYLENE (TCE)	[1]	0.5 J	1 U	1.3	1.4 U	3.1	1.89	1.46	1 U
VINYL CHLORIDE	[5]	2 U	5 U	2 U	1 U	1 U	1 U	1 U	1 U
XYLENES (TOTAL)	[1000]	1 U	5 U	5 U	1 U	1 U	1 U	1 U	1 U

MW-EPA-6A

Parameter	[Criteria]	7/16/1998	10/19/1998
1,1,1-TRICHLOROETHANE	[30]	1 U	5 U
1,1,2-TRICHLOROETHANE	[3]	1 U	3 U
1,1-DICHLOROETHANE	[50]	1 U	5 U
1,1-DICHLOROETHENE	[2]	1 U	2 U
1,2-DICHLOROETHANE	[2]	1 U	2 U
ACETONE	[700]	5 U	5 U
BROMODICHLOROMETHANE	[1]	1 U	1 U
CARBON DISULFIDE	[800]	1 U	5 U
CHLOROBENZENE	[50]	1 U	5 U
CHLOROFORM	[6]	1 U	5 U
CHLOROMETHANE	[30]	2 U	5 U
CIS-1,2-DICHLOROETHENE	[70]	0.4 J	5 U
TETRACHLOROETHYLENE	[1]	1 U	1 U
TRANS-1,2-DICHLOROETHENE	[100]	1 U	5 U
TRICHLOROETHYLENE (TCE)	[1]	22	15
VINYL CHLORIDE	[5]	2 U	5 U
XYLENES (TOTAL)	[1000]	1 U	0.7 J

MW-115

Parameter	[Criteria]	7/21/1998	10/19/1998	8/31/1999	1/12/2000	5/3/2000	8/10/2000	12/5/2000	3/22/2001	3/31/2005
1,1,1-TRICHLOROETHANE	[30]	89	76	70	73.7	69.5	52	37.8	43.5	73
1,1,2-TRICHLOROETHANE	[3]	1 J	1.2 J	1.6 J	1.6	1.3 J	1 J	1.01	0.86 J	1.5
1,1-DICHLOROETHANE	[50]	18	14	13	15.1	12.2	9.63	10.4	8.13	13
1,1-DICHLOROETHENE	[2]	12	8.7	10	14.5	12.3	8.14	13.8	10.4	17
1,2-DICHLOROETHANE	[2]	5 U	2 U	0.6 J	0.5 J	1 U	1 U	1 U	1 U	0.6
ACETONE	[700]	25 U	5 U	5 U	5 U	5 UJ	5 U	5 U	5 U	1 U
BROMODICHLOROMETHANE	[1]	5 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	0.3 U
CARBON DISULFIDE	[800]	5 U	5 U	5 U	1 U	1 U	1 U	1 U	1 U	0.2 U
CHLOROBENZENE	[50]	5 U	5 U	5 U	1 U	1 U	1 U	1 U	1 U	0.3 U
CHLOROFORM	[6]	5 U	5 U	5 U	1 U	1 U	1 U	1 U	1 U	0.5
CHLOROMETHANE	[30]	10 U	5 U	2 U	1 U	1 U	1 U	3.04 U	1 U	0.4 U
CIS-1,2-DICHLOROETHENE	[70]	5 U	5 U	5 U	0.7 J	1 U	1 U	1 U	1 U	0.6
MTBE	[70]	--	--	--	--	--	--	--	--	6.1
TETRACHLOROETHYLENE	[1]	5 U	1 U	1 U	1 U	1 U	0.57 J	0.54 J	0.65 J	0.9
TRANS-1,2-DICHLOROETHENE	[100]	5 U	5 U	5 U	1 U	12.3	1 U	1 U	1 U	0.3 U
TRICHLOROETHYLENE (TCE)	[1]	0.9 J	0.7 J	1.1	1.1 U	1.1 J	1.02	0.86 J	0.85 J	1.4
VINYL CHLORIDE	[5]	10 U	5 U	2 U	1 U	1 U	1 U	1 U	1 U	0.4 U
XYLENES (TOTAL)	[1000]	5 U	5 U	5 U	1 U	1 U	1 U	1 U	1 U	0.2 U

MW-EPA-8A

Parameter	[Criteria]	3/31/2005
1,1,1-TRICHLOROETHANE	[30]	0.3 U
1,1,2-TRICHLOROETHANE	[3]	0.3 U
1,1-DICHLOROETHANE	[50]	0.4 U
1,1-DICHLOROETHENE	[2]	0.3 U
1,2-DICHLOROETHANE	[2]	0.4 U
ACETONE	[700]	1 U
BROMODICHLOROMETHANE	[1]	0.3 U
CARBON DISULFIDE	[800]	0.2 U
CHLOROBENZENE	[50]	0.3 U
CHLOROFORM	[6]	0.3 U
CHLOROMETHANE	[30]	0.4 U
CIS-1,2-DICHLOROETHENE	[70]	0.4 U
TETRACHLOROETHYLENE	[1]	0.4 U
TRANS-1,2-DICHLOROETHENE	[100]	0.3 U
TRICHLOROETHYLENE (TCE)	[1]	0.4 U
VINYL CHLORIDE	[5]	0.4 U
XYLENES (TOTAL)	[1000]	0.2 U

MW-134

Parameter	[Criteria]	3/28/2005
1,1,1-TRICHLOROETHANE	[30]	0.3 U
1,1,2-TRICHLOROETHANE	[3]	0.3 U
1,1-DICHLOROETHANE	[50]	0.4 U
1,1-DICHLOROETHENE	[2]	0.3 U
1,2-DICHLOROETHANE	[2]	0.4 U
ACETONE	[700]	1 U
BROMODICHLOROMETHANE	[1]	0.3 U
CARBON DISULFIDE	[800]	0.2 U
CHLOROBENZENE	[50]	0.3 U
CHLOROFORM	[6]	0.3 U
CHLOROMETHANE	[30]	0.4 U
CIS-1,2-DICHLOROETHENE	[70]	0.4 U
TETRACHLOROETHYLENE	[1]	0.4 U
TRANS-1,2-DICHLOROETHENE	[100]	0.3 U
TRICHLOROETHYLENE (TCE)	[1]	0.9
VINYL CHLORIDE	[5]	0.4 U
XYLENES (TOTAL)	[1000]	0.2 U

MW-EPA-4A

Parameter	[Criteria]	7/14/1998	10/19/1998	8/26/1999	1/12/2000	4/27/2000	8/9/2000	12/1/2000	3/22/2001
1,1,1-TRICHLOROETHANE	[30]	0.8 J	1.1 J	0.6 J	1 J	1.2 J	1.17	0.85 J	0.62 J
1,1,2-TRICHLOROETHANE	[3]	1 U	3 U	3 U	1 UJ	1 U	1 U	1 U	1 UJ
1,1-DICHLOROETHANE	[50]	1 U	5 U	5 U	1 UJ	1 U	1 U	1 U	1 UJ
1,1-DICHLOROETHENE	[2]	0.5 J	1.2 J	1.2 J	0.8 J	0.8 J	1 U	1 U	1 UJ
1,2-DICHLOROETHANE	[2]	1 U	2 U	2 U	1 UJ	1 U	1 U	1 U	1 UJ
ACETONE	[700]	5 U	5 U	5 U	5 UJ	5 UJ	5 U	5 U	5 UJ
BROMODICHLOROMETHANE	[1]	1 U	1 U	1 U	1 UJ	1 U	1 U	1 U	1 UJ
CARBON DISULFIDE	[800]	1 U	5 U	5 U	1 UJ	1 U	1 U	1 U	1 UJ
CHLOROBENZENE	[50]	1 U	5 U	5 U	1 UJ	1 U	1 U	1 U	0.86 J
CHLOROFORM	[6]	1 U	5 U	5 U	1 UJ	1 U	1 U	1 U	1 UJ
CHLOROMETHANE	[30]	2 U	5 U	2 U	1 UJ	1 U	1 U	1 U	1 UJ
CIS-1,2-DICHLOROETHENE	[70]	0.4 J	1 J	0.7 J	1 UJ	1 U	1 U	1 U	1 UJ
TETRACHLOROETHYLENE	[1]	2	3.2	1.6	1.5 J	1.7 J	1.75	0.91 J	0.72 J
TRANS-1,2-DICHLOROETHENE	[100]	1 U	5 U	5 U	1 UJ	1 U	1 U	1 U	1 UJ
TRICHLOROETHYLENE (TCE)	[1]	4	3.6	5	2.5 J	2.8 J	2.58	1.78 J	1.49 J
VINYL CHLORIDE	[5]	2 U	5 U	2 U	1 UJ	1 U	1 U	1 U	1 UJ
XYLENES (TOTAL)	[1000]	1 U	5 U	5 U	1 UJ	1 U	1 U	1 U	1 UJ

MW-121

Parameter	[Criteria]	7/16/1998	10/19/1998	8/25/1999	1/13/2000	4/28/2000	8/10/2000	12/4/2000	3/23/2001	4/1/2005
1,1,1-TRICHLOROETHANE	[30]	1 U	5 U	5 U	5 U	1 U	1 U	1 U	1 U	0.3 U
1,1,2-TRICHLOROETHANE	[3]	1 U	3 U	3 U	5 U	1 U	1 U	1 U	1 U	0.3 U
1,1-DICHLOROETHANE	[50]	1 U	5 U	5 U	5 U	1 U	1 U	1 U	1 U	0.4 U
1,1-DICHLOROETHENE	[2]	1 U	2 U	2 U	5 U	1 U	1 U	1 U	1 U	0.3 U
1,2-DICHLOROETHANE	[2]	1 U	2 U	2 U	5 U	1 U	1 U	1 U	1 U	0.4 U
ACETONE	[700]	5 U	5 U	5 U	25 U	5 UJ	5 U	5 U	5 U	1 U
BROMODICHLOROMETHANE	[1]	1 U	1 U	1 U	5 U	1.1	1 U	1 U	1 U	0.3 U
CARBON DISULFIDE	[800]	1 U	5 U	5 U	5 U	1 U	1 U	1 U	1 U	0.2 U
CHLOROBENZENE	[50]	1 U	5 U	5 U	5 U	1 U	1 U	1 U	1 U	0.3 U
CHLOROFORM	[6]	1 U	5 U	1.2 J	12.8 U	7.8 U	3.76	4.12	1.61	0.3 U
CHLOROMETHANE	[30]	2 U	5 U	2 U	5 U	1 U	1 U	1 U	1 U	0.4 U
CIS-1,2-DICHLOROETHENE	[70]	5	3.3 J	2.6 J	5 U	1.6	2.41	1.48	2.04	1.9
TETRACHLOROETHYLENE	[1]	0.7 J	1 U	1 U	5 U	1 U	1.04	1 U	1.66	0.4 U
TRANS-1,2-DICHLOROETHENE	[100]	1 U	5 U	5 U	5 U	1 U	1 U	1 U	1 U	0.3 U
TRICHLOROETHYLENE (TCE)	[1]	45 J-	50	49	49.2	49	55.4	65.2	60	74
VINYL CHLORIDE	[5]	2 U	5 U	2 U	5 U	1 U	1 U	1 U	1 U	0.4 U
XYLENES (TOTAL)	[1000]	1 U	5 U	5 U	5 U	1 U	1 U	1 U	1 U	0.2 U

MW-88A

Parameter	[Criteria]	7/14/1998	10/15/1998	8/26/1999	1/12/2000	4/27/2000	8/9/2000	12/1/2000	3/22/2001	4/4/2005
1,1,1-TRICHLOROETHANE	[30]	1 U	5 U	5 U	1 U	1 U	1 U	1 U	1 U	0.3 U
1,1,2-TRICHLOROETHANE	[3]	1 U	3 U	3 U	1 U	1 U	1 U	1 U	1 U	0.3 U
1,1-DICHLOROETHANE	[50]	1 U	5 U	5 U	1 U	1 U	1 U	1 U	1 U	0.4 U
1,1-DICHLOROETHENE	[2]	1 U	2 U	2 U	1 U	1 U	1 U	1 U	1 U	0.3 U
1,2-DICHLOROETHANE	[2]	1 U	2 U	2 U	1 U	1 U	1 U	1 U	1 U	0.4 U
ACETONE	[700]	5 U	5 U	5 U	5 U	5 UJ	5 U	5 U	5 U	1 U
BROMODICHLOROMETHANE	[1]	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	0.3 U
CARBON DISULFIDE	[800]	1 U	5 U	5 U	1 U	4 UJ	1 U	1 U	1 U	0.2 U
CHLOROBENZENE	[50]	1 U	5 U	5 U	1 U	1 U	1 U	1 U	1 U	0.3 U
CHLOROFORM	[6]	1 U	5 U	5 U	1 U	1 U	1 U	1 U	1 U	0.3 U
CHLOROMETHANE	[30]	2 U	5 U	2 U	1 U	1 U	1 U	1 U	1 U	0.4 U
CIS-1,2-DICHLOROETHENE	[70]	15	14	12	14	13.4 J	7.52	28.2	4.97	0.4 U
TETRACHLOROETHYLENE	[1]	1 U	1 U	1 U	1 U	1 U	1 U	0.78 J	1 U	0.4 U
TRANS-1,2-DICHLOROETHENE	[100]	0.6 J	5 U	0.7 J	0.6 J	0.6 J	0.55 J	1.09	1 U	0.3 U
TRICHLOROETHYLENE (TCE)	[1]	0.7 J	0.8 J	1.1	0.8 J	1 U	0.7 J	20.2	1 U	0.4 U
VINYL CHLORIDE	[5]	2 U	5 U	2 U	1 U	1 U	1 U	0.53 J	1 U	0.4 U
XYLENES (TOTAL)	[1000]	1 U	5 U	5 U	1 U	1 U	1 U	1 U	1 U	0.2 U

MW-87A

Parameter	[Criteria]	7/16/1998	10/15/1998	8/24/1999	1/13/2000	4/28/2000	8/10/2000	12/4/2000	3/23/2001	4/4/2005
1,1,1-TRICHLOROETHANE	[30]	1 U	5 U	5 U	1 U	1 U	1 U	1 U	1 U	0.3 U
1,1,2-TRICHLOROETHANE	[3]	1 U	3 U	3 U	1 U	1 U	1 U	1 U	1 U	0.3 U
1,1-DICHLOROETHANE	[50]	1 U	5 U	5 U	1 U	1 U	1 U	1 U	1 U	0.4 U
1,1-DICHLOROETHENE	[2]	1 U	2 U	2 U	1 U	1 U	1 U	1 U	1 U	0.3 U
1,2-DICHLOROETHANE	[2]	1 U	2 U	2 U	1 U	1 U	1 U	1 U	1 U	0.4 U
ACETONE	[700]	5 U	5 U	5 U	5 U	5 UJ	5 U	5 U	5 U	1 U
BROMODICHLOROMETHANE	[1]	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	0.3 U
CARBON DISULFIDE	[800]	1 U	5 U	5 U	1 U	3.7	1 U	1 U	1 U	0.2 U
CHLOROBENZENE	[50]	1 U	5 U	5 U	1 U	1 U	1 U	1 U	1 U	0.3 U
CHLOROFORM	[6]	2 U	0.8 J	1 J	1 U	1 U	1 U	0.64 J	0.61 J	0.3 U
CHLOROMETHANE	[30]	2 U	5 U	2 U	1 U	1 U	1 U	0.92 J	1 U	0.4 U
CIS-1,2-DICHLOROETHENE	[70]	0.3 J	5 U	5 U	0.6 J	1 U	1 U	1 U	1 U	0.4
TETRACHLOROETHYLENE	[1]	3	1.6	0.8 J	0.7 J	0.8 J	1 J	0.96 J	1.05	0.9
TRANS-1,2-DICHLOROETHENE	[100]	1 U	5 U	5 U	1 U	1 U	1 U	1 U	1 U	0.3 U
TRICHLOROETHYLENE (TCE)	[1]	12	8.5	2.2	2.6 U	1.9	2.01	1.99	1.64 U	9.4
VINYL CHLORIDE	[5]	2 U	5 U	2 U	1 U	1 U	1 U	1 U	1 U	0.4 U
XYLENES (TOTAL)	[1000]	1 U	5 U	5 U	1 U	1 U	1 U	1 U	1 U	0.2 U

MW-138

Parameter	[Criteria]	4/1/2005
1,1,1-TRICHLOROETHANE	[30]	0.3 U
1,1,2-TRICHLOROETHANE	[3]	0.3 U
1,1-DICHLOROETHANE	[50]	0.4 U
1,1-DICHLOROETHENE	[2]	0.3 U
1,2-DICHLOROETHANE	[2]	0.4 U
ACETONE	[700]	1 U
BROMODICHLOROMETHANE	[1]	0.3 U
CARBON DISULFIDE	[800]	0.2 U
CHLOROBENZENE	[50]	0.3 U
CHLOROFORM	[6]	0.3 U
CHLOROMETHANE	[30]	0.4 U
CIS-1,2-DICHLOROETHENE	[70]	7.2
TETRACHLOROETHYLENE	[1]	4.8
TRANS-1,2-DICHLOROETHENE	[100]	0.3 U
TRICHLOROETHYLENE (TCE)	[1]	73
VINYL CHLORIDE	[5]	0.4 U
XYLENES (TOTAL)	[1000]	0.2 U

MW-125

Parameter	[Criteria]	7/20/1998	10/15/1998	8/24/1999	1/13/2000	4/28/2000	8/10/2000	12/4/2000	3/23/2001	4/4/2005
1,1,1-TRICHLOROETHANE	[30]	1 U	5 U	5 U	1 U	1 U	1 U	1 U	1 U	0.3 U
1,1,2-TRICHLOROETHANE	[3]	1 U	3 U	3 U	1 U	1 U	1 U	1 U	1 U	0.3 U
1,1-DICHLOROETHANE	[50]	1 U	5 U	5 U	1 U	1 U	1 U	1 U	1 U	0.4 U
1,1-DICHLOROETHENE	[2]	1 U	2 U	2 U	1 U	1 U	1 U	1 U	1 U	0.3 U
1,2-DICHLOROETHANE	[2]	1 U	2 U	2 U	1 U	1 U	1 U	1 U	1 U	0.4 U
ACETONE	[700]	5 U	5 U	5 U	5 U	5 UJ	5 U	5 U	5 U	1 U
BROMODICHLOROMETHANE	[1]	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	0.3 U
CARBON DISULFIDE	[800]	1 U	5 U	5 U	1 U	0.7 J	1 U	1 U	1 U	0.2 U
CHLOROBENZENE	[50]	1 U	5 U	5 U	1 U	1 U	1 U	1 U	1 U	0.3 U
CHLOROFORM	[6]	0.5 J	5 U	5 U	1 U	1 U	1 U	1 U	1 U	0.3 U
CHLOROMETHANE	[30]	2 U	5 U	2 U	1 U	1 U	1 U	1.43	1 U	0.4 U
CIS-1,2-DICHLOROETHENE	[70]	0.4 J	5 U	5 U	1 U	1 U	1 U	1 U	1 U	0.4 U
TETRACHLOROETHYLENE	[1]	0.2 J	1 U	1 U	1 U	1 U	1 U	1 U	1 U	0.4 U
TRANS-1,2-DICHLOROETHENE	[100]	1 U	5 U	5 U	1 U	1 U	1 U	1 U	1 U	0.3 U
TRICHLOROETHYLENE (TCE)	[1]	33	34	31	33	25.2	22.4	29.4	25	7.1
VINYL CHLORIDE	[5]	2 U	5 U	2 U	1 U	1 U	1 U	1 U	1 U	0.4 U
XYLENES (TOTAL)	[1000]	1 U	5 U	5 U	1 U	1 U	1 U	1 U	1 U	0.2 U

MW-8

Parameter	[Criteria]	7/14/1998	10/15/1998	8/30/1999	1/13/2000	4/28/2000	8/10/2000	12/4/2000	3/23/2001	4/4/2005
1,1,1-TRICHLOROETHANE	[30]	5 U	5 U	5 U	5 U	1 U	1 U	1 U	1 U	0.3 U
1,1,2-TRICHLOROETHANE	[3]	5 U	3 U	3 U	5 U	1 U	1 U	1 U	1 U	0.3 U
1,1-DICHLOROETHANE	[50]	5 U	5 U	5 U	5 U	1 U	1 U	1 U	1 U	0.4 U
1,1-DICHLOROETHENE	[2]	5 U	2 U	2 U	5 U	1 U	1 U	1 U	1 U	0.3 U
1,2-DICHLOROETHANE	[2]	5 U	2 U	2 U	5 U	1 U	1 U	1 U	1 U	0.4 U
ACETONE	[700]	25 U	5 U	5 U	25 U	5 UJ	5 U	5 U	5 U	1 U
BROMODICHLOROMETHANE	[1]	5 U	1 U	1 U	5 U	1 U	1 U	1 U	1 U	0.3 U
CARBON DISULFIDE	[800]	5 U	5 U	5 U	5 U	1 U	1 U	1 U	1 U	0.2 U
CHLOROBENZENE	[50]	5 U	5 U	5 U	5 U	1 U	1 U	1 U	1 U	0.3 U
CHLOROFORM	[6]	5 U	5 U	5 U	5 U	1 U	1 U	1 U	1 U	0.3 U
CHLOROMETHANE	[30]	10 U	5 U	2 U	5 U	1 U	1 U	1 U	1 U	0.4 U
CIS-1,2-DICHLOROETHENE	[70]	6	5.6	5.5	7	4.3	4.17	8.86 J	5.39	5
TETRACHLOROETHYLENE	[1]	5 U	1 U	1 U	5 U	1 U	1 U	1 U	1 U	0.4
TRANS-1,2-DICHLOROETHENE	[100]	5 U	5 U	5 U	5 U	1 U	1 U	1 U	1 U	0.3 U
TRICHLOROETHYLENE (TCE)	[1]	140	99	130	103.5	135.2 J	127	103	103 J	140
VINYL CHLORIDE	[5]	10 U	5 U	2 U	5 U	1 U	1 U	1 U	1 U	0.4 U
XYLENES (TOTAL)	[1000]	5 U	5 U	5 U	5 U	1 U	1 U	1 U	1 U	0.2 U

MW-89A

Parameter	[Criteria]	7/15/1998	10/14/1998	9/2/1999	1/14/2000	4/28/2000	8/15/2000	12/5/2000	3/23/2001	3/30/2005
1,1,1-TRICHLOROETHANE	[30]	1 U	5 U	5 U	1 U	1 U	1 U	1 U	1 U	0.3 U
1,1,2-TRICHLOROETHANE	[3]	1 U	3 U	3 U	1 U	1 U	1 U	1 U	1 U	0.3 U
1,1-DICHLOROETHANE	[50]	1 U	5 U	5 U	1 U	1 U	1 U	1 U	1 U	0.4 U
1,1-DICHLOROETHENE	[2]	1 U	2 U	2 U	1 U	1 U	1 U	1 U	1 U	0.3 U
1,2-DICHLOROETHANE	[2]	1 U	2 U	2 U	1 U	1 U	1 U	1 U	1 U	0.4 U
ACETONE	[700]	5 U	5 U	5 U	5 U	5 UJ	5 U	2.93 J	5 U	1 U
BROMODICHLOROMETHANE	[1]	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	0.3 U
CARBON DISULFIDE	[800]	1 U	5 U	5 U	1 U	1 U	1 U	1 U	1 U	0.2 U
CHLOROBENZENE	[50]	1 U	5 U	5 U	1 U	1 U	1 U	1 U	1 U	0.3 U
CHLOROFORM	[6]	1 U	5 U	5 U	1 U	1 U	1 U	1 U	1 U	0.3 U
CHLOROMETHANE	[30]	2 U	5 U	2 U	2.5 U	1 U	1 U	4.89 U	1 U	0.4 U
CIS-1,2-DICHLOROETHENE	[70]	1 U	5 U	5 U	1 U	1 U	1 U	1 U	1 U	0.4 U
TETRACHLOROETHYLENE	[1]	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	0.4 U
TRANS-1,2-DICHLOROETHENE	[100]	1 U	5 U	5 U	1 U	1 U	1 U	1 U	1 U	0.3 U
TRICHLOROETHYLENE (TCE)	[1]	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	0.4 U
VINYL CHLORIDE	[5]	2 U	5 U	2 U	1 U	1 U	1 U	1 U	1 U	0.4 U
XYLENES (TOTAL)	[1000]	1 U	5 U	5 U	1 U	1 U	1 U	1 U	1 U	0.2 U

MW-106A

Parameter	[Criteria]	7/16/1998	10/21/1998	8/30/1999	1/13/2000	5/1/2000	8/14/2000	12/4/2000	3/23/2001
1,1,1-TRICHLOROETHANE	[30]	1 U	5 U	5 U	1 U	1 U	1 U	1 U	1 U
1,1,2-TRICHLOROETHANE	[3]	1 U	3 U	3 U	1 U	1 U	1 U	1 U	1 U
1,1-DICHLOROETHANE	[50]	1 U	5 U	5 U	1 U	1 U	1 U	1 U	1 U
1,1-DICHLOROETHENE	[2]	1 U	2 U	2 U	1 U	1 U	1 U	1 U	1 U
1,2-DICHLOROETHANE	[2]	1 U	2 U	2 U	1 U	1 U	1 U	1 U	1 U
ACETONE	[700]	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
BROMODICHLOROMETHANE	[1]	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
CARBON DISULFIDE	[800]	2 U	5 U	5 U	1 U	1 U	1 U	1 U	1 U
CHLOROBENZENE	[50]	1 U	5 U	5 U	1 U	1 U	1 U	1 U	1 U
CHLOROFORM	[6]	1 U	5 U	5 U	1 U	1 U	1 U	1 U	1 U
CHLOROMETHANE	[30]	2 U	5 U	2 U	1 U	1 U	1 U	1.38	1 U
CIS-1,2-DICHLOROETHENE	[70]	0.9 J	0.9 J	1 J	1	1 U	0.8 J	0.78 J	1 U
TETRACHLOROETHYLENE	[1]	0.3 J	1 U	1	1 U	1 U	1 U	1 U	1 U
TRANS-1,2-DICHLOROETHENE	[100]	1 U	5 U	5 U	1 U	1 U	1 U	1 U	1 U
TRICHLOROETHYLENE (TCE)	[1]	7	5.8	7.4	5.5	2.8 U	5.31	5.01	2.79
VINYL CHLORIDE	[5]	0.9 J	0.9 J	2 U	1.1	1 U	0.95 J	0.85 J	1 U
XYLENES (TOTAL)	[1000]	1 U	5 U	5 U	1 U	1 U	1 U	1 U	1 U

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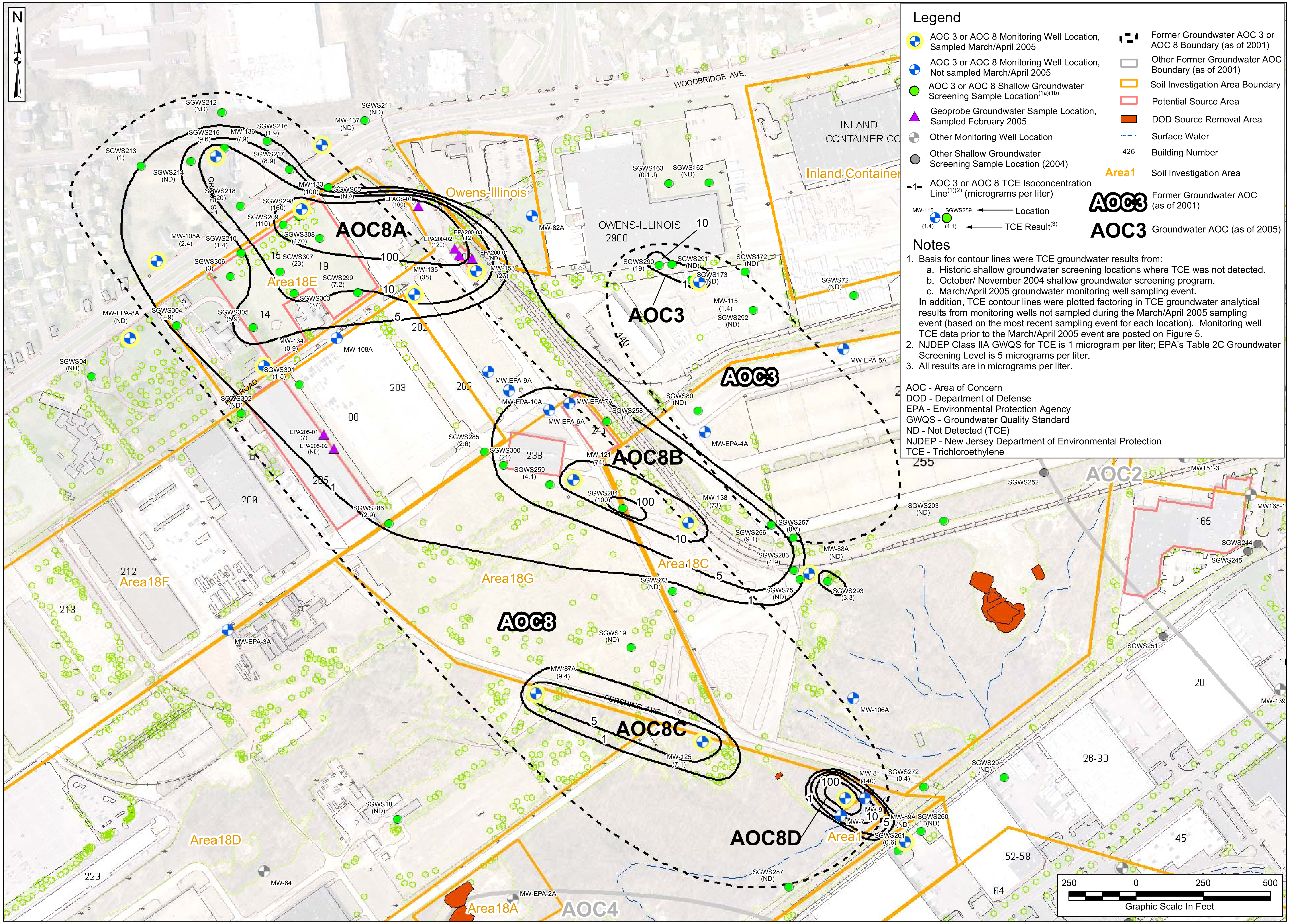
DATE CREATED:	8-22-2007
DRAWING:	05449_GW-AOC8.mxd
PATH:	K:\Raritan01\RaritanGIS\Mxd\0108_RAWP\
REVISION No.	0
WORK ORDER No.	03886.110.027.0005
REPORT NAME:	DRAFT - GROUNDWATER REMEDIAL ACTION WORK PLAN FEBRUARY 2008
CLIENT NAME:	U.S. ARMY CORPS OF ENGINEERS
PROJECT NAME:	FORMER RARITAN ARSENAL
DRAWING TITLE:	GROUNDWATER AOC 3 AND AOC 8: COMPARISON OF THE DETECTED VOC LIST TO THE NJDEP CLASS IIA GWQS JULY 1998 TO APRIL 2005
FIGURE:	2-5
SCALE:	*See scale bar
DATE:	2-1-08



Legend

●	AOC 3 or AOC 8 Monitoring Well Location, Sampled March/April 2005
●	AOC 3 or AOC 8 Monitoring Well Location, Not sampled March/April 2005
🟢	AOC 3 or AOC 8 Shallow Groundwater Screening Sample Location[(1a)(1b)]
▲	Geoprobe Groundwater Sample Location, Sampled February 2005
●	Other Monitoring Well Location
●	Other Shallow Groundwater Screening Sample Location (2004)
-1-	AOC 3 or AOC 8 TCE Isoconcentration Line[(1)(2)] (micrograms per liter)
MW-115 SGWS259	← Location
(1.4) (4.1)	← TCE Result[(3)]
▪ ▪ ▪	Former Groundwater AOC 3 or AOC 8 Boundary (as of 2001)
▭	Other Former Groundwater AOC Boundary (as of 2001)
🟧	Soil Investigation Area Boundary
🟥	Potential Source Area
🟥	DOD Source Removal Area
··· — ·	Surface Water
426	Building Number
Area1	Soil Investigation Area
AOC3	Former Groundwater AOC (as of 2001)
AOC3	Groundwater AOC (as of 2005)

Notes

1. Basis for contour lines were TCE groundwater results from:
   a. Historic shallow groundwater screening locations where TCE was not detected.
   b. October/ November 2004 shallow groundwater screening program.
   c. March/April 2005 groundwater monitoring well sampling event.

   In addition, TCE contour lines were plotted factoring in TCE groundwater analytical results from monitoring wells not sampled during the March/April 2005 sampling event (based on the most recent sampling event for each location). Monitoring well TCE data prior to the March/April 2005 event are posted on Figure 5.
2. NJDEP Class IIA GWQS for TCE is 1 microgram per liter; EPA's Table 2C Groundwater Screening Level is 5 micrograms per liter.
3. All results are in micrograms per liter.

AOC - Area of Concern
DOD - Department of Defense
EPA - Environmental Protection Agency
GWQS - Groundwater Quality Standard
ND - Not Detected (TCE)
NJDEP - New Jersey Department of Environmental Protection
TCE - Trichloroethylene

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SCALE: *see scale bar
DATE: 2-1-08

TITLE:
GROUNDWATER AOC 3 AND AOC 8: GENERALIZED TCE ISOPLETH MAP AS OF APRIL 2005

FIGURE #: 2-6
DRAWING NUMBER: 05450_GW-ISO-AOC8.mxd
DRAWING LOCATION: K:\Raritan01\RaritanGIS\Mxd\0108_RAWP\

REPORT:
DRAFT - GROUNDWATER
REMEDIAL ACTION WORK PLAN
FEBRUARY 2008

PROJECT: FORMER RARITAN ARSENAL

CLIENT NAME: U.S. ARMY CORPS OF ENGINEERS

MW-130

Parameter	[Criteria]	9/1/1999	1/10/2000	4/25/2000	8/8/2000	11/29/2000	3/20/2001
1,3,5-TRINITROBENZENE	[0]	26 U	1.2 U	1.2 U	0.817	0.26 U	0.26 U
1,3-DINITROBENZENE	[0]	26 U	2.4	1.2 U	3.59	2.85	1.14
2,4,6-TRINITROTOLUENE	[0]	567.9	352	450.3 J	772	470	507
2,4/2,6-DINITROTOLUENES	[10]	--	--	1.2 U	28.7	--	--
2,4-DINITROTOLUENE (VOC)	[10]	26 U	1.2 U	--	--	36	--
2,6-DINITROTOLUENE (VOC)	[10]	766.5	1.2 U	--	--	0.26 U	--
2-AMINO-4,6-DINITROTOLUENE	[0]	8 U	405 J	311.8	413	390	211
2-NITROTOLUENE	[0]	52 U	--	--	--	--	--
3-NITROTOLUENE	[0]	52 U	--	--	--	--	--
4-AMINO-2,6-DINITROTOLUENE	[0]	462.8	328 J	247.8	360	380	253
4-NITROTOLUENE	[0]	52 U	--	--	--	--	--
HMX	[0]	52 U	2.6 U	2.6 U	1.3 U	0.519 U	0.519 U
NITROBENZENE (VOC)	[6]	26 U	1.2 U	1.2 U	0.65 U	0.26 U	--
RDX	[0]	52 U	2.6 U	2.6 UJ	1.3 U	0.519 U	0.519 U
TETRYL	[0]	52 U	2.6 U	2.6 U	1.3 U	0.519 U	0.519 U

MW-123 (Abandoned)

Parameter	[Criteria]	7/17/1998	10/13/1998	9/1/1999	1/10/2000	4/25/2000	8/8/2000	11/29/2000	3/20/2001
1,3,5-TRINITROBENZENE	[0]	0.39 U	1.2 UJ	1.2 U	1.2 U	1.2 U	0.65 U	0.26 U	0.26 U
1,3-DINITROBENZENE	[0]	0.39 U	0.7 J	1 J	1 J	1.2 U	1.43	0.94	0.808
2,4,6-TRINITROTOLUENE	[0]	0.39 U	1.1 J	1.2	1.1 J	1.2 UJ	1.61	0.83	0.26 U
2,4/2,6-DINITROTOLUENES	[10]	--	--	--	--	8	10.7	--	--
2,4-DINITROTOLUENE (VOC)	[10]	1.2	3.8 J	1.2 U	1.2 U	--	--	8.1	--
2,6-DINITROTOLUENE (VOC)	[10]	0.41 U	1.2 UJ	135.3	1.2 U	--	--	0.26 U	--
2-AMINO-4,6-DINITROTOLUENE	[0]	--	47 J	125.7 J+	96.4 J	86.8	133	66	94.1
2-NITROTOLUENE	[0]	--	2.6 UJ	2.6 U	--	--	--	--	--
3-NITROTOLUENE	[0]	--	2.6 UJ	2.6 U	--	--	--	--	--
4-AMINO-2,6-DINITROTOLUENE	[0]	--	14 J	25.1	25.4	25.8	37.1	25.8	22.4
4-NITROTOLUENE	[0]	--	2.6 UJ	2.6 U	--	--	--	--	--
AMINO-DNT'S	[0]	20	--	--	--	--	--	--	--
HMX	[0]	3.4 U	2.6 UJ	2.6 U	2.6 U	2.6 U	1.3 U	0.519 U	0.519 U
NITROBENZENE (VOC)	[6]	0.41 U	1.2 UJ	1.2 U	1.2 U	1.2 U	0.65 U	0.26 U	--
RDX	[0]	1.6 U	2.6 UJ	2.6 U	2.6 U	2.6 UJ	1.3 U	0.519 U	0.519 U
TETRYL	[0]	1.2 U	2.6 UJ	2.6 U	2.6 U	2.6 U	1.3 U	0.519 U	0.519 U

MW-42A

Parameter	[Criteria]	11/14/1994	7/17/1998	10/12/1998	9/1/1999	1/10/2000	4/25/2000	8/8/2000	11/29/2000	3/20/2001
1,3,5-TRINITROBENZENE	[0]	0.2 U	0.2 U	1.2 U	1.3 U	1.2 U	1.2 U	0.65 U	0.26 U	0.26 U
1,3-DINITROBENZENE	[0]	0.2 U	0.2 U	1.2 UJ	1.3 U	1.2 U	1.2 U	0.65 U	0.26 U	0.26 U
2,4,6-TRINITROTOLUENE	[0]	0.2 U	0.2 U	0.4 UJ	0.4 U	1.2 U	1.2 UJ	0.65 U	0.26 U	0.26 U
2,4/2,6-DINITROTOLUENES	[10]	--	--	--	--	--	1.2 U	0.65 U	--	--
2,4-DINITROTOLUENE (VOC)	[10]	0.2 U	0.2 U	1.2 UJ	1.3 U	1.2 U	--	--	0.26 U	--
2,6-DINITROTOLUENE (VOC)	[10]	0.2 U	0.2 U	1.2 U	1.3 U	1.2 U	--	--	0.26 U	--
2-AMINO-4,6-DINITROTOLUENE	[0]	--	--	1.9 J	1.4 J	1.3 J	1 J	1.19	0.743	0.43
2-NITROTOLUENE	[0]	--	--	2.6 UJ	2.6 U	--	--	--	--	--
3-NITROTOLUENE	[0]	--	--	2.6 U	2.6 U	--	--	--	--	--
4-AMINO-2,6-DINITROTOLUENE	[0]	--	--	0.7 J	0.4 U	1.2 U	1.2 U	0.65 U	0.26 U	0.26 U
4-NITROTOLUENE	[0]	--	--	2.6 U	2.6 U	--	--	--	--	--
AMINO-DNT'S	[0]	5.7	1.2	--	--	--	--	--	--	--
HMX	[0]	1.7 U	1.7 U	2.6 UJ	2.6 U	2.6 U	2.6 U	1.3 U	0.519 U	0.519 U
NITROBENZENE (VOC)	[6]	0.2 U	0.2 U	1.2 UJ	1.3 U	1.2 U	1.2 U	0.65 U	0.26 U	--
RDX	[0]	0.87 U	0.78 U	2.6 U	2.6 U	2.6 U	2.6 UJ	1.3 U	[illegible] U	0.519 U
TETRYL	[0]	0.7 U	0.58 U	2.6 UJ	2.6 U	2.6 UJ	2.6 U	1.3 U	0.519 U	0.519 U

MW-124

Parameter	[Criteria]	7/17/1998	10/13/1998	9/1/1999	1/10/2000	4/25/2000	8/8/2000	11/29/2000	3/20/2001
1,3,5-TRINITROBENZENE	[0]	0.2 U	6 U	13 U	1.2 U	1.2 U	0.65 U	0.26 U	0.26 U
1,3-DINITROBENZENE	[0]	7.3	--	7.4 J	8.1	6.7	8.8	7.6	6.97
2,4,6-TRINITROTOLUENE	[0]	0.2 U	--	8	7.5	5.9 J	8.98	7.7	5.16
2,4/2,6-DINITROTOLUENES	[10]	--	--	--	--	49.2	61.7	--	--
2,4-DINITROTOLUENE (VOC)	[10]	62	--	13 U	59.5	--	--	53	--
2,6-DINITROTOLUENE (VOC)	[10]	5	6 U	13 U	1.2 U	--	--	0.26 U	--
2-AMINO-4,6-DINITROTOLUENE	[0]	--	--	314 J+	251 J	183.1	248	261	225
2-NITROTOLUENE	[0]	--	13 U	26 U	--	--	--	--	--
3-NITROTOLUENE	[0]	--	13 U	26 U	--	--	--	--	--
4-AMINO-2,6-DINITROTOLUENE	[0]	--	--	64.3	76	58.8	79.2	85	60.9
4-NITROTOLUENE	[0]	--	13 U	26 U	--	--	--	--	--
AMINO-DNT'S	[0]	340	--	--	--	--	--	--	--
HMX	[0]	1.7 U	13 U	26 U	2.6 U	2.6 U	1.3 U	0.519 U	0.519 U
NITROBENZENE (VOC)	[6]	0.2 U	6 U	13 U	1.2 U	1.2 U	0.65 U	0.26 U	--
RDX	[0]	0.78 U	13 U	26 U	2.6 U	2.6 UJ	1.3 U	0.519 U	0.519 U
TETRYL	[0]	0.58 U	13 U	26 U	2.6 U	2.6 U	1.3 U	0.519 U	0.519 U

MW-76B

Parameter	[Criteria]	11/11/1994	12/13/1994	7/17/1998	10/12/1998	9/1/1999	1/10/2000	4/25/2000	8/8/2000	11/29/2000	3/20/2001
1,3,5-TRINITROBENZENE	[0]	0.2 U	0.2 UJ	0.2 U	1.2 U	1.3 U	1.2 U	1.2 U	0.65 U	0.26 U	0.26 U
1,3-DINITROBENZENE	[0]	0.2 U	0.2 UJ	0.2 U	1.2 UJ	1.3 U	1.2 U	1.2 U	0.65 U	0.26 U	0.26 U
2,4,6-TRINITROTOLUENE	[0]	0.2 U	0.2 UJ	0.2 U	0.4 UJ	0.4 U	1.2 U	1.2 UJ	0.65 U	0.26 U	0.26 U
2,4/2,6-DINITROTOLUENES	[10]	--	--	--	--	--	--	1.2 U	0.65 U	--	--
2,4-DINITROTOLUENE (VOC)	[10]	0.2 U	0.2 UJ	0.2 U	1.2 UJ	1.3 U	1.2 U	--	--	0.26 U	--
2,6-DINITROTOLUENE (VOC)	[10]	0.2 U	0.2 UJ	0.2 U	1.2 U	1.3 U	1.2 U	--	--	0.26 U	--
2-AMINO-4,6-DINITROTOLUENE	[0]	--	--	--	0.4 UJ	0.4 U	1.2 U	1.2 U	0.65 U	0.26 U	0.26 U
2-NITROTOLUENE	[0]	--	--	--	2.6 U	2.6 U	--	--	--	--	--
3-NITROTOLUENE	[0]	--	--	--	2.6 UJ	2.6 U	--	--	--	--	--
4-AMINO-2,6-DINITROTOLUENE	[0]	--	--	--	0.4 UJ	0.4 U	1.2 U	1.2 U	0.65 U	0.26 U	0.26 U
4-NITROTOLUENE	[0]	--	--	--	2.6 U	2.6 U	--	--	--	--	--
AMINO-DNT'S	[0]	0.39 U	0.39 UJ	0.39 U	--	--	--	--	--	--	--
HMX	[0]	1.7 U	1.7 UJ	1.7 U	2.6 UJ	2.6 U	2.6 U	2.6 U	1.3 U	0.519 U	0.519 U
NITROBENZENE (VOC)	[6]	0.2 U	0.2 UJ	0.2 U	1.2 UJ	1.3 U	1.2 U	1.2 U	0.65 U	0.26 U	--
RDX	[0]	0.87 U	0.87 UJ	0.78 U	2.6 U	2.6 U	2.6 U	2.6 UJ	1.3 U	0.519 U	0.519 U
TETRYL	[0]	0.7 U	0.7 UJ	0.58 U	2.6 UJ	2.6 U	2.6 U	2.6 U	1.3 U	0.519 U	0.519 U

MW-17 (Abandoned)

Parameter	[Criteria]	11/15/1994
1,3,5-TRINITROBENZENE	[0]	0.2 U
1,3-DINITROBENZENE	[0]	0.2 U
2,4,6-TRINITROTOLUENE	[0]	0.2 U
2,4-DINITROTOLUENE (VOC)	[10]	3.8
2,6-DINITROTOLUENE (VOC)	[10]	0.53
AMINO-DNT'S	[0]	22
HMX	[0]	1.7 U
NITROBENZENE (VOC)	[6]	0.2 U
RDX	[0]	0.87 U
TETRYL	[0]	0.7 U

MW-76A

Parameter	[Criteria]	11/10/1994	12/13/1994
1,3,5-TRINITROBENZENE	[0]	0.2 U	0.2 U
1,3-DINITROBENZENE	[0]	0.2 U	0.2 U
2,4,6-TRINITROTOLUENE	[0]	0.2 U	0.2 U
2,4-DINITROTOLUENE (VOC)	[10]	0.2 U	0.2 U
2,6-DINITROTOLUENE (VOC)	[10]	0.2 U	0.2 U
AMINO-DNT'S	[0]	0.39 U	0.39 U
HMX	[0]	1.7 U	1.7 U
NITROBENZENE (VOC)	[6]	0.2 U	0.2 U
RDX	[0]	0.87 U	0.87 U
TETRYL	[0]	0.7 U	0.7 U

Legend

●	AOC 9 Monitoring Well Location, Sampled March/April 2005
●	AOC 9 Monitoring Well Location, Not Sampled March/April 2005
🟢	AOC 9 Shallow Groundwater Screening Sample Location - See Figure 15
●	Other Monitoring Well Location
●	Other Shallow Groundwater Screening Sample Location
☐	Groundwater AOC 9 Boundary (as of 2005)
🟧	Soil Investigation Area Boundary
🟥	DOD Source Removal Area
▭	VOC Analytical Results For Monitoring Well Sampled In 2005
···–··	Surface Water
426	Building Number
Area10	Soil Investigation Area
AOC9	Groundwater AOC (as of 2005)
TRICHLOROETHYLENE (TCE)	Compound concentration exceeding the NJDEP Class IIA GWQS for the last groundwater sample event the location was sampled.
13	Concentration exceeds the NJDEP Class IIA GWQS.

Notes

1. The criteria listed are the NJDEP Class IIA GWQS.
2. The results and criteria are in micrograms per liter.
3. Data included in the analytical text boxes begin with the July 1998 groundwater sampling event. This event was the first of eight quarterly groundwater sampling events. Text boxes include all groundwater sample events from July 1998 to April 2005. If an event is not listed, the location was not sampled during that event. If a monitoring well is shown and it does not have a text box then that location was sampled prior to the July 1988 groundwater sampling event, sampled for parameters other than VOCs, or was never sampled.
4. The compound list is Groundwater AOC-specific. The compound list includes those compounds detected in at least one groundwater monitoring well sample starting with the July 1998 groundwater sampling event for the associated Groundwater AOC.

AOC - Area of Concern
DOD - Department of Defense
GWQS - Groundwater Quality Standard
J - Estimated Concentration
NJDEP - New Jersey Department of Environmental Protection
MDL - Method Detection Limit
U - Not detected at MDL listed
VOC - Volatile Organic Compounds

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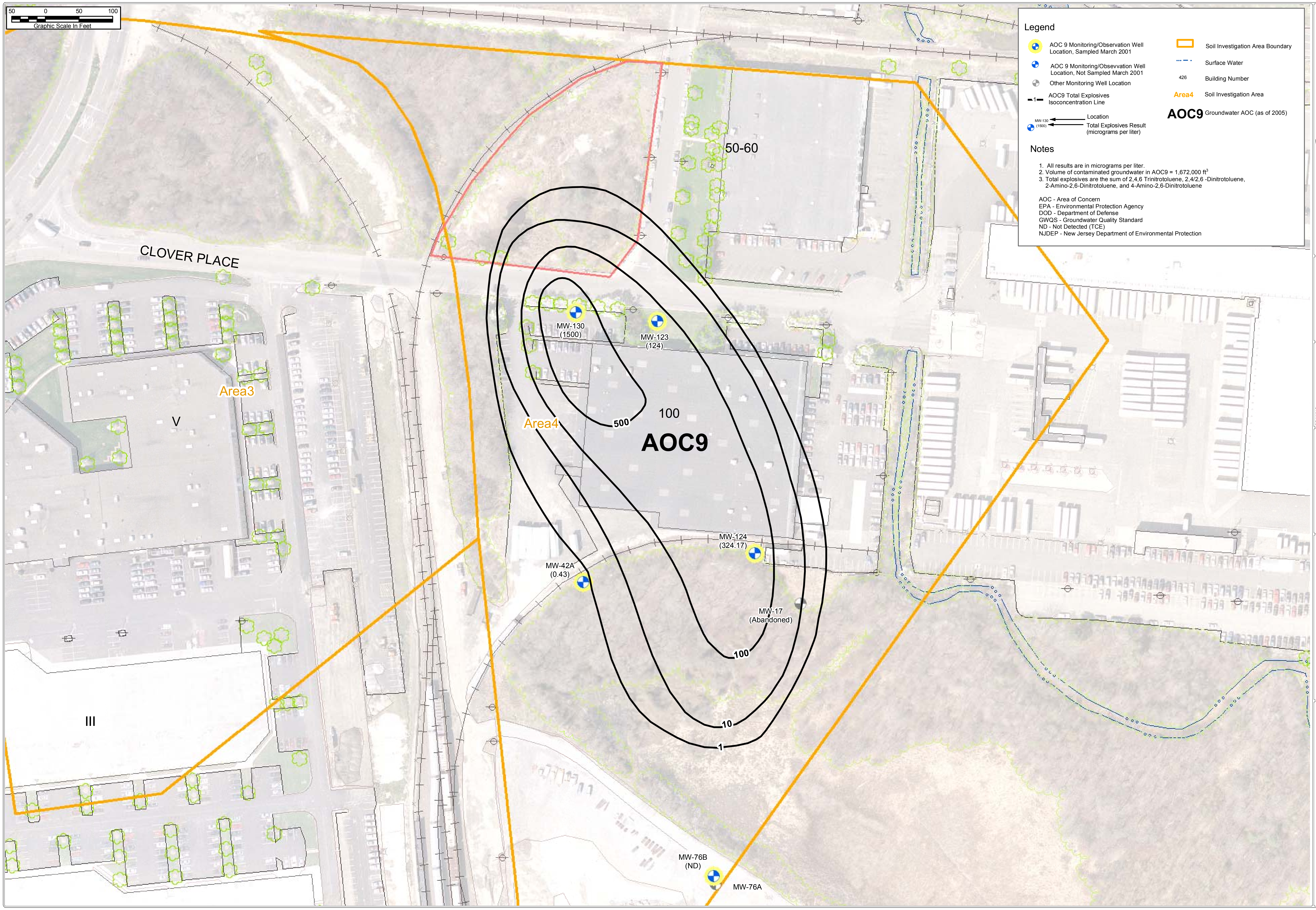
DATE CREATED:	8-1-2007
DRAWING:	05451_GW-AOC9.mxd
PATH:	K:\Raritan01\RaritanGIS\Mxd\0108_RAWP\
REVISION No.	0
WORK ORDER No.	03886.110.027.0005
REPORT NAME:	DRAFT - GROUNDWATER REMEDIAL ACTION WORK PLAN FEBRUARY 2008
CLIENT NAME:	U.S. ARMY CORPS OF ENGINEERS
PROJECT NAME:	FORMER RARITAN ARSENAL
DRAWING TITLE:	GROUNDWATER AOC 9: COMPARISON OF THE DETECTED EXPLOSIVES TO THE NJDEP CLASS IIA GWQS NOVEMBER 1994 TO MARCH 2001
FIGURE:	2-7
SCALE:	*see scale bar
DATE:	2-1-08



Legend

●	AOC 9 Monitoring/Observation Well Location, Sampled March 2001
●	AOC 9 Monitoring/Obsevvation Well Location, Not Sampled March 2001
●	Other Monitoring Well Location
▬1▬	AOC9 Total Explosives Isoconcentration Line
MW-130 ←	Location
(1500) ←	Total Explosives Result (micrograms per liter)
▭	Soil Investigation Area Boundary
··· — ·	Surface Water
426	Building Number
Area4	Soil Investigation Area
AOC9	Groundwater AOC (as of 2005)

Notes

1. All results are in micrograms per liter.
2. Volume of contaminated groundwater in AOC9 = 1,672,000 ft^3
3. Total explosives are the sum of 2,4,6 Trinitrotoluene, 2,4/2,6 -Dinitrotoluene, 2-Amino-2,6-Dinitrotoluene, and 4-Amino-2,6-Dinitrotoluene

AOC - Area of Concern
EPA - Environmental Protection Agency
DOD - Department of Defense
GWQS - Groundwater Quality Standard
ND - Not Detected (TCE)
NJDEP - New Jersey Department of Environmental Protection

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DATE CREATED:	8-24-2007
DRAWING:	05452_GW-ISO-AOC9.mxd
PATH:	K:\Raritan01\RaritanGIS\Mxd\0108_RAWP\
REVISION No.	0
WORK ORDER No.	03886.110.027.0005
REPORT NAME:	DRAFT - GROUNDWATER REMEDIAL ACTION WORK PLAN FEBRUARY 2008
CLIENT NAME:	U.S. ARMY CORPS OF ENGINEERS
PROJECT NAME:	FORMER RARITAN ARSENAL
DRAWING TITLE:	GROUNDWATER AOC 9: GENERALIZED TOTAL EXPLOSIVES ISOPLETH MAP AS OF MARCH 2001
FIGURE:	2-8
SCALE:	*see scale bar
DATE:	2-1-08

N
W
E
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MW-129

Parameter	[Criteria]	10/20/1998	10/20/1998	8/27/1999	1/14/2000	1/14/2000	5/1/2000	5/1/2000	5/1/2000	5/1/2000	8/11/2000	8/11/2000	12/5/2000	12/5/2000	3/26/2001	3/26/2001	4/1/2005
1,1,1-TRICHLOROETHANE	[30]	10 U	10 U	5 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	0.3 U
2-BUTANONE	[300]	10 U	10 U	5 U	5 U	5 U	5 U	2 J	5 U	2 J	5 U	5 U	5 U	5 U	5 U	5 U	0.9 U
BROMODICHLOROMETHANE	[1]	2 U	2 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	0.3 U
CARBON DISULFIDE	[800]	6.4 J	10 U	5 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	0.2 U
CHLOROFORM	[6]	1 J	1.1 J	1.2 J	1 U	1 U	1 U	1 U	1 U	1 U	1.01	0.99 J	0.98 J	1.1	1.11	1.04	4.6
CHLOROMETHANE	[30]	10 U	10 U	2 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	3.29 U	3.82 U	1 U	1 U	0.4 U
CIS-1,2-DICHLOROETHENE	[70]	61	68	26	33.8	33.6	23	25.3	23	25.3	25.4	24.3	18.2	22.2	16	15.8	6
TETRACHLOROETHYLENE	[1]	2 U	2 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	0.4 U
TRANS-1,2-DICHLOROETHENE	[100]	10 U	10 U	5 U	0.2 J	0.2 J	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	0.3 U
TRICHLOROETHYLENE (TCE)	[1]	160	170	39	43.9	42.2	32.2	37.1	32.2	37.1	32	30.7	21.3	26.2	26.5	26.4	13

MW-131

Parameter	[Criteria]	8/31/1999	1/14/2000	5/1/2000	8/11/2000	12/5/2000	3/23/2001	4/1/2005
1,1,1-TRICHLOROETHANE	[30]	10 U	0.6 J	1 U	1 U	1 U	1 U	0.6 U
2-BUTANONE	[300]	10 U	5 U	5 U	5 U	5 U	5 U	1.8 U
BROMODICHLOROMETHANE	[1]	2 U	1 U	1 U	1 U	1 U	1 U	0.6 U
CARBON DISULFIDE	[800]	10 U	1 U	1.9 U	1 U	1 U	1 U	0.5 U
CHLOROFORM	[6]	10 U	1 U	1 U	1.05	0.73 J	0.89 J	3.5
CHLOROMETHANE	[30]	4 U	1 U	1 U	1 U	2.03 U	1 U	0.8 U
CIS-1,2-DICHLOROETHENE	[70]	54	53.4	30 J-	55 J	98.8	78.2 J	82
TETRACHLOROETHYLENE	[1]	2 U	0.2 J	1 U	1 U	1 U	1 U	0.7 U
TRANS-1,2-DICHLOROETHENE	[100]	10 U	1 U	1 U	0.51 J	1 U	1 U	6.7
TRICHLOROETHYLENE (TCE)	[1]	1500	1200	520.4 J	692	838	397 J	210

MW-150

Parameter	[Criteria]	4/1/2005
1,1,1-TRICHLOROETHANE	[30]	0.3 U
2-BUTANONE	[300]	0.9 U
BROMODICHLOROMETHANE	[1]	0.3 U
CARBON DISULFIDE	[800]	0.2 U
CHLOROFORM	[6]	0.3 U
CHLOROMETHANE	[30]	0.4 U
CIS-1,2-DICHLOROETHENE	[70]	0.4 U
TETRACHLOROETHYLENE	[1]	0.4 U
TRANS-1,2-DICHLOROETHENE	[100]	0.3 U
TRICHLOROETHYLENE (TCE)	[1]	0.4 U

MW-149

Parameter	[Criteria]	4/1/2005
1,1,1-TRICHLOROETHANE	[30]	0.3 U
2-BUTANONE	[300]	0.9 U
BROMODICHLOROMETHANE	[1]	0.8
CARBON DISULFIDE	[800]	0.2 U
CHLOROFORM	[6]	8.3
CHLOROMETHANE	[30]	0.4 U
CIS-1,2-DICHLOROETHENE	[70]	6.3
TETRACHLOROETHYLENE	[1]	0.4 U
TRANS-1,2-DICHLOROETHENE	[100]	0.3 U
TRICHLOROETHYLENE (TCE)	[1]	54

MW-132

Parameter	[Criteria]	9/21/1999	1/14/2000	5/1/2000	8/11/2000	12/5/2000	3/26/2001	4/1/2005
1,1,1-TRICHLOROETHANE	[30]	5 U	1 U	1 U	1 U	1 U	1 U	0.3 U
2-BUTANONE	[300]	5 U	5 U	3 J	5 U	5 U	5 U	0.9 U
BROMODICHLOROMETHANE	[1]	1 U	1 U	1 U	1 U	1 U	1 U	0.3 U
CARBON DISULFIDE	[800]	5 U	1 U	1.6 U	1 U	1 U	1 U	0.2 U
CHLOROFORM	[6]	5 U	1 U	1 U	1 U	1 U	1 U	0.3 U
CHLOROMETHANE	[30]	2 U	1 U	0.9 J	1 U	17 U	1.44	0.4 U
CIS-1,2-DICHLOROETHENE	[70]	5 U	1 U	1 U	1 U	1 U	1 U	0.4 U
TETRACHLOROETHYLENE	[1]	1 U	1 U	1 U	1 U	1 U	1 U	0.4 U
TRANS-1,2-DICHLOROETHENE	[100]	5 U	1 U	1 U	1 U	1 U	1 U	0.3 U
TRICHLOROETHYLENE (TCE)	[1]	1 U	1 U	1 U	1 U	1.19	1 U	0.4 U

Legend

●	AOC 10 Monitoring Well Location, Sampled March/April 2005
●	AOC 10 Monitoring Well Location, Not Sampled March/April 2005
🟢	AOC 10 Shallow Groundwater Screening Sample Location - See Figure 15
●	Other Monitoring Well Location
●	Other Shallow Groundwater Screening Sample Location
▭	Groundwater AOC 10 Boundary (as of 2005)
🟨	Soil Investigation Area Boundary
🟥	DOD Source Removal Area
··– ··	Surface Water
426	Building Number
Area10	Soil Investigation Area
AOC10	Groundwater AOC (as of 2005)
TRICHLOROETHYLENE (TCE)	Compound concentration exceeding the NJDEP Class IIA GWQS for the last groundwater sample event the location was sampled.
13	Concentration exceeds the NJDEP Class IIA GWQS.
▭	VOC Analytical Results For Monitoring Well Sampled In 2005

Notes

1. The criteria listed are the NJDEP Class IIA GWQS.
2. The results and criteria are in micrograms per liter.
3. Data included in the analytical text boxes begin with the July 1998 groundwater sampling event. This event was the first of eight quarterly groundwater sampling events. Text boxes include all groundwater sample events from July 1998 to April 2005. If an event is not listed, the location was not sampled during that event. If a monitoring well is shown and it does not have a text box then that location was sampled prior to the July 1988 groundwater sampling event, sampled for parameters other than VOCs, or was never sampled.
4. The compound list is Groundwater AOC-specific. The compound list includes those compounds detected in at least one groundwater monitoring well sample starting with the July 1998 groundwater sampling event for the associated Groundwater AOC.
5. Volume of contaminated groundwater in AOC10 = 2,379,000 ft^3

AOC - Area of Concern
DOD - Department of Defense
GWQS - Groundwater Quality Standard
J - Estimated Concentration
NJDEP - New Jersey Department of Environmental Protection
MDL - Method Detection Limit
U - Not detected at MDL listed
VOC - Volatile Organic Compounds

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DATE CREATED: 8-1-2007
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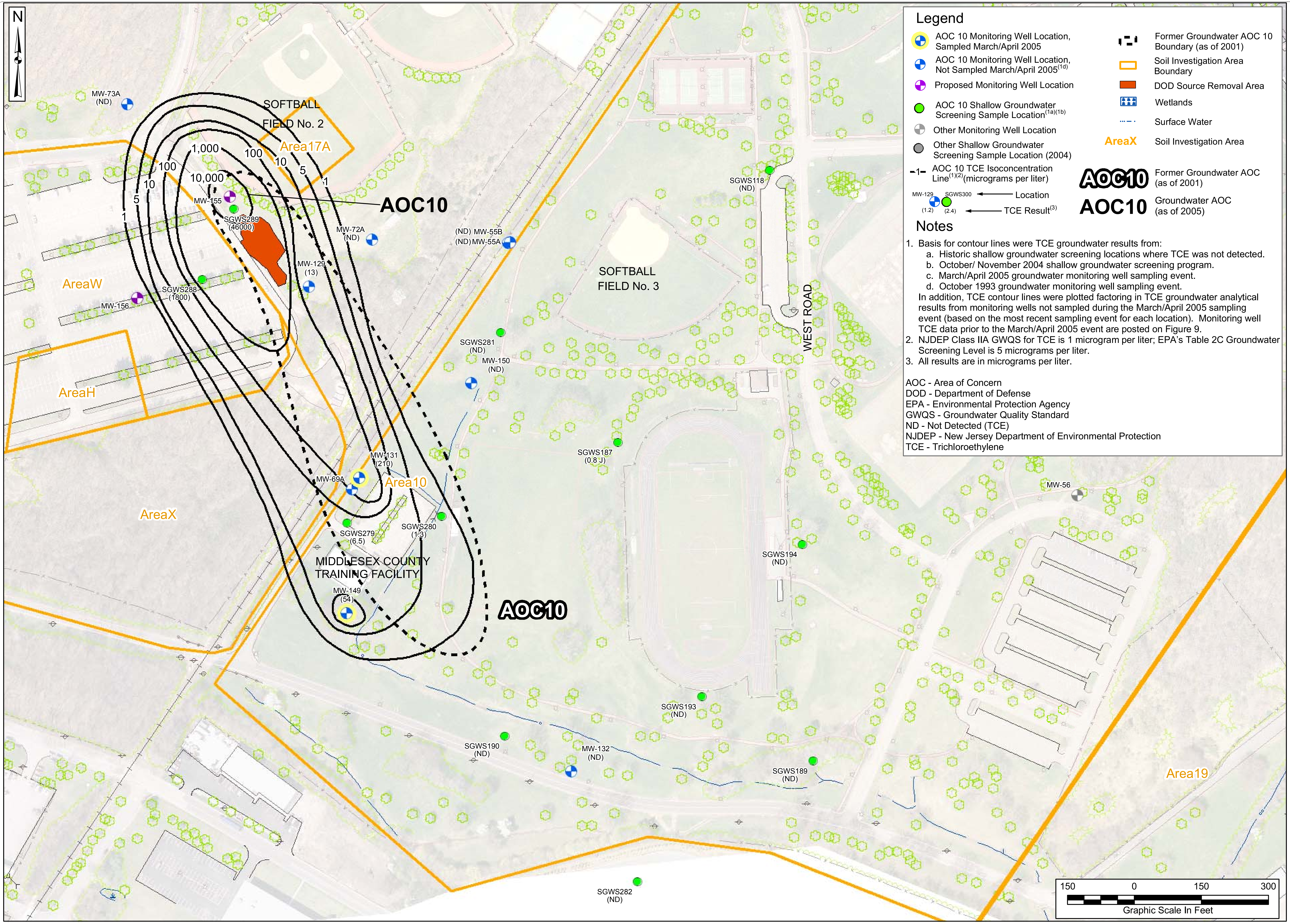
PATH: K:\Raritan01\RaritanGIS\Mxd\0108_RAWP\
REVISION No.: 0
WORK ORDER No.: 03886.110.027.0005
REPORT NAME: DRAFT - GROUNDWATER REMEDIAL ACTION WORK PLAN FEBRUARY 2008
CLIENT NAME: U.S. ARMY CORPS OF ENGINEERS
PROJECT NAME: FORMER RARITAN ARSENAL
DRAWING TITLE: GROUNDWATER AOC 10: COMPARISON OF THE DETECTED VOC LIST TO THE NJDEP CLASS IIA GWQS JULY 1998 TO APRIL 2005
DATE: 2-1-08
SCALE: See scale bar
FIGURE: 2-9



Legend

●	AOC 10 Monitoring Well Location, Sampled March/April 2005
●	AOC 10 Monitoring Well Location, Not Sampled March/April 2005(1d)
●	Proposed Monitoring Well Location
●	AOC 10 Shallow Groundwater Screening Sample Location(1a)(1b)
●	Other Monitoring Well Location
●	Other Shallow Groundwater Screening Sample Location (2004)
-1-	AOC 10 TCE Isoconcentration Line(1)(2)(micrograms per liter)
MW-129 SGWS300	Location
(1.2) (2.4)	TCE Result(3)
▭	Former Groundwater AOC 10 Boundary (as of 2001)
▭	Soil Investigation Area Boundary
🟥	DOD Source Removal Area
▨	Wetlands
··· – ·	Surface Water
AreaX	Soil Investigation Area
AOC10	Former Groundwater AOC (as of 2001)
AOC10	Groundwater AOC (as of 2005)

Notes

1. Basis for contour lines were TCE groundwater results from:
   a. Historic shallow groundwater screening locations where TCE was not detected.
   b. October/ November 2004 shallow groundwater screening program.
   c. March/April 2005 groundwater monitoring well sampling event.
   d. October 1993 groundwater monitoring well sampling event.

   In addition, TCE contour lines were plotted factoring in TCE groundwater analytical results from monitoring wells not sampled during the March/April 2005 sampling event (based on the most recent sampling event for each location). Monitoring well TCE data prior to the March/April 2005 event are posted on Figure 9.
2. NJDEP Class IIA GWQS for TCE is 1 microgram per liter; EPA's Table 2C Groundwater Screening Level is 5 micrograms per liter.
3. All results are in micrograms per liter.

AOC - Area of Concern
DOD - Department of Defense
EPA - Environmental Protection Agency
GWQS - Groundwater Quality Standard
ND - Not Detected (TCE)
NJDEP - New Jersey Department of Environmental Protection
TCE - Trichloroethylene

WESTON SOLUTIONS
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DRAWN BY: J. LYNES
REVIEWED BY: R. COSTA
PROJECT MANAGER: P. BOVITZ
SCALE: *see scale bar
DATE: 2-1-08

TITLE:
GROUNDWATER AOC 10: GENERALIZED TCE ISOPLETH MAP AS OF APRIL 2005

FIGURE #: 2-10
DRAWING NUMBER: 05454_GW-ISO-AOC10.mxd
DRAWING LOCATION: K:\Raritan01\RaritanGIS\Mxd\0108_RAWP\

REPORT:
DRAFT - GROUNDWATER
REMEDIAL ACTION WORK PLAN
FEBRUARY 2008

PROJECT: FORMER RARITAN ARSENAL

CLIENT NAME: U.S. ARMY CORPS OF ENGINEERS

Notes

1. Monitoring well MW-153 is an EPA well that was adopted as part of the USACE 2004-2005 Site-Wide Groundwater Investigation.
2. Monitoring wells MW-133 through MW-137 were installed in 2004 as part of the 18E Supplemental Investigation.
3. Shallow groundwater screening locations completed in 2004-2005 as part of the 18E Investigation and Groundwater AOC 8-EPA Building Investigation are not depicted on this figure.

AOC - Area of Concern
DOD - Department of Defense
EPA - Environmental Protection Agency
USACE - United States Army Corps of Engineers

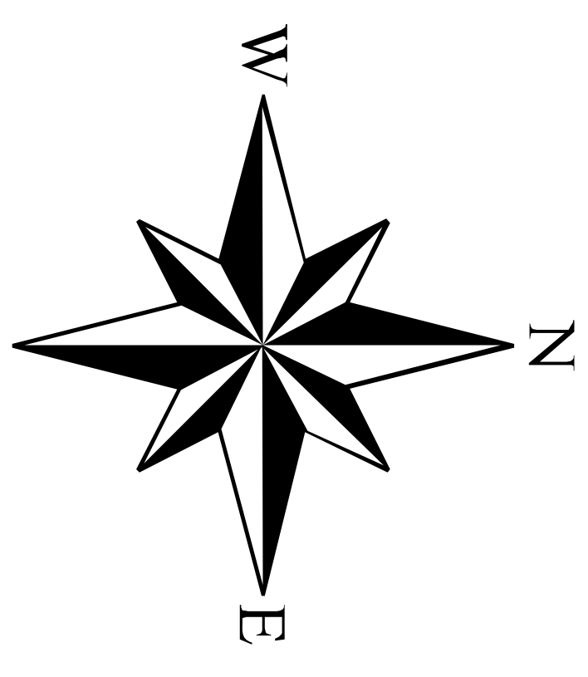
DRAWING TITLE:
PROPOSED SITE-WIDE CLASSIFICATION
EXCEPTION AREA BOUNDARY
AND LONG-TERM COMPLIANCE POINTS

REPORT NAME:
DRAFT - GROUNDWATER
REMEDIAL ACTION WORK PLAN
FEBRUARY 2008

CLIENT NAME:
UNITED STATES ARMY
CORPS OF ENGINEERS

PROJECT NAME:
FORMER RARTIAN ARSENAL

FIGURE: 3-1
SCALE: *see scale bar
DATE: 2-1-08



REPORT DATE: FEBRUARY 2008
DRAWING PATH: 05455_Sitemap.mxd
K:\Raritan01\RaritanGIS\
Mxd\0108_RAWP\
REVISION No. 0
WORK ORDER No. 03886.110.027.0005

PROJECT MANAGER: PAUL BOVITZ
CHECKED BY: RALPH COSTA
DRAWN/MODIFIED BY: STEVE POULTNEY
DATE CREATED: 7-31-07

Weston Solutions, Inc.
205 Campus Drive Edison, New Jersey 08837-3939
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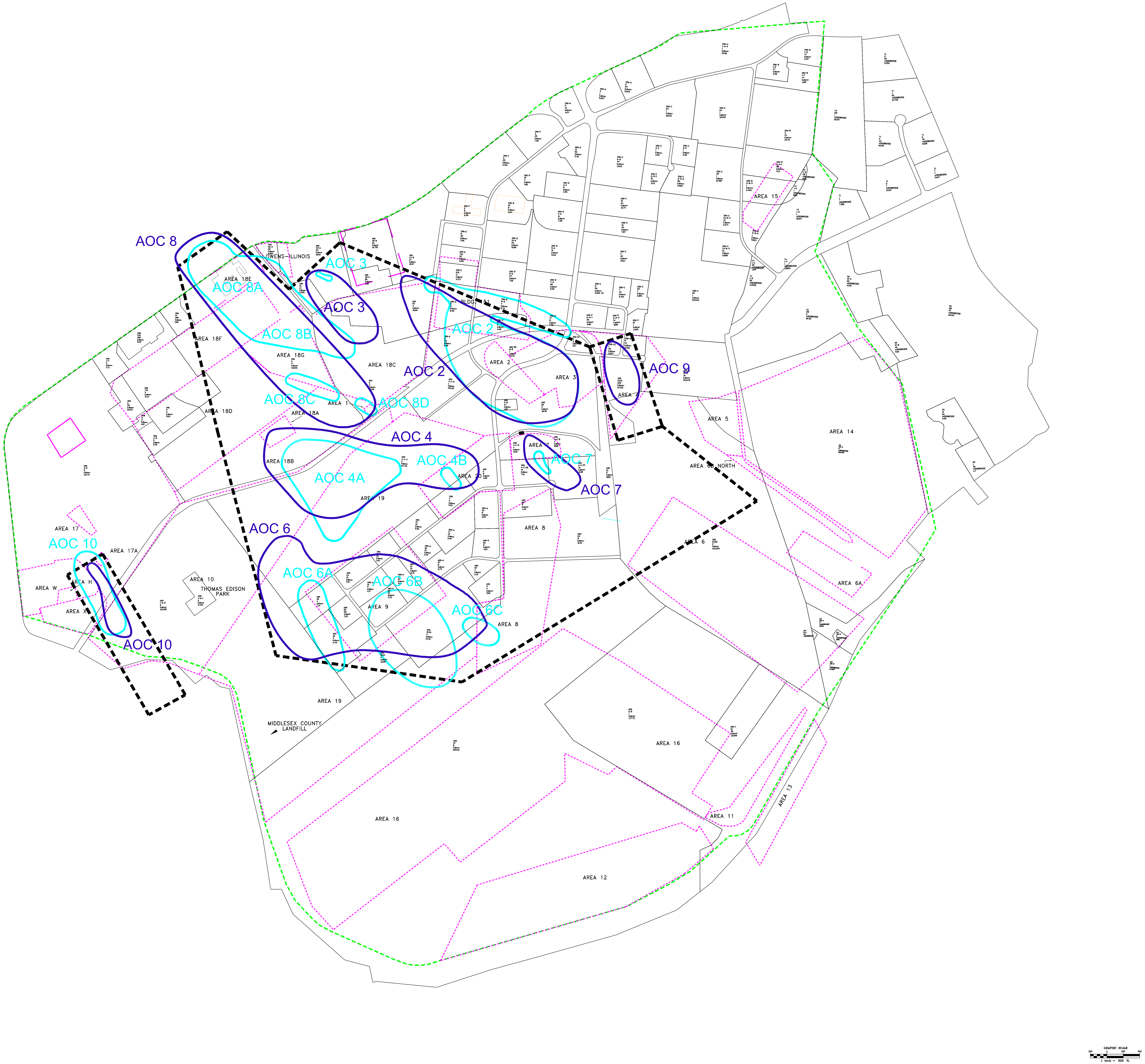

LEGEND:

APPROXIMATE GROUNDWATER AOC AS OF 2005

APPROXIMATE GROUNDWATER AOC AS PER THE JUNE 1999 GROUNDWATER MONITORING REMEDIAL ACTION WORK PLAN

ARSENAL BOUNDARY

INVESTIGATION AREAS

PROPOSED CLASSIFICATION EXCEPTION AREA BOUNDARIES

395 — BLOCK
1-2 — LOT
0 — OWNER#
EDISON — TOWNSHIP
100.00 — ACREAGE

NOTE:

ALL PROPERTY BOUNDARIES ARE APPROXIMATED.

THIS MAP WAS PRODUCED FROM TAX MAPS SUPPLIED BY THE LOCAL MUNICIPALITIES DATED 06-07. PROPERTIES HAVE NOT BEEN GROUND TRUTHED AND REPRESENT AN APPROXIMATE LOCATION OF THE PROPERTY BOUNDARIES.

THE EXTENT OF GROUNDWATER AOCs IS APPROXIMATE, BASED ON INTERPRETATION OF AVAILABLE SHALLOW GROUNDWATER SCREENING AND MONITORING WELL SAMPLING RESULTS.

THIS SITE MAP HAS BEEN ADAPTED FROM A PHOTOGRAMETRIC BASE MAP OF THE FORMER RARITAN ARSENAL PREPARED BY GEOD CORPORATION (12/22/92 OVER FLIGHT PHOTOGRAPHY) UNDER SUBCONTRACT TO WESTON.

THE APPROXIMATE BOUNDARY OF GROUNDWATER AOC 10 HAS BEEN REDRAWN TO INCLUDE MW-131 AS REQUIRED BY THE NJDEP IN JANUARY 2000.

N

SEAL

N.J. PROFESSIONAL ENGINEER
No. 00000

CLIENT NAME:

U.S. ARMY CORPS OF ENGINEERS

PROJECT NAME:

DRAFT
GROUNDWATER REMEDIAL ACTION
WORK PLAN - FEBRUARY 2008

EDISON, NEW JERSEY

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DRAWING TITLE:

PROPOSED SITE-WIDE CLASSIFICATION EXCEPTION AREA WITH TAX MAP BOUNDARIES

WORK ORDER No.:	03886.110.027.0005	PROJECT MANAGER:	P. BOVITZ		
DRAWN BY:	S. POULTNEY	CHECKED BY:	R. COSTA		
DRAWING NAME:	05456_BecrRarMap.dwg	DIRECTORY/ FOLDER:	K:\Raritan01\RarGIS\Cad\0807_GWRAWP\		
CONTRACT No.:	DAC-A31-00-D0023	DELIVERY ORDER No.:	56		
SCALE:	*see scale bar on map	REPORT DATE:	FEBRUARY 2008		
DATE:	2-1-08	REVISION No.:	0	FIGURE No.:	3-2

APPENDIX A

State of New Jersey
Department of Environmental Protection

James E. McGreevey
Governor

Bradley M. Campbell
Commissioner

James T. Moore
USACE New York District
190 Route 18, Suite 202
East Brunswick, New Jersey 08816

MAR 12 2003

Re: Draft Final Groundwater Natural Attenuation Report (July 2002)
Former Raritan Arsenal Site
Edison and Woodbridge, Middlesex County, New Jersey

Dear Mr. Moore:

The New Jersey Department of Environmental Protection (NJDEP or Department) has completed review of the above-referenced document that was prepared on behalf of the United States Army Corps of Engineers (USACE) by Roy F. Weston, Inc. (Weston) of Edison, New Jersey. The subject document is conditionally approved pending incorporation of the following NJDEP comments into a report addendum.

NJDEP COMMENTS

General Comments

1. Based on the plume characteristics of AOC Plume 9 (Area 4 TNT) and AOC Plume 10 (Area W drum dump), surface water monitoring is required downgradient of these areas.

2. For purposes of assessing surface water quality as part of the proposed groundwater monitoring network, sample results are compared against the Oak Ridge National Laboratories (ORNL) Tier II surface water quality criteria rather than the NJDEP Surface Water Quality Standards (N.J.A.C. 7:9B). In accordance with N.J.A.C. 7:26E, Technical Requirements for Site Remediation (Technical Rules), the NJDEP Surface Water Quality Standards or the Federal Surface Water Quality Criteria (40 CFR Part 131), whichever are more stringent, shall be used to determine compliance. If a NJDEP Surface Water Quality Standard or Federal Surface Water Quality Criterion is unavailable for a specific compound or element of concern, use of the ORNL criteria may be proposed as appropriate.

3. The highest reported total VOC concentrations in surface water were detected at location SW06-1 with results ranging from 10 to 90 ug/l. Similarly, sampling conducted at this location during the 1995-1996 Site-Wide Surface Water Investigation detected one of the highest concentrations of total VOCs at that time with TCE reported at 20 ug/l. Surface water sample location SW06-1 is situated within the northern portion of a large ponded area immediately south of Area 9. Since sample results from the closest groundwater monitoring well MW-48 which is located 300 to 400 northeast of SW06-1 does not indicate any

significant impact to surface water, further investigation is required in an upgradient and/or upland direction to evaluate potential source areas.

4. Extremely high concentrations of total VOCs (up to 13 mg/l) reported in groundwater samples from well MW-114 indicate a potential concern for indoor air contamination for buildings located within the immediate vicinity of this well. In accordance with the Technical Rules, specifically N.J.A.C. 7:26E-6.3(d)7, groundwater contamination natural attenuation proposals shall include evaluation for potential vapor risks to any receptors. Information regarding the current and future use of Buildings 151, 165 and any other buildings located proximate to well MW-114 shall therefore be provided for NJDEP review. The current groundwater contaminant concentrations have implications for any future site development directly over the plume, particularly in areas where total VOCs are reported at 1 mg/l or higher.

5. Benzene is present in the AOC 4 plume located downgradient of the Area 18A waste disposal pit and therefore may be related to former DOD operations. The Department agrees, however, that chlorobenzene does not appear to be related to former DOD operations based on site information available at this time.

6. The Department strongly recommends that focused in-situ soil and/or groundwater treatment be considered in former, significant source areas to promote reduction of contaminant concentrations within reasonable timeframes (i.e., Building 256 leachfield and associated buried waste areas, Area W, etc.).

Specific Comments

1. Section 2.1, page 2-1. The last sentence on page 2-1 states that "The CEA/WRA is expected to remain in effect until groundwater contaminants no longer exceed GWQS." By definition, the CEA/WRA ***must*** remain in effect until the contaminants no longer exceed the GWQS. The text shall therefore be corrected appropriately.

2. Section 3.2.3.4, page 3-26. The fifth bullet incorrectly refers to well MW-90B as a sentinel well for AOC 4. Well MW-90B is located over 3,500 feet from AOC 4 in a general sidegradient position and therefore cannot be considered as a sentinel well for AOC 4.

3. Section 3.2.4.1, page 3-28. The text incorrectly refers to wells MW-54 and MW-90B as sentinel wells for AOC 6. Well MW-90B is located approximately 1,500 feet from AOC 6 and is at least partially sidegradient of groundwater flow. Although well MW-54 had been designated as a sentinel well for AOC 6, contaminant contours on Figure 5-1 now indicate that well MW-54 is a fringe well.

4. Section 3.2.6.4, page 3-38. The last bullet cites that lack of contaminants in sentinel wells is evidence of adequate natural attenuation. However, the absence of contaminants in the AOC 8 sentinel wells is more likely due to the fact that groundwater is discharging to the stream prior to reaching any sentinel well. As discussed in Section 3.2.6.2, TCE was detected in every surface water sample collected within AOC 8. Furthermore, the well located most

downgradient of the AOC 8 plume, well MW-8, contains significantly elevated concentrations of VOCs including TCE reported at 103 ug/l in the most recent sample. Well MW-8 is located proximate to surface water sample SW-8-06.

5. Section 3.2.2, page 3-46. The proposed monitoring well network as shown on Figure 5-1 is insufficient for purposes of the CEA. Several additional wells shall be proposed within the CEA boundary, particularly in areas where source removal has not been completed such as Building 256, Buildings 14, 15 and 19, DDA 1 and 2, TNT in soil at AOC 9, and residual soil contamination at AOC 10.

6. Section 3.3.2.1, page 3-47. The text incorrectly states that well MW-15 is in a suitable location to ***continue*** (emphasis added) serving as a sentinel well. The text shall therefore be corrected to clarify that well MW-15 has only been sampled once and has not been used as a sentinel well. Furthermore, the proposed natural attenuation monitoring program does not propose sampling of well MW-15 as a sentinel well. The Department recommends that sampling of well MW-15 be included as part of the natural attenuation monitoring program.

7. Section 3.3.2.4, page 3-48. The CEA calculations indicate that TCE is the main contaminant dictating the duration and distance of the CEA and that due to the relatively flat water table, the plume would only travel 77 feet past well MW-48B. However, Figure 3-23 shows that the plume is already between 1,500 and 3,000 feet long and the contaminant contours for the eighth round of groundwater samples shows the plume 500 feet past MW-48B. These discrepancies shall be further discussed and/or corrected in the text.

8. Section 3.3.2.6, page 3-49. The text states that TCE from AOC 8 would extend 1,707 feet to a location within AOC 4 and well MW-89A is referenced as a sentinel well. However, well MW-89A is located 300 feet downgradient of well MW-8 that reported TCE at a concentration of 103 ug/l in the most recent sample. See also previous Comment No. 4 regarding groundwater contaminant discharge to the stream in AOC 8.

9. Section 4.0, page 4-4. Further information shall be provided regarding the contaminants of concern at former Buildings 14, 15 and 19. The USACE proposes additional investigation and possible remediation in these areas.

10. Section 4.1, page 4-4. The text states that "The TCE concentrations in well MW-114 are expected to drop after additional source material is removed." As discussed in previous Comment No. 5, several additional wells are required within the CEA boundary, particularly in areas where source removal has not been completed.

11. Section 4.2, page 4-6 and 4-7. It is premature to conclude that surface water contamination is conclusively below ecological benchmarks because (1) not all areas that require monitoring have been sampled and therefore data gaps exist; (2) the NJDEP Surface Water Quality Standards have been exceeded at several locations across the site; and (3) a full assessment of explosives residues in surface water and sediment has not yet been conducted. Additional surface water and sediment sampling is required as further detailed in the Department's

forthcoming comment letter regarding the May 2002 Screening Level Ecological Risk Assessment.

12. Section 5.1, page 5-1. The proposal to use three existing wells and five new sentinel wells for long-term groundwater compliance monitoring is insufficient. The eight proposed wells are spaced approximately 1,000 to 2,000 feet apart and encompass the known extent of the plumes as well as the projected extent of contaminant migration. Since projected contaminant migration was calculated using conservative assumptions, the sentinel wells are located thousands of feet downgradient of some contaminant plumes. Pursuant to the Technical Rules, specifically 7:26E-6.3(e)1i4, sentinel wells shall be located no further than five years travel time from the delineated downgradient extent of the contaminant plume. Pollutant transport rates are provided in Table 3-8 of the Technical Rules and shall be used to modify the proposed long-term groundwater compliance monitoring network by including additional interior CEA sentinel wells.

13. Section 5.1, page 5-1. The second paragraph states that the "USACE proposes to not include source or plume wells in its long-term monitoring plan, since the purpose of these wells is to monitor short-term conditions at source areas that have undergone or have planned removal actions." As discussed in the previous Comment No. 10, interior sentinel wells are required as part of the long-term groundwater compliance monitoring program for ongoing evaluation of source areas to ensure that contaminant plumes are naturally attenuating (i.e., contaminant plumes are diminishing) consistent with the estimated CEA calculations. The second paragraph also states that the "USACE will work with NJDEP to discuss focused short-term monitoring at selected source areas to verify reduction levels following completed or planned source removal." These wells shall be proposed consistent with previous Comment Nos. 5, 9 and 10, and shall be provided as part of the report addendum.

14. Section 5.2.2, page 5-4. Pursuant to the Technical Rules, specifically 7:26E-6.3(e)3ii(1), additional remediation is required if contaminant concentrations in a sentinel well exceed applicable standards. As stated in the text, if there is a confirmed exceedance of an applicable standard in a sentinel well, the USACE proposes to move the compliance point further downgradient through installation of an additional sentinel well downgradient of the plume. This approach is inconsistent with the Department's CEA requirements and therefore unacceptable. In addition, contingency triggers shall also include the discovery of new DOD-related source areas and the failure of interior area monitoring wells to show a reduction in primary contaminant concentrations. The latter indicates an ongoing source of contamination requiring remediation.

15. Section 5.2.3, page 5-5. The text states that "As soon as sufficient data have been collected to demonstrate that natural attenuation has achieved the applicable GWQS, USACE will request approval from NJDEP that remediation for the site has been successfully completed." Based on the proposed eight sentinel wells that are located several thousand feet downgradient of the fringe of the plumes and significantly further downgradient from suspected source areas, it would be expected that these sentinel wells will remain free of VOCs for several years. The lack of VOC in these distant wells, however, will not confirm

that the GWQS have been achieved throughout the CEA. As previously discussed, interior CEA well monitoring is required.

16. Section 5.2.3, page 5-5. The text includes that "If, after a sufficient period of time, the monitoring data demonstrates the attenuation of the contaminants has subsided and USACE and NJDEP concur that remedial objectives are not being achieved, contingency measures would be implemented as presented in Subsection 5.4. USACE would in any case demonstrate achievement of protection of the environmental and human health." Clarification of the USACE's assertion of the latter shall be provided.

If you have any questions regarding the Department's comments, please feel free to contact me at 609-633-1478 or via email at *trish.conti@dep.state.nj.us*.

Patricia A. Conti

Patricia A. Conti, Case Manager
Bureau of Case Management

c:
James Kelly, USACE
Anne Hayton, NJDEP
Dave Van Eck, NJDEP
Nancy Hamill, NJDEP

naturalattenuation.1/3-03

29 September 2006

Anthony Cinque, Case Manager
New Jersey Department of Environmental Protection
Bureau of Case Management, 5th Floor
401 East State Street, CN-028
Trenton, NJ 08625-0028

**Re: Response to NJDEP Comment Letter received 06 May 2006
on the Draft Supplemental Groundwater Data Report,
Groundwater AOCs 2, 3, 4, 6, 7, 8 and 10
Former Raritan Arsenal Site, Edison, New Jersey**

Dear Mr. Cinque:

The United States Army Corps of Engineers (USACE) has reviewed your letter received on 6 May 2006 containing New Jersey Department of Environmental Protection (NJDEP) comments on the *Draft Supplemental Groundwater Data Report, Groundwater AOCs 2, 3, 4, 6, 7, 8 and 10* dated 14 October 2005. USACE's response to the various NJDEP comments is provided in the attached document. The NJDEP comments have been italicized.

If you have any questions, please give me a call at (732) 435-0079.

Very truly yours,

James T. Moore, CPG
Project Manager

Attachments

cc: J. Kelly, USACE
P. Bovitz, Weston

ATTACHMENT A
RESPONSE TO NJDEP COMMENT LETTER RECEIVED 06 MAY 2006
DRAFT SUPPLEMENTAL GROUNDWATER DATA REPORT, GROUNDWATER AOCS 2, 3, 4, 6, 7, 8 AND 10 DATED 14 OCTOBER 2005

Specific Comments:

Comment #1: *Executive Summary: With regard to the evaluation of groundwater contamination in relation to the potential building vapor intrusion pathway, the July 2005 NJDEP Vapor Intrusion Guidance is to be used.*

> **Response:** Future submittals, in which groundwater contamination is evaluated in relation to the existence of a potential building vapor intrusion pathway, will utilize the NJDEP Vapor Intrusion Guidance (VIG). However, please note that the conclusions presented in the Draft Supplemental Groundwater Data Report would not be affected by comparing them to VIG groundwater screening criteria, since the revised plume boundaries are based on the 1 ug/L (NJDEP Class IIA GWQS) TCE isoconcentration contour, which is equivalent to the VIG groundwater screening level for TCE.

Comment #2: *Section 4.1, Evaluation of Groundwater AOC Plume Boundaries: The NJDEP is unsure as to why the main portion of former AOC 8 is now AOC 8A/B. The USACE proposes separate remedial actions for AOC 8A and AOC 8B in Section 5.2. If there are two separate source areas creating overlapping plumes A and B, perhaps a Separate AOC 8A and AOC 8B should be delineated.*

> **Response:** Since the low-concentration portions of Groundwater AOCs 8A and 8B merge together, and the plume boundaries as shown on Figure 3 are based on the 1 microgram per liter (ug/L) trichloroethylene isoconcentration line (correlating to its Groundwater Quality Standard/Vapor Intrusion Groundwater Screening level), Groundwater AOC 8A and 8B appear as a single plume on this figure. Figures 2, 3 and 11 have been revised to show Groundwater AOCs 8A and 8B more clearly (see Attachment B).

Comment #3: *Section 4.1.5, Groundwater AOC 7, page 4-12 and 4-13: The USACE contends that since the groundwater samples collected by OBG in 1988 and 1989 had no VOCs, and VOCs were detected in sampling performed in 1989 and 1994, the groundwater contamination would likely be from a non-DOD source. The NJDEP cannot concur with this assessment at this time. OBG wells MW-10 and MW-12 were up and sidegradient of the Area 7 sources. The sole downgradient well, MW-11, may not have been in the ideal location to monitor for potential groundwater contamination. Soil samples collected within Area 7 detected contamination, but as the area has been an active PSE&G fleet maintenance yard, the origin of the contamination is not clear.*

> **Response:** USACE has not found any evidence to date indicating the contamination within AOC 7 is related to former DOD activities. However, USACE agrees to collect a groundwater sample from MW-59 to confirm the downward VOC concentration trend in

Groundwater AOC 7. This sampling will be performed in the next 30 days. The following information is provided to support USACE's contention that the contamination detected in Groundwater AOC 7 is not related to DOD activities.

Records indicate that during the 1963 decontamination effort performed by Letterkenny Army Depot (LEAD) in Area 7, trenches and sewer lines were excavated, ammunition cleaned out, and approximately 7,000 cubic yards of "dirt mixed with small arms cartridge cases and projectiles" plus "residue scrap metal" was removed and transported to Area 3. The depositional area of the 7,000 cubic yards was investigated as part of the Phase II RI in Area 3 and VOC contamination was not identified within this material.

OBG installed and sampled three monitoring wells (MW-10, MW-11, and MW-12) in Area 7 during 1988. In addition, soil samples were collected from three soil borings, two of which were located within the former suspected TNT sump/tank area. The results of OBG soil sampling did not detect contaminants at concentrations exceeding the most stringent NJDEP soil cleanup criteria. All compounds were present at concentrations below the NJDEP GWQS during the 1988 groundwater sampling of MW-10, MW-11, and MW-12. VOCs were not detected in any of the groundwater samples collected by OBG.

Dames & Moore conducted a soil gas survey over a large portion of Area 7, including locations remote from the known location of past DOD activity (TNT sump/tank area), but throughout the current PSE&G maintenance yard. Dames & Moore also advanced six soil borings, installed one overburden groundwater monitoring well (MW-59), and sampled MW-10, MW-11, MW-12, and MW-59 during 1992. The analytical groundwater results indicated that MW-11 and MW-59 contained concentrations of benzene, chlorobenzene, 1,1-DCA, 1,1,2,2-tetrachloroethane, TCE, and vinyl chloride exceeding the GWQS. Four of the six soil borings were installed within the former TNT sump area and the sampling of these borings did not detect VOCs at concentrations exceeding the most stringent NJDEP soil cleanup criteria. The results of the Dames & Moore soil gas survey indicated that chlorinated VOCs were not detected in the sampling points installed in the vicinity of the historical DOD activity (TNT sump). Two soil boring locations were selected based on the results of the soil gas survey. Sample location B7-1 contained concentrations of PCE and xylene exceeding the NJDEP soil cleanup criteria; however, the location of boring B7-1 was remote from the TNT sump.

Additional soil and groundwater analytical results indicate that the contamination associated with groundwater AOC 7 is not related to former DOD activities. The results of the 1989 OBG (VOCs undetected in groundwater) and 1992 Dames & Moore (VOCs detected in groundwater) sampling indicate that a recent VOC release impacted groundwater quality. The results of soil sampling within potential DOD source areas (TNT sump and former aboveground storage tank) did not identify any significant VOC contamination, indicating that these areas of concern are not the source of Groundwater AOC 7.

Comment #4: *Page 4-2: In the discussion on GW AOC 2, the USACE suggests that a "separate and/or partially contributing" source to groundwater contamination may exist in the vicinity of* *buildings 165, 151 and 160. To date (and despite several rounds of investigations to identify alternate sources) no evidence of an alternate soil or groundwater source has been found. In addition, for former Army Buildings 255 and 256, the magnitude of the soil contamination (TCE and PCE in the thousands of ppm) and groundwater contamination (up to 3000 ppb) that historically existed in Area 18C is expected to garner the greatest percentage of chlorinated solvent impact on groundwater over other potential sources of these contaminants that may exist in the area.*

> **Response:** The suggestion was made as one hypothesis. The report text discussed another as well, that groundwater flow has taken two separate paths. For clarification purposes, "several rounds of investigations," as referenced in the comment above, were not conducted to identify alternate sources, but to identify the extent of the primary source of contamination for Groundwater AOC 2 located within Area 18C: the Area 18C-Building 256 Ramp Area. As described in the *Draft Supplemental Groundwater Data Report*, USACE conducted limited soil sampling under Building 165 during the installation of subslab vapor probes in late July/August 2003. The results of this sampling indicated low levels of PCE in soils under the floor slab of the building. The presence of PCE in soils under Building 165, coupled with the presence of floor drains under this building, and the results from grab groundwater sampling around the building suggests the potential presence of other VOC (e.g., TCE) contaminant sources under the building. The comment is otherwise noted.

Comment #5: *The USACE states that an alternate TCE source may exist in this area due to the following: evidence of historical floor drains in Building 165 former non-DOD uses of this building and observations of higher VOCs in groundwater south of this building, along with a possible "split" plume configuration. However, at this point the existence of an alternate source is not well supported. With regard to plume characteristics, the current concentration gradient may be explained by disturbances at this Area 18C source area (two separate removal actions of large volumes of soil) and the presence of intermittent clay lenses.*

> **Response:** Comment noted. Based on treatability testing performed to date, USACE is considering an active remedial strategy to address VOC contamination in AOC 2 groundwater which will likely include a natural attenuation component and a CEA. USACE expects to issue a Groundwater RAWP describing the selected remedial strategy, and will move forward with the implementation of the selected remedial approach.

Comment #6: *It is noted that for evaluation of groundwater plume AOC 3, only one monitoring well was used to evaluate this plume and TCE levels up to 90 ppb were consistently found. It is noted that for evaluation of groundwater plume AOC 7, the former Source area well, MW-59 was not tested. A stronger evaluation of this plume would include more recent data from this well.*

> **Response:** The wells proposed for monitoring were described in a workplan submitted to and approved by NJDEP. Monitoring well MW-115 has been used to evaluate VOC concentrations in groundwater plume AOC 3, as well as data from shallow groundwater screening points SGWS173, SGWS290, and SGWS291.

As shown on Figure 5, historic TCE concentrations within Groundwater AOC 3 have only marginally exceeded the NJDEP Class IIA GWQS for TCE of 1 ug/L. USACE requests clarification on NJDEP's reference to TCE concentrations up to 90 ppb being found in the groundwater AOC 3 plume.

As stated earlier, the USACE agrees to collect a groundwater sample from MW-59 to confirm that the contamination present within Groundwater AOC 7 is comprised of non-DOD-related contaminants. This sampling will be performed within 30 days.

Comment #7: *Section 4.2, General Evaluation of Natural Attenuation - Original Groundwater AOC 7, page 4-18: The report states "the previous plume monitoring well MW-59 was not sampled as part of this investigation. However, the results from well MW-11 indicated that no contaminants were detected above the NJDEP GWQS." While the NJDEP acknowledges these statements, the section omits the continued presence of contamination (chlorobenzene, benzene, TCE) in well MW-59 and does not discuss the presence or absence of natural attenuation observed in past investigations. In later sections, the USACE contends that the groundwater contamination is most likely from a non-DOD source.*

Response: Per the *Draft Groundwater AOC Delineation Work Plan and Site-Specific Sampling and Analysis Plan* (August 2004), MW-59 was not sampled under the recent investigation. The referenced concentrations of chlorobenzene and benzene in MW-59 are not DOD-related. The last recorded TCE concentration (March 2001) was 6.19 micrograms per liter (ug/L) compared to a maximum concentration of 25 ug/L measured in December 1999. As noted above, there has been no known DOD source identified that would account for this contamination, but USACE will sample MW-59 within 30 days to confirm the downward VOC concentration trend in Groundwater AOC 7.

Comment #8: *Section 4.2, General Evaluation of Natural Attenuation - Original Groundwater AOC 8, page 4-18: The USACE proposes to decommission well MW-8 and replace it with an equivalent well proximate to that location. The USACE reasons that "a review of the groundwater results from MW-8 indicates the water quality has fluctuated greatly over time" and that "a new well may provide more reproducible results." The NJDEP has no objection to the decommissioning and replacement of MW-8, but does not concur with the rationale. The groundwater data from MW-8 provided in Figure 5, shows consistent groundwater quality among the nine sampling rounds collected between 1998 and 2005. Levels of TCE have been consistently in the same order of magnitude (between 99 and 140 ug/l) and low levels of cis-1,2-DCE were also regularly reported.*

Response: Comment noted. USACE may opt to decommission and replace MW-8. USACE plans to issue a Groundwater RAWP describing the selected remedial strategy for AOC 8D.

Comment #9: *Section 4.3, Evaluation of Groundwater Concentrations in Relation to Indoor Air Quality: The NJDEP July 2005 Vapor Intrusion Guidance document should have been used for this portion of the report. Since it was not, this section requires revision to incorporate the*

NJDEP indoor air guidelines. Tables should be developed which indicate per plume: 1) sample locations within 100 feet of a building which exceed NJDEP groundwater to indoor air screening levels (Table 1 of the NJDEP Vapor Intrusion Guidance document) along with a listing of such buildings and 2) sample locations within 100 feet of a building which exceed rapid action screening criteria (Table 2 of the NJDEP Vapor Intrusion Guidance document) along with a listing of threatened buildings.

> **Response:** At the time the preliminary draft of the report was prepared, the VIG had not been finalized. The text discussion has since been superseded by the *Draft Indoor Air Quality Semi-Annual Report #2* dated September 2006 which the NJDEP has received under separate cover. As a result, USACE will not be revising or re-issuing the text or tables in this report. The NJDEP VIG has been used to evaluate the vapor intrusion pathway for all buildings that lie within a 100-foot radius of the newly defined groundwater boundaries, similar to that which was conducted for Groundwater AOC 4A and 4B and for Groundwater AOC 6A, 6B, and 6C in the 23 January 2006 work plans for subslab soil gas, indoor air and subslab soil sampling.

Comment #10: *The document should clearly present the numerical screening level used for assessment of groundwater concentrations in relation to vapor intrusion evaluations. The November 2002 USEPA Table 2C GW screening level for TCE is 5 ppb. However, the July 2005 NJDEP Groundwater Screening Level for Vapor Intrusion for TCE is 1 ppb. The latter should be used.*

> **Response:** The revised groundwater AOC plume boundaries are based on the NJDEP Class IIA GWQS for TCE of 1 ug/L. The NJDEP vapor intrusion groundwater screening level for TCE, as presented in Table G-1 of the VIG, is also 1 ug/L; therefore, the redefined groundwater plume boundaries, and the approach for evaluating buildings for vapor intrusion within 100 feet of these redefined plume boundaries, would not change through the use of the VIG groundwater screening level for TCE.

Comment #11: *In addition, the USACE are using the previously approved rule of "50 times" the November 2002 USEPA Table 2C GW screening level as an indication of immediate action. However, since the issuance of the NJDEP July 2005 Vapor Intrusion Guidance document, Rapid Action Screening levels are provided in Table 2 and should be used/referenced accordingly.*

> **Response:** USACE has passed the point of prioritizing buildings for an expedited evaluation of vapor intrusion as all of the buildings have been evaluated. Subslab soil gas and/or indoor air sampling has already been conducted for those buildings considered a priority for such evaluations based on the procedure identified in the agreed-upon *Approach for Evaluating Potential Indoor Air Quality Impacts, Former Raritan Arsenal* (21 September 2004).

Comment #12: *AOC 2: Figure 4 refers the reader to Figure 16 for data on temporary shallow wells. However, the data is found on Figure 10. Correction is needed and all figures and text* *should be reviewed for appropriate labeling. Buildings 20 and 33 warrant further evaluation in relation to the AOC 2 plume.*

> **Response:** The figures will be corrected and re-issued. Since the report was issued, two rounds of subslab soil gas and indoor air sampling have been conducted at Buildings 20 (20 Northfield Avenue) and 33 (Campus Plaza 7). The results of the October 2004 sampling event were provided in the *Draft Indoor Air Quality Semi-Annual Report, Former Raritan Arsenal* dated November 2005. The findings of the winter 2006 vapor intrusion investigations have been provided in the *Draft Indoor Air Quality Semi-Annual Report #2* dated September 2006 submitted to NJDEP.

Comment #13: *Section 5: For those GW AOCs which USACE is seeking No Further Action (NFA) approval based on potential non-DOD sources, justification beyond reported use of solvents at a nearby non- DOD facility is needed.*

> **Response:** The comment implies that an NFA request has been made solely on the basis of reported solvent use by others. As a point of clarification, the NFA requests are based on a lack of documented DOD uses in the areas, coupled with information suggesting the chemicals may have been used by others. USACE has specifically requested No Further Action for Groundwater AOC 3, Groundwater AOC 4B, Groundwater AOC 6B, and Groundwater AOC 7. Additional supporting information for each of these plumes is provided in the responses to the specific Groundwater AOC comments, below.

Comment #14: *Section 5.1, AOCs Requiring No Further Action, pages 5-1 to 5-3: The USACE requests NFA for several AOC plumes, as discussed below.*

> **Response:** Please see the responses for each groundwater AOC plume below.

Comment #15: *Groundwater AOC 3: The plume size was scaled back because downgradient wells and SGWS locations were essentially clean. The one well within this plume (MW-l5)* [sic] *has predominantly 1,1,1-TCA at levels, which are not reducing. In this report the USACE is dismissing this whole plume as a non-DOD issue. Unless the USACE can submit detailed evidence of the non-DOD source, at least one additional downgradient well is recommended. Since contamination levels (111-TCA) are not reducing, that suggests a potential ongoing source. In the Draft Indoor Air Quality Evaluation (February 2005), Section 3.2.2.1 states that a potential source of the contamination in the groundwater AOC 3 plume is an area located on the property owned by Owens Illinois. The Archival Search Report (1993) included a statement from a former Arsenal employee indicating that residual wastes that accumulated in the TCE degreasing vats in Building 15 were buried approximately 500 yards east of Building 15 corresponding to present day Owens Illinois property.*

> **Response:** The concentrations of 1,1,1-trichloroethane (1,1,1-TCA) detected in MW-115 ranged from 37.8 ug/L (December 2000) to 89 ug/L (July 1998), which is two orders of magnitude lower than its vapor intrusion groundwater screening level of 2,300 ug/L (per the March 2006 NJDEP VIG Table 1). Likewise, the concentrations of 1,1-dichloroethene detected in MW-115 were well below (8.14 ug/L in August 2000 to 17

ug/L in March 2005) its vapor intrusion groundwater screening level of 250 ug/L. The concentrations of trichloroethylene detected in MW-115 were either below the GWQS/groundwater screening level of 1 ug/L or marginally exceeded it on a sporadic basis. USACE recommends NFA for Groundwater AOC 3 based on the following facts:

- The plume size has been adequately delineated and its size scaled back based on recent data;
- There are no groundwater receptors; and
- Vapor intrusion is not of concern since VIG groundwater screening levels have not been exceeded (or, in the case of trichloroethylene, have been marginally exceeded but on a sporadic basis).

USACE believes that the source of contamination within Groundwater AOC 3 is not DOD-related. Several investigations have been conducted in this area, and no evidence has been found to verify the anecdotal "evidence" cited by NJDEP regarding the presence of a waste burial area in the vicinity of the southern wall of the Owens-Illinois building. Specifically, we investigated all known potential sources in the referenced area during the Supplemental Remedial Investigation (SRI) and found no evidence of a DOD source of the plume.

Please note that many industrial processes and operations use 1,1,1-TCA for a variety of cleaning, degreasing and other operational needs (EPA *Technical Fact Sheet for 1,1,1-Trichloroethane Hazards and Alternatives*, October 2000, EPA 905-F-00-026). Common uses, among others, are as follows: vapor degreasing of metal products; cleaning precision instruments; lubricant in metal cutting oils; as a solvent in drain cleaners, shoe polishes, spot cleaners, insecticides and printing inks; printing press cleaning. Common industries that may use 1,1,1-TCA are manufacturers of fabricated metal parts, metal finishers, electronic components, fasteners, and medical equipment. Furthermore, 1,1,1-TCA is commonly used in the glass manufacturing industry. Per the EPA Office of Compliance Sector Notebook Project, *Profile of the Stone, Clay, Glass, and Concrete Products Industry*, September 1995, EPA/310-R-95-017, "Glass plant maintenance wastes include solvents generated in the forming process, furnace slag, and refractory wastes…1,1,1-TCA may also be used during the forming process to remove a thin layer of graphite coating that is applied to the glass forms or molds." Two industrial entities that may have used 1,1,1-TCA as part of their manufacturing or operational processes are located in the vicinity of Groundwater AOC 3. These entities are Owens-Illinois (a glass packaging manufacturer) and Rimex Metals (a metals manufacturer).

Comment #16: *Groundwater AOC 4B: The USACE notes that there is an upgradient non-DOD source (150,000 gallon spill of waste oils and organic solvents at the Petroleum Chemical Technology facility in 1980, near former Building 455). The investigation and cleanup of the spill was handled by the USEPA (ID#NJD980529606) and the NJDEP has no documentation regarding this issue. If the USACE wants to support that there is a non-DOD source here, supporting information must be provided. A reducing trend in contaminant levels has been observed in well MW-122, and there is evidence of natural degradation. The NJDEP would* *allow monitored natural attenuation at AOC 4B. The USACE would remain responsible unless persuasive documentation of the non-DOD source is provided.*

> **Response:** USACE submitted a letter (from H. Farrell McMillan, Chief, USACE Engineering/Planning Division) dated May 4, 2006 to NJDEP that attached information from NJDEP files documenting the historical use and subsequent release of oily liquid and chlorinated solvents during the September 1980 vandalism at the former Petroleum Chemical Technology facility. A copy of that letter is provided as Attachment C.
>
> While USACE still believes that the contamination within Groundwater AOC 4B is from a non-DOD source, the USACE will agree to monitor the plume on a long term basis, consistent with CERCLA, to confirm decreasing contaminant concentration trends in Groundwater AOC 4B.

Comment #17: *Groundwater AOC 6B: The USACE contends that the TCE in the groundwater in AOC 6B is from Garden State Builders (104 Sunfield Avenue). According to the NJDEP records, the case was handled within the NJDEP's Bureau of Underground Storage Tanks, with KCSL ID # NJL600098313 (discharge case 91-12-30-1746). A 3,000 gallon leaded UST was removed in December of 1991 and groundwater contamination was discovered. The case was given an NFA in March 1996. It appears that the UST case involved BTEX compounds, and not TCE. If the USACE wants to support that there is a non-DOD source here, they will have to provide more supporting information.*

> **Response:** Since the groundwater report was submitted, an evaluation was performed of the potential for vapor intrusion at several buildings (104 Sunfield, 107 Sunfield, and 97 Sunfield) in the vicinity of the Groundwater AOC 6B footprint. This investigation was conducted in accordance with the *Proposed Work Plan For Subslab Soil Gas, Indoor Air and Subslab Soil Sampling; Addendum to Groundwater AOC 6A, 6B, and 6C* (23 January 2006). Based on the findings of the investigations, no evidence of a complete vapor intrusion pathway was identified at any of these buildings. The findings of the indoor air investigation were submitted in September 2006 under separate cover. This determination that there are no receptors associated with Groundwater AOC 6B further corroborates the conclusion that No Further Action is appropriate for this plume.
>
> Regarding the source of the plume, based on information identified in the *Archival Search Report* (Dames and Moore, 1992) and through evaluation of the Environmental Monitoring Systems Laboratory (EMSL) historical aerial photographs, Army use of Area 9, which encompasses the footprint of Groundwater AOC 6B, was limited to storage of various grades of explosives and ammunition in magazines. There is no evidence of solvent storage or use by the Army within Area 9. The fact that other parties have used the property, resulting in spills, provides evidence that another source could exist.

Comment #18: *Groundwater AOC 7: This plume size was scaled back. The downgradient wells and SGWS locations were also mainly clean, with a few low-level hits of TCE. The main contaminated well (MW-59) was sampled frequently in the past, but was not included in the latest round. Since the main contaminant is chlorobenzene, the USACE is dismissing this plume* *as a non-DOD source. The NJDEP has concurred in the past that chlorobenzene does not appear to be a DOD-related contaminant.*

Response: Comment noted. See prior responses.

Comment #19: *Areas Outside Groundwater AOC Boundaries: The USACE requests no further action for VOCs and BN compounds in Area 12 (well MW-152), lead in Area 18BG (well MW-148), and VOCs in the area of the former MCC UST (well MW-151). The data in Table 22 support the request, showing little or no contamination. The NJDEP concurs with the request, with the understanding that the three subject wells cannot fully represent groundwater conditions across the respective Areas of Concern. The Areas of Concern would need to be revisited in the event additional DOD related sources are discovered.*

Response: Comment noted.

Comment #20: *Section 5.2, AOCs to be incorporated into a Groundwater RA WP, pages 5-3 to 5-6: This section of the report briefly discusses the groundwater AOCs that will receive additional attention. The USACE states that "a groundwater RAWP will be prepared and submitted at a later date under separate cover." The proposal should follow the Technical Requirements for Site Remediation, specifically N.J.A.C. 7:26E-6.3(d) et seq. The NJDEP will defer substantive comment until the RAWP is submitted, however the following preliminary comments are provided.*

Response: Comment noted.

Comment #21: *Groundwater AOC 8A and B: Groundwater AOC 8A and 8B are not distinct on the figures, except possibly Figure 11. The USACE propose separate remedial actions for AOC 8A and AOC 8B. If there are two separate source areas creating overlapping plumes A and B, perhaps a separate AOC 8A and AOC 8B should be represented on the figures.*

Response: Comment noted. Figures have been revised and are provided as Attachment B. See response to comment re: Section 4.1, Evaluation of Groundwater AOC Plume Boundaries.

Comment #22: *Groundwater AOC 8D: The USACE proposes Monitored Natural Attenuation (MNA) for this area. As stated in this section, "the TCE concentrations in groundwater have been fluctuating between 99 ug/l and 140 ug/l since July 1998; a trend cannot be established." Without a demonstrated decreasing trend, MNA cannot be approved.*

Response: Comment noted. As stated previously, USACE may decommission and replace MW-8. Please see previous response to Comment #8.

Comment #23: *Groundwater AOC 10: While there have been reducing levels of groundwater contamination following the source removal activities, this section states that "most of the remaining contamination at this site is situated below the water table." This remaining ongoing source should be addressed before a MNA proposal is accepted.*

Response: Since (1) significant source removal has occurred; (2) decreasing contaminant trends have been observed in groundwater; and (3) there are no receptors at risk for exposure to Groundwater AOC 10-related VOCs, USACE recommends the monitored natural attenuation remedial approach for Groundwater AOC 10.

In 2005, Shaw Environmental, Inc. (Shaw), under contract to USACE, performed an evaluation of remedial alternatives for the residual contamination, including that below the water table, associated with Area W. Shaw's findings were reported in *Technical Evaluation of Remedial Alternatives for Area W – Final Report* (December 14, 2005), a copy of which is provided as Attachment D. The remedial alternatives evaluated included air sparging combined with soil vapor extraction, in-situ chemical oxidation using permanganate, in-situ thermal desorption, excavation with off-site disposal of soils, and monitored natural attenuation for groundwater with a deed notice for soils. The remedial alternatives were evaluated against the criteria of effectiveness, implementability, and cost.

Shaw recommended that monitored natural attenuation for groundwater with a deed notice for soils be selected as the remedy for the contamination associated with Area W for the following reasons:

- A significant portion of the source area was previously remediated via soil excavation;
- Most of the remaining contamination in Area W lies below the water table; therefore, a deed notice would be effective at protecting human health by controlling access to the area of concern; and
- Natural groundwater attenuation has been documented within the Groundwater AOC 10 plume.

Another factor supporting the proposal for MNA for Groundwater AOC 10 is the lack of receptors for the constituents within this plume. Drinking water and irrigation wells are not installed within or downgradient from the plume, and therefore no exposure pathway for groundwater exists. The groundwater does not discharge to surface water or wetland areas within the footprint of the plume, thereby no potential ecological receptors would be impacted.

Finally, analytical results from two subslab soil gas/indoor air sampling events, conducted at the only building (Middlesex County Training Facility) within a 100-foot radius of the plume, show that vapor intrusion of groundwater constituents into indoor air is not occurring.

Comment #24: *Section 5.3, IAQ Prioritization: The Indoor Air Quality evaluation must be conducted by incorporating the NJDEP July 2005 Vapor Intrusion Guidance document. Once this is done appropriate priorities can be established for existing buildings on site.*

Response: See previous comment responses.

RA13-01207-AABB

State of New Jersey
DEPARTMENT OF ENVIRONMENTAL PROTECTION

JON S. CORZINE
Governor

LISA P. JACKSON
Commissioner

Bureau of Case Management
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January 12, 2007

James T. Moore
USACE New York District
190 Route 18, Suite 202
East Brunswick, NJ 08816

NOTICE OF DEFICIENCY

Re: Draft Indoor Air Quality Semi-Annual Report #2:
Former Raritan Arsenal
Edison Township, Middlesex County, New Jersey
SRP PI# 006021

Dear Mr. Moore:

The Department acknowledges receipt on September 8, 2006 of the Draft Indoor Air Quality Semi-Annual Report #2 submitted pursuant to the Department of Defense State Memorandum of Agreement (DSMOA) executed on April 3, 1992 and the Technical Requirements for Site Remediation at N.J.A.C. 7:26E.

General Comments:

Groundwater Area of Concern 2

Building 165: The USACE recommends continued semi-annual monitoring. A subslab ventilation system has been operating here since approximately September 2004. The NJDEP concurs.

Building 150: This building is located immediately north of Building 160. Initial subslab data indicate the presence of PCE and TCE, however, other non-DOD contaminants are also present in even higher concentrations. Toluene has been found in groundwater and subslab soil gas samples. Toluene is not considered to be related to former Department of Defense (DOD) operations. This portion of the case has been referred to the NJDEP's Office of Wellfield Remediation for further evaluation.

Campus Plaza III: The USACE recommends no further action. The NJDEP concurs for the DOD-related issues as neither PCE nor TCE have been detected in subslab or indoor air samples. However, 1,4-dichlorobenzene was detected at elevated levels in all four indoor air samples and is not considered to be DOD related, therefore this issue should be addressed by the current building owner/operator. This issue has been referred to the NJDEP's Office of Wellfield Remediation for further evaluation.

Campus Plaza VIII: The USACE recommends no further action. The NJDEP concurs with this approach for DOD related contaminants, however, other non DOD-related compounds have been detected. Methylene chloride has been detected and is not considered to be related to former DOD operations. Therefore, this issue should be further evaluated by the building owner/tenant. It should be noted that Methylene Chloride has been detected in indoor air above the NJDEP's Rapid Action Levels. This matter has been referred to the NJDEP's Office of Wellfield Remediation for further evaluation.

25-27 Campus Drive: The USACE recommends no further action. The NJDEP concurs with this approach.

20 Northfield Avenue: The USACE recommends no further action. The NJDEP concurs with this approach.

Groundwater Area of Concern 4

75 Northfield Avenue/86 Northfield Avenue: The USACE recommends no further action. The NJDEP concurs with this approach. The NJDEP evaluated the groundwater results in the vicinity of this building and concurs with the USACE's assessment that TCE and PCE concentrations in groundwater monitoring locations (permanent wells and temporary well points) in the vicinity of this building are low.

125 Northfield Avenue: The USACE recommend no further action. The NJDEP concurs. Groundwater data did not indicate a need for subslab investigation. Based on the subslab results for 105-115 and 114 Northfield Avenue, the NJDEP concurs that no further action for vapor intrusion investigation is acceptable.

36/50 Mayfield Avenue: Based on groundwater results, the USACE recommended no further action. The NJDEP concurs.

52/62-68/60-84 Mayfield Avenue: Based on groundwater results, the USACE recommend no further action. The NJDEP concurs.

83– 85 Mayfield Avenue; 1-23 Mayfield Avenue; 29-39 Mayfield Avenue and 70 Newfield Avenue: Based on groundwater results, the USACE recommended no further action. The NJDEP concurs.

Groundwater Area of Concern 6

104 Sunfield Avenue and 107 Sunfield Avenue: After negative subslab soil gas results, the USACE recommend no further action. The NJDEP concurs.

Raritan Expo Center, Bldg. 97: After two rounds of subslab soil gas data which do not indicate a threat to indoor air, coupled with 1 round of indoor air data which did not reveal DOD-related contaminants, the USACE recommend no further action. The NJDEP concurs.

125 Newfield and 105 Sunfield Avenue: Based on groundwater quality, no vapor intrusion pathway was indicated, therefore no subslab sampling was conducted. The USACE recommend no further action. The NJDEP concurs.

Groundwater Area of Concern 8

2815 and 2825 Woodbridge Avenue: The USACE recommends no further action. The NJDEP concurs as prior investigations have ruled out vapor intrusion concerns.

USEPA Building 5: The USACE recommends no further action. The NJDEP concurs as prior investigations have ruled out vapor intrusion concerns.

USEPA Buildings 10 and 18: The USACE recommends continued monitoring to ensure effective operation of the subslab systems in place. Prior investigations indicated the potential for a complete vapor intrusion pathway, therefore the building owner, USEPA, installed subslab remediation systems. Pursuant to N.J.A.C. 7:26E-1.11 and N.J.A.C. 7:26E-4.4(h)viii the NJDEP concurs with the continued monitoring of these buildings.

USEPA Building 205: Initial investigations by the USEPA indicated a complete vapor intrusion pathway, therefore USEPA installed a subslab ventilation system. More recent testing indicates continued elevated subslab soil gas levels of TCE. The USACE recommends continued monitoring. Pursuant to N.J.A.C. 7:26E-1.11 and N.J.A.C. 7:26E-4.4(h)viii the NJDEP concurs that continued monitoring is necessary.

Groundwater Area of Concern 10

Middlesex County Training Facility: The USACE recommends no further action for this building. Based on two rounds of indoor air and subslab soil gas testing, it is agreed that the primary vapor intrusion concern is from Freon 12 (dichlorodifluoromethane) which was found in elevated levels in both subslab and indoor air samples. Subslab samples revealed up to 200,000 ug/m3, exceeding its corresponding soil gas screening level of 9,000 ug/m3. Indoor air samples generally revealed 4.6 ug/m3, with the exception of the library sample, which revealed up to 21,000 ug/m3. The Freon 12 indoor air screening criterion is 180 ug/m3. The building owner should have been notified of this concern, with remedial measures taken. PCE was detected in subslab soil gas at 60 ug/m3 in November 2004 and 11 ug/m3 in December 2005. PCE was not detected in indoor air samples in November 2004, however it was detected in 1 of 4 samples in December 2005. In this case, Freon 12 represents the greatest threat to indoor air quality for this building. However, pursuant to N.J.A.C. 7:26E-1.11 and N.J.A.C. 7:26E-4.4(h)viii continued monitoring is needed and should include evaluation for PCE and TCE to confirm that this compound is not a contaminant of concern. Freon 12 is not considered to be related to former DOD operations and should be further evaluated by the building owner/tenant. This portion of the case has been referred to the NJDEP's Office of Wellfield Remediation for further evaluation.

Deficiencies:

Groundwater Area of Concern 2

Building 151: The USACE recommends no further action. The NJDEP does not concur. Although the most recent two rounds of indoor air and subslab data do not indicate a current complete vapor intrusion pathway, a threat to indoor air quality remains based on historical subslab data and the location of this building immediately downgradient of the plume source area and directly over the AOC 2 groundwater plume. The NJDEP notes that this building is currently unoccupied. While the NJDEP has historically required the installation of a subslab ventilation system, as agreed to recently, the USACE will continue the indoor air monitoring of this building on a semi-annual basis in accordance with N.J.A.C. 7:26E-1.11 and N.J.A.C. 7:26E-4.4(h)3viii as long as this building remains unoccupied. In addition, the November 7, 2006 response to comment letter regarding this building is currently under review and a response will be forthcoming shortly.

Building 160: The USACE recommends continued semi-annual monitoring. The NJDEP has historically recommended installation of a subslab system based on the threat to indoor air quality due to consistently elevated PCE and TCE subslab soil gas concentrations and groundwater quality. However, since indoor air quality has remained acceptable, the NJDEP has agreed to permit the USACE to continue monitoring in the short term, provided monitoring occurs on a quarterly basis, due to the vapor intrusion threat posed by site conditions, therefore pursuant to N.J.A.C. 7:26E-1.11 and N.J.A.C. 7:26E-4.4(h)3viii quarterly monitoring shall be conducted at this building. In addition, the November 7, 2006 response to comment letter regarding this building is currently under review and a response will be forthcoming.

Campus Plaza I: The USACE recommends no further action. PCE was detected in indoor air (3.9 and 5.2 ug/m3) and in subslab soil gas (3.5 and 3.9 ug/m3); TCE was detected in subslab soil gas at 5.4 ug/m3. Although the indoor air concentrations exceed the indoor air screening level of 3 ug/m3, the values are marginally above the criteria and not found consistently. However pursuant to N.J.A.C. 7:26E-1.11 and N.J.A.C. 7:26E-4.4(h)3viii, the USACE shall continue monitoring of subslab soil gas due to the location of this building over the AOC 2 groundwater plume and the elevated subslab TCE levels observed at Campus Plaza buildings II and IV, upgradient of this building. This building shall be scheduled for sampling during the next sampling event.

Campus Plaza II: The USACE recommends further monitoring on a semi-annual basis because existing data indicate the potential for a complete vapor intrusion pathway. However, existing data already indicates a complete vapor intrusion pathway and remedial action is required. Pursuant to the NJDEP's letter dated November 3, 2006 and pursuant to N.J.A.C. 7:26E-1.11, N.J.A.C. 7:26E-1.4(b), the NJDEP's Vapor Intrusion Guidance, and as agreed, a subslab ventilation system will be installed in this building. In addition, the November 17, 2006 letter regarding this building is currently under review and a response will be forthcoming shortly.

Campus Plaza IV: The USACE recommends further monitoring on a semi-annual basis because existing data indicate the potential for a complete vapor intrusion pathway. However, subslab TCE concentrations are found ranging from 11 to 320 ug/m3 and increasing. In September 2006, TCE in subslab soil gas was found at levels of 100, 700 and 910 ug/m3. PCE is also found in subslab soil gas. TCE and PCE have been detected exceeding the NJDEP Vapor Intrusion Guidance indoor air screening levels. Recently the NJDEP has agreed to permit the continued monitoring of this building on a quarterly basis. In accordance with N.J.A.C. 7:26E-1.11 and N.J.A.C. 7:26E-4.4(h)3viii the building foundation should be inspected for any cracks and/or utility conduits and sealed. Following this, and as agreed, another round of indoor air and subslab testing will be performed. If subslab and indoor air levels persist, a subslab ventilation system will be required. In addition, the November 17, 2006 letter regarding this building is currently under review and a response will be forthcoming shortly.

Campus Plaza V: The USACE recommends no further action because the owner/tenant installed a subslab ventilation system. Prior to installation, site data indicated the potential for a complete vapor intrusion pathway as TCE was detected in most subslab sample locations at levels greater than the NJDEP Vapor Instrusion Guidance soil gas screening criteria and TCE had been detected in indoor air. Pursuant to N.J.A.C. 7:26E-1.11 and N.J.A.C. 7:26E-4.4(h)3viii periodic indoor air and subslab testing are needed to monitor the success of the remedial action, as the subslab system was installed to abate DOD-related contaminants. In addition, the NJDEP requests clarification as to who is conducting the ongoing monitoring of the system as well as the frequency of sampling.

Campus Plaza VII: The USACE recommends no further action because with one exception; TCE and PCE have been detected below soil gas screening levels. In one sample, 86 ug/m3 of TCE was detected in January 2006. PCE was detected in all 4 subslab samples ranging from 8 to 27 ug/m3 (below the NJDEP soil gas screening level of 34 ug/m3). In addition, although below the NJDEP indoor screening criteria of 3 ug/m3, both TCE and PCE were detected in indoor air. Based on this scenario and pursuant to N.J.A.C. 7:26E-1.11 and N.J.A.C. 7:26E-4.4(h)3viii the USACE shall perform another round of subslab soil gas and indoor air monitoring to ensure that levels remain below levels of concern, since a complete vapor intrusion pathway is potentially indicated by existing data.

Groundwater Area of Concern 4

90/100-112 Northfield Avenue: The USACE recommends further monitoring because PCE was detected ranging from 38 to 81 ug/m3 in 6 of 7 subslab sampling locations. In addition, 1,2-dichloroethane (29 ug/m3) was detected above its corresponding NJDEP Vapor Intrusion Guidance soil gas screening level of 20 ug/m3. Followup subslab and initial indoor air sampling was performed in September 2006. TCE was detected (13 ug/m3) in 2 of 7 subslab soil gas locations. It is noted however, that an elevated detection limit of 11 ug/m3 is reported for the remaining locations. PCE was not detected in soil gas, however an elevated detection limit of 14 ug/m3 is reported. Although both detection limits are below the NJDEP Vapor Intrusion Guidance soil screening levels for these contaminants, the presence of PCE or TCE cannot be completely ruled out. PCE was detected in indoor air at 2 locations at 9.5 and 5 ug/m3, both of which exceed the corresponding indoor air screening level of 3 ug/m3. Based on these two sampling rounds (March and September 2006) a complete vapor intrusion pathway for PCE is indicated. Pursuant to N.J.A.C. 7:26E-1.11 and N.J.A.C. 7:26E-4.4(h)3viii, further indoor air and subslab monitoring by the USACE is required at this time.

95-97 Northfield Avenue: The USACE recommends no further action. The NJDEP concurs, however pursuant to N.J.A.C. 7:26E-1.6(c) clarification for slightly elevated detection limits is requested.

105-115 Northfield Avenue: The USACE recommend no further action. The NJDEP concurs, however pursuant to N.J.A.C. 7:26E-1.6(c) clarification for slightly elevated detection limits is requested.

114 Northfield Avenue: The USACE recommend no further action. The NJDEP concurs, however pursuant to N.J.A.C. 7:26E-1.6(e) clarification for slightly elevated detection limits is requested.

86/90-94/98-102 Mayfield Avenue: The USACE recommended no further action. The NJDEP concurs however pursuant to N.J.A.C. 7:26E-1.6(e) clarification for slightly elevated detection limits is requested.

Groundwater Area of Concern 6

102-168 Fernwood Avenue: The USACE recommends follow-up soil gas sampling after the initial round in March 2006 revealed TCE in 1 out of 4 samples slightly exceeding the NJDEP Vapor Intrusion Guidance soil gas screening level. PCE was detected in 4 of 5 samples, although below the corresponding screening level for soil gas. Follow-up sampling performed in September 2006 indicated soil gas levels for TCE (up to 750 ug/m3) and PCE (36 ug/m3). PCE was detected in 1 of 6 indoor air samples; TCE was not detected in any of the indoor air samples. Pursuant to N.J.A.C. 7:26E-1.11 and N.J.A.C. 7:26E-4.4(h)3viii this building requires further monitoring. If PCE and TCE are detected a subslab ventilation system will be required.

110 Newfield Avenue: The USACE recommends follow-up soil gas sampling after the initial round in March 2006 revealed PCE in both subslab samples. Follow-up soil gas testing at 5 locations in September 2006 revealed no PCE or TCE (detection limits of 14 and 11 ug/m3, respectively). However, TCE was detected in 1 of 4 indoor air samples at 15 ug/m3. Based on these more recent results, the USACE recommends no further action. However, due to the location of this building immediately over the groundwater plume and downgradient of 102-168 Fernwood pursuant to N.J.A.C. 7:26E-1.11 and N.J.A.C. 7:26E-4.4(h)3viii additional subslab and indoor air monitoring is warranted.

45 Fernwood Avenue: The USACE recommends follow-up soil gas sampling after the initial round in March 2006 revealed PCE in 2 of 5 subslab samples. Follow-up soil gas testing at 5 locations in September 2006 revealed no PCE or TCE. However, TCE and PCE were detected in all indoor air locations exceeding the NJDEP Vapor Intrusion Guidance screening levels. Based on groundwater results and this scenario, the USACE conclude that tenant-related activities may be responsible for these results. Although this could be possible it has not been demonstrated by the USACE. Therefore, pursuant to N.J.A.C. 7:26E-1.11 and N.J.A.C. 7:26E-4.4(h)3viii additional subslab and indoor air monitoring is required due to the location of this building over the groundwater plume.

Building 467: The USACE recommends follow-up soil gas sampling after the initial round in March 2006 revealed PCE in 2 of 5 subslab samples. Follow-up soil gas testing revealed 11 ug/m3 of TCE, while PCE was reported as not detected. However, both TCE and PCE were detected in indoor air samples at levels slightly exceeding NJDEP Vapor Intrusion Guidance screening levels. The USACE recommends an additional round of indoor air and subslab monitoring. Pursuant to N.J.A.C. 7:26E-1.11 and N.J.A.C. 7:26E-4.4(h)3viii, the NJDEP concurs that further sampling is necessary in the form of subslab soil gas and indoor air. While the NJDEP notes that this building is scheduled to be sampled in March 2007, it should be sampled in the January 2007 sampling event.

Groundwater Area of Concern 8

USEPA Building 200: The USACE recommends continued monitoring to ensure effective operation of the subslab ventilation system in place. A complete vapor intrusion pathway was observed in the past, therefore the building owner, USEPA, installed a subslab remediation system. However, recent testing has indicated continuing problems (TCE detected in indoor air samples and elevated TCE in soil gas) therefore pursuant N.J.A.C. 7:26E-1.11 and N.J.A.C. 7:26E-4.4(h)viii a re-evaluation of the subslab system is needed through coordination between USACE and USEPA.

USEPA Building 209: Initial investigation of subslab soil gas and indoor air occurred in January and February 2006. Chloroform and TCE were found in soil gas above screening criteria. PCE and TCE were not found at levels exceeding indoor air screening criteria. The USACE recommends no further action. However, pursuant to N.J.A.C. 7:26E-1.11 and N.J.A.C. 7:26E-4.4(h)viii follow-up monitoring of subslab soil gas is needed. If levels decline, no further action would be appropriate. However, as long as soil gas levels exceed soil gas screening levels, a threat to indoor air quality is indicated, therefore monitoring shall continue.

Building 238: Initial subslab soil gas indicated the presence of chloroform and carbon tetrachloride exceeding the NJDEP Vapor Intrusion Guidance soil gas screening levels. TCE was also detected, but at a level below screening criteria. Due to interior renovations, indoor air sampling was postponed. The USACE recommends another round of subslab soil gas monitoring followed by indoor air testing. Since the NJDEP has recently been informed that the building has been occupied, pursuant to N.J.A.C. 7:26E-1.11 and N.J.A.C. 7:26E-4.4(h)viii the USACE shall conduct indoor air testing at the same time as subslab soil gas testing.

USEPA Guard Shack: Elevated TCE was found in subslab soil gas in the original guard shack. That building has since been removed and a new guard shack was built nearby, with a subslab ventilation system. The USACE recommends monitoring to determine the effectiveness of the remediation system. Pursuant to N.J.A.C. 7:26E-1.11 and N.J.A.C. 7:26E-4.4(h)viii the NJDEP concurs. In addition, subslab testing should be initiated.

Corrective Actions

You must take the following corrective actions:

Please address the noted deficiencies within thirty (30) days after receipt of this letter. Note that deficiencies included herein which are not addressed to the Department's satisfaction within the specified time period will be subject to the provisions of the DSMOA. To determine whether the uncorrected deficiencies will be minor with a period of time to correct or non-minor subject to penalty or MOA termination refer to the table at N.J.A.C. 7:26C-10.4(c).

If you require copies of Departmental Guidance Documents or applications, many of these are available on the internet at www.state.nj.us/dep/srp. If you have any questions regarding this matter please contact me at (609) 633-1416 prior to the date indicated.

Sincerely,

Anthony Cinque

Anthony Cinque, Case Manager
Bureau of Case Management

c: Robert Fritz, Summit Associates
John Orozco, Federal Business Centers
Bernie Adler, Adler Development
John Grun, Edison Health Department
Edison Township Municipal Clerk
Don Drost, Middlesex County College
Akhil Verma, USEPA
Kwong Cho, USEPA
Anne Hayton, BEERA
Dave VanEck, BGWPA

Based on the Response to 06 May 2006 NJDEP Comments (see below) MW-59 in Groundwater AOC 7 was sampled on October 2, 2006.

NJDEP 06 MAY 2006 COMMENT #3:

Section 4.1.5, Groundwater AOC 7, page 4-12 and 4-13: The USACE contends that since the groundwater samples collected by OBG in 1988 and 1989 had no VOCs, and VOCs were detected in sampling performed in 1989 and 1994, the groundwater contamination would likely be from a non-DOD source. The NJDEP cannot concur with this assessment at this time. OBG wells MW-l0 and MW-12 were up and sidegradient of the Area 7 sources. The sole downgradient well, MW-11, may not have been in the ideal location to monitor for potential groundwater contamination. Soil samples collected within Area 7 detected contamination, but as the area has been an active PSE&G fleet maintenance yard, the origin of the contamination is not clear.

USACE RESPONSE TO NJDEP COMMENT:

USACE has not found any evidence to date indicating the contamination within AOC 7 is related to former DOD activities. However, USACE agrees to collect a groundwater sample from MW-59 to confirm the downward VOC concentration trend in Groundwater AOC 7. This sampling will be performed in the next 30 days. The following information is provided to support USACE's contention that the contamination detected in Groundwater AOC 7 is not related to DOD activities.

OCTOBER 2, 2006 RESULTS:

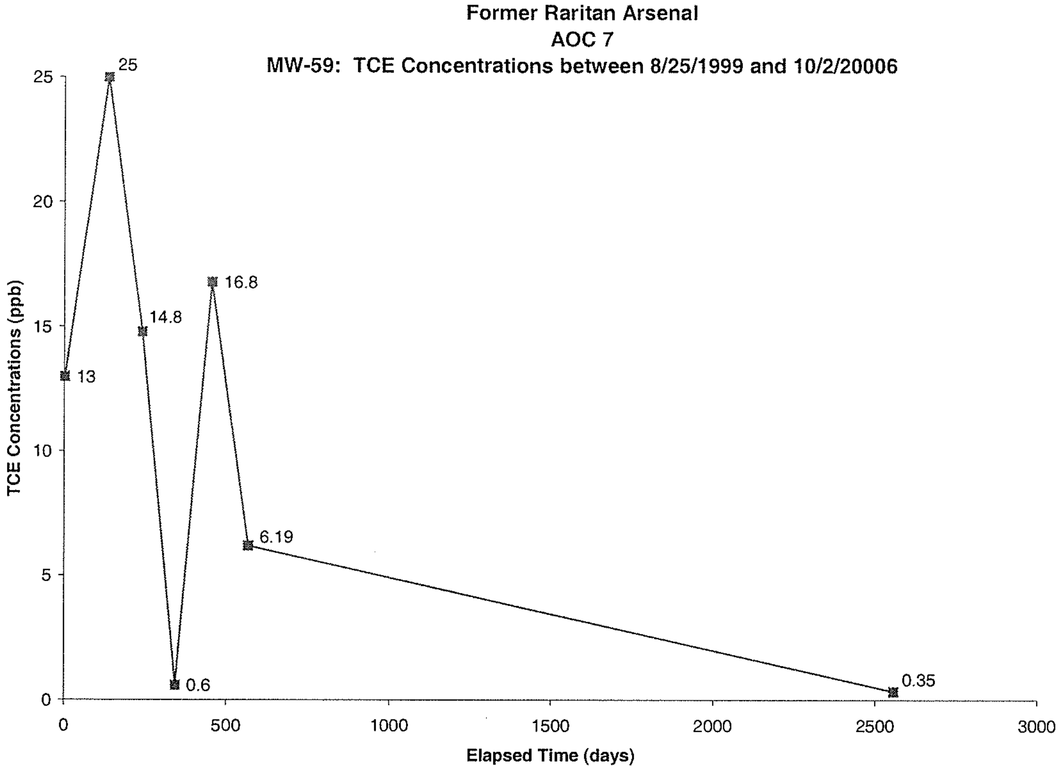
The results of the October 2006 groundwater sample from MW-59 are summarized in the Table below. Although chlorobenzene and benzene exceeded their respective NJDEP GWQS, the NJDEP has already agreed that chlorobenzene has a non-DOD source and benzene may have a non-DOD source. The graph below shows the historic (1999-2006) TCE concentrations in MW-59; and supports the USACE natural attenuation position. The complete laboratory package is provided as part of this Appendix.

USACE recommends no further action for Groundwater AOC 7 based on the following:

- There is no evidence that the groundwater contamination is related to former DOD activities; and
- The October 2, 2006 groundwater results demonstrate TCE concentrations have decreased to below the NJDEP GWQS.

Sample ID:	**NJDEP**	**GW8-MW-59**		**GW8-MW-59-Z**		**TB**	
Lab Sample No:	**higher**	**774588**		**774589**		**774590**	
Sampling Date:	**value of**	**10/02/06**		**10/02/06**		**09/29/06**	
Matrix:	**PQLs and**	**WATER**		**WATER**		**WATER**	
Dilution Factor:	**GWQS**	**2.0**		**2.0**		**1.0**	
Units:	**ug/L**	**ug/L**		**ug/L**		**ug/L**	
VOLATILE COMPOUNDS (GC/MS)							
Chloromethane	30	0.6	U	0.6	U	0.3	U
Bromomethane	10	0.6	U	0.6	U	0.3	U
VinylChloride	5	0.6	U	0.6	U	0.3	U
Chloroethane	100	0.5	U	0.5	U	0.2	U
MethyleneChloride	3	1.0	U	1.0	U	0.5	U
Acetone	700	2.5	U	2.5	U	1.3	U
CarbonDisulfide	800	0.7	U	0.7	U	0.3	U
1,1-Dichloroethene	2	0.7	U	0.7	U	0.4	U
1,1-Dichloroethane	50	0.8		0.9		0.3	U
trans-1,2-Dichloroethene	100	0.9	U	0.9	U	0.4	U
cis-1,2-Dichloroethene	70	0.9	U	0.9	U	0.4	U
Chloroform	6	1.0	U	1.0	U	0.5	U
1,2-Dichloroethane	2	0.6	U	1.0		0.3	U
2-Butanone	300	1.9	U	1.9	U	0.9	U
1,1,1-Trichloroethane	30	0.7	U	0.7	U	0.3	U
CarbonTetrachloride	2	0.6	U	0.6	U	0.3	U
Bromodichloromethane	1	0.6	U	0.6	U	0.3	U
1,2-Dichloropropane	1	0.6	U	0.6	U	0.3	U
cis-1,3-Dichloropropene	NA	0.5	U	0.5	U	0.2	U
Trichloroethene	1	0.7	U	0.7	U	0.4	U
Dibromochloromethane	10	0.5	U	0.5	U	0.3	U
1,1,2-Trichloroethane	3	0.7	U	0.7	U	0.3	U
Benzene	1	**3.2**		**3.2**		0.3	U
trans-1,3-Dichloropropene	NA	0.5	U	0.5	U	0.2	U
Bromoform	4	0.4	U	0.4	U	0.2	U
4-Methyl-2-Pentanone	400	1.0	U	1.0	U	0.5	U
2-Hexanone	100	1.0	U	1.0	U	0.5	U
Tetrachloroethene	1	0.9	U	0.9	U	0.4	U
1,1,2,2-Tetrachloroethane	1	0.7	U	0.7	U	0.3	U
Toluene	1,000	0.8	U	0.8	U	0.4	U
Chlorobenzene	50	**230**		**250**		0.4	U
Ethylbenzene	700	0.9	U	0.9	U	0.5	U
Styrene	100	0.8	U	0.8	U	0.4	U
Xylene(Total)	1000	0.8	U	0.8	U	0.4	U
Total Confident Conc. VOAs		234		255		0	
Total Estimated Conc. VOA TICs		0		0		0	

U - The compound was not detected at the indicated concentration.
J -Data indicates the presence of a compound that meets the identification criteria. The result is less than the quantitation limit but greater than zero. 'The concentration given is an approximate value.
GW8-MW-59-Z is a duplicate sample.


Former Raritan Arsenal
AOC 7
MW-59: TCE Concentrations between 8/25/1999 and 10/2/20006
TCE Concentrations (ppb)
0
5
10
15
20
25
Elapsed Time (days)
0
500
1000
1500
2000
2500
3000
13
25
14.8
0.6
16.8
6.19
0.35

SEVERN TRENT STL

STL Edison
777 New Durham Road
Edison, NJ 08817

Tel 732 549 3900 Fax 732 549 3679
www.stl-inc.com

10/26/2006

Weston Solutions, Inc.
205 Campus Drive

Edison, NJ 08837-3939

Attention: Mr. Ralph Costa

Laboratory Results
Job No. X772 - Raritan Arsenal

Dear Mr. Costa:

Enclosed are the results you requested for the following sample(s) received at our laboratory on October 2, 2006.

Lab No.	Client ID	Analysis Required
774588	GW8-MW-59	TCL VOA+10
774589	GW8-MW-59-Z	TCL VOA+10
774590	TB	TCL VOA+10

If you have any questions please contact your Project Manager, David Lissy, at (732) 549-3900.

Very Truly Yours,

Michael J. Urban

Michael Urban
Laboratory Manager

Analytical Results Summary

Client ID: **GW8-MW-59**
Site: Raritan Arsenal

Lab Sample No: **774588**
Lab Job No: X772

Date Sampled: 10/02/06
Date Received: 10/02/06
Date Analyzed: 10/06/06
GC Column: DB624
Instrument ID: VOAMS3.i
Lab File ID: ca14049.d

Matrix: WATER
Level: LOW
Purge Volume: 5.0 ml
Dilution Factor: 2.0

VOLATILE ORGANICS - GC/MS
METHOD 624

Parameter	Analytical Result Units: ug/l	Method Detection Limit Units: ug/l
Chloromethane	ND	0.6
Bromomethane	ND	0.6
Vinyl Chloride	ND	0.6
Chloroethane	ND	0.5
Methylene Chloride	ND	1.0
Acetone	ND	2.5
Carbon Disulfide	ND	0.7
1,1-Dichloroethene	ND	0.7
1,1-Dichloroethane	0.8	0.6
trans-1,2-Dichloroethene	ND	0.9
cis-1,2-Dichloroethene	ND	0.9
Chloroform	ND	1.0
1,2-Dichloroethane	ND	0.6
2-Butanone	ND	1.9
1,1,1-Trichloroethane	ND	0.7
Carbon Tetrachloride	ND	0.6
Bromodichloromethane	ND	0.6
1,2-Dichloropropane	ND	0.6
cis-1,3-Dichloropropene	ND	0.5
Trichloroethene	ND	0.7
Dibromochloromethane	ND	0.5
1,1,2-Trichloroethane	ND	0.7
Benzene	3.2	0.7
trans-1,3-Dichloropropene	ND	0.5
Bromoform	ND	0.4
4-Methyl-2-Pentanone	ND	1.0
2-Hexanone	ND	1.0
Tetrachloroethene	ND	0.9
1,1,2,2-Tetrachloroethane	ND	0.7
Toluene	ND	0.8
Chlorobenzene	230	0.9
Ethylbenzene	ND	0.9
Styrene	ND	0.8
Xylene (Total)	ND	0.8

Client ID: **GW8-MW-59**
Site: Raritan Arsenal

Lab Sample No: **774588**
Lab Job No: X772

Date Sampled: 10/02/06
Date Received: 10/02/06
Date Analyzed: 10/06/06
GC Column: DB624
Instrument ID: VOAMS3.i
Lab File ID: ca14049.d

Matrix: WATER
Level: LOW
Purge Volume: 5.0 ml
Dilution Factor: 2.0

VOLATILE ORGANICS - GC/MS
TENTATIVELY IDENTIFIED COMPOUNDS
METHOD 624

COMPOUND NAME	RT	EST. CONC. ug/l	Q
1. NO VOLATILE ORGANIC COMPOUNDS FOUND			
2.			
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30.			

TOTAL ESTIMATED CONCENTRATION 0.0

Client ID: **GW8-MW-59-Z**	Lab Sample No: **774589**
Site: Raritan Arsenal	Lab Job No: X772

Date Sampled: 10/02/06	Matrix: WATER
Date Received: 10/02/06	Level: LOW
Date Analyzed: 10/07/06	Purge Volume: 5.0 ml
GC Column: DB624	Dilution Factor: 2.0
Instrument ID: VOAMS3.i	
Lab File ID: ca14068.d	

VOLATILE ORGANICS - GC/MS
METHOD 624

Parameter	Analytical Result Units: ug/l	Method Detection Limit Units: ug/l
Chloromethane	ND	0.6
Bromomethane	ND	0.6
Vinyl Chloride	ND	0.6
Chloroethane	ND	0.5
Methylene Chloride	ND	1.0
Acetone	ND	2.5
Carbon Disulfide	ND	0.7
1,1-Dichloroethene	ND	0.7
1,1-Dichloroethane	0.9	0.6
trans-1,2-Dichloroethene	ND	0.9
cis-1,2-Dichloroethene	ND	0.9
Chloroform	ND	1.0
1,2-Dichloroethane	1.0	0.6
2-Butanone	ND	1.9
1,1,1-Trichloroethane	ND	0.7
Carbon Tetrachloride	ND	0.6
Bromodichloromethane	ND	0.6
1,2-Dichloropropane	ND	0.6
cis-1,3-Dichloropropene	ND	0.5
Trichloroethene	ND	0.7
Dibromochloromethane	ND	0.5
1,1,2-Trichloroethane	ND	0.7
Benzene	3.2	0.7
trans-1,3-Dichloropropene	ND	0.5
Bromoform	ND	0.4
4-Methyl-2-Pentanone	ND	1.0
2-Hexanone	ND	1.0
Tetrachloroethene	ND	0.9
1,1,2,2-Tetrachloroethane	ND	0.7
Toluene	ND	0.8
Chlorobenzene	250	0.9
Ethylbenzene	ND	0.9
Styrene	ND	0.8
Xylene (Total)	ND	0.8

Client ID: **GW8-MW-59-Z**
Site: Raritan Arsenal

Lab Sample No: **774589**
Lab Job No: X772

Date Sampled: 10/02/06
Date Received: 10/02/06
Date Analyzed: 10/07/06
GC Column: DB624
Instrument ID: VOAMS3.i
Lab File ID: ca14068.d

Matrix: WATER
Level: LOW
Purge Volume: 5.0 ml
Dilution Factor: 2.0

VOLATILE ORGANICS - GC/MS
TENTATIVELY IDENTIFIED COMPOUNDS
METHOD 624

COMPOUND NAME	RT	EST. CONC. ug/l	Q
1. NO VOLATILE ORGANIC COMPOUNDS FOUND			
2.			
3.			
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30.			

TOTAL ESTIMATED CONCENTRATION 0.0

Client ID: **TB**
Site: Raritan Arsenal

Lab Sample No: **774590**
Lab Job No: X772

Date Sampled: 09/29/06
Date Received: 10/02/06
Date Analyzed: 10/07/06
GC Column: DB624
Instrument ID: VOAMS3.i
Lab File ID: ca14061.d

Matrix: WATER
Level: LOW
Purge Volume: 5.0 ml
Dilution Factor: 1.0

VOLATILE ORGANICS - GC/MS
METHOD 624

Parameter	Analytical Result Units: ug/l	Method Detection Limit Units: ug/l
Chloromethane	ND	0.3
Bromomethane	ND	0.3
Vinyl Chloride	ND	0.3
Chloroethane	ND	0.2
Methylene Chloride	ND	0.5
Acetone	ND	1.3
Carbon Disulfide	ND	0.3
1,1-Dichloroethene	ND	0.4
1,1-Dichloroethane	ND	0.3
trans-1,2-Dichloroethene	ND	0.4
cis-1,2-Dichloroethene	ND	0.4
Chloroform	ND	0.5
1,2-Dichloroethane	ND	0.3
2-Butanone	ND	0.9
1,1,1-Trichloroethane	ND	0.3
Carbon Tetrachloride	ND	0.3
Bromodichloromethane	ND	0.3
1,2-Dichloropropane	ND	0.3
cis-1,3-Dichloropropene	ND	0.2
Trichloroethene	ND	0.4
Dibromochloromethane	ND	0.3
1,1,2-Trichloroethane	ND	0.3
Benzene	ND	0.3
trans-1,3-Dichloropropene	ND	0.2
Bromoform	ND	0.2
4-Methyl-2-Pentanone	ND	0.5
2-Hexanone	ND	0.5
Tetrachloroethene	ND	0.4
1,1,2,2-Tetrachloroethane	ND	0.3
Toluene	ND	0.4
Chlorobenzene	ND	0.4
Ethylbenzene	ND	0.5
Styrene	ND	0.4
Xylene (Total)	ND	0.4

Client ID: **TB**	Lab Sample No: **774590**
Site: Raritan Arsenal	Lab Job No: X772
Date Sampled: 09/29/06	Matrix: WATER
Date Received: 10/02/06	Level: LOW
Date Analyzed: 10/07/06	Purge Volume: 5.0 ml
GC Column: DB624	Dilution Factor: 1.0
Instrument ID: VOAMS3.i	
Lab File ID: ca14061.d	

VOLATILE ORGANICS - GC/MS
TENTATIVELY IDENTIFIED COMPOUNDS
METHOD 624

COMPOUND NAME	RT	EST. CONC. ug/l	Q
1. NO VOLATILE ORGANIC COMPOUNDS FOUND			
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30.			

TOTAL ESTIMATED CONCENTRATION 0.0

General Information

Chain of Custody

STL EDISON
777 New Durham Road
Edison, New Jersey 08817
Phone: (732) 549-3900 Fax: (732) 549-3679

CHAIN OF CUSTODY / ANALYSIS REQUEST

PAGE 1 OF 1

Name (for report and invoice): RALPH COSTA
Company: WESTON SOLUTIONS, INC.
Address: 205 CAMPUS DR.
City: EDISON State: NJ Zip: 08837
Phone: 732-417-5830 Fax: 732-417-5801

Sampler's Name (Printed): C. BROWNELL
P.O. #

Site/Project Identification: RARITAN ARSENAL (SITE WIDE G/WATER)
State (Location of Site): NJ: ☑ NY: ☐ Other:
Regulatory Program:

Analysis Turnaround Time
Standard ☑
Rush Charges Authorized For:
1 Week ☐
3 Day ☐
Other ☐

ANALYSIS REQUESTED (ENTER "X" BELOW TO INDICATE REQUEST)

LAB USE ONLY
Project No.
Job No. X772

Sample Identification	Date	Time	Matrix	No. of Cont.	VOC	Sample Numbers
GW8-MW-59	10/02/06		W	3	✓	774588
GW8-MW-59-Z	10/02/06		W	3	✓	774589
TB-	09/29/06		W	2	✓	774590

Preservation Used: (1 = ICE), 2 = HCl, 3 = H_2SO_4, 4 = HNO_3, 5 = NaOH
6 = Other ICE, 7 = Other
Soil:
Water:

Special Instructions REPORT (FAX, EDD) Cooler Temp: Water Metals Filtered (Yes/No)?

Relinquished by	Company	Date/Time	Received by	Company
1.	WESTON SOLUTIONS	10/2/06 11:50		STL
2.				
3.				
4.				

Laboratory Certifications: New Jersey (12028), New York (11452), Pennsylvania (68-522), Connecticut (PH-0200), Rhode Island (132).

STL-6003

Laboratory Chronicles

INTERNAL CUSTODY RECORD
AND
LABORATORY CHRONICLE
STL Edison

777 New Durham Road, Edison, New Jersey
08817

Job No: X772

Site: Raritan Arsenal

Client: Weston Solutions, Inc.

VOAMS

WATER - 624

Lab Sample ID	Date Sampled	Date Received	Preparation Date	Technician's Name	Analysis Date	Analyst's Name	QA Batch
774588	10/2/2006	10/2/2006			10/6/2006	Boykin, Kenneth	3601
774589	10/2/2006	10/2/2006			10/7/2006	Boykin, Kenneth	3601
774590	9/29/2006	10/2/2006			10/7/2006	Boykin, Kenneth	3601

Methodology Review

Analytical Methodology Summary

Volatile Organics:

Unless otherwise specified, water samples are analyzed for volatile organics by purge and trap GC/MS as specified in EPA Method 624. Drinking water samples are analyzed by EPA Method 524.2 Rev 4.1. Solid samples are analyzed for volatile organics as specified in the EPA publication “Test Methods for Evaluating Solid Waste” (SW-846, 3rd Edition) Method 8260B.

Acid and Base/Neutral Extractable Organics:

Unless otherwise specified, water samples are analyzed for acid and/or base/neutral extractable organics by GC/MS in accordance with EPA Method 625. Solids are analyzed for acid and/or base/neutral extractable organics as specified in the EPA publication “Test Methods for Evaluating Solid Waste” (SW-846, 3rd Edition) Method 8270C.

GC/MS Nontarget Compound Analysis:

Analysis for nontarget compounds is conducted, upon request, in conjunction with GC/MS analyses by EPA Methods 624, 625, 8260B and 8270C. Nontarget compound analysis is conducted using a forward library search of the EPA/NIH/NBS mass spectral library of compounds at the greatest apparent concentration (10% or greater of the nearest internal standard) in each organic fraction (15 for volatile, 15 for base/neutrals and 10 for acid extractables).

Organochlorine Pesticides and PCBs:

Unless otherwise specified, water samples are analyzed for organochlorine pesticides and PCBs by dual column gas chromatography with electron capture detectors as specified in EPA Method 608. Solid samples are analyzed as specified in the EPA publication “Test Methods for Evaluating Solid Waste” (SW-846, 3rd Edition) Method 8081A for organochlorine pesticides and Method 8082 for PCBs.

Total Petroleum Hydrocarbons:

Water samples are analyzed for petroleum hydrocarbons by I.R. using EPA Method 418.1. Solid samples are prepared for analysis by soxhlet extraction consistent with the March 1990 N.J. DEP “Remedial Investigation Guide” Appendix A, page 52, and analyzed by U.S. EPA Method 418.1

Metals Analysis:

Metals analyses are performed by any of four techniques specified by a Method Code provided on each data report page, as follows:

P - Inductively Coupled Plasma Atomic Emission Spectroscopy (ICP)

A - Flame Atomic Absorption

F - Furnace Atomic Absorption

CV - Manual Cold Vapor (Mercury)

Water samples are digested and analyzed using EPA methods provided in “Methods for Chemical Analysis of Water and Wastewater” (EPA 600/4-79-020). Solid samples are analyzed as specified in the EPA publication “Test Methods for Evaluating Solid Waste” (SW-846, 3rd Edition); samples are digested according to Method 3050B “Acid Digestion of Soil, Sediments and Sludges.”

Specific method references for ICP analyses are water Method - 200.7/SW846 6010B and for solid matrix - 6010B. Mercury analyses are conducted by the manual cold vapor technique specified by water Method 245.1/7470A and solid Method 7471A. Other specific Atomic Absorption method references are as follows:

Element	Water Test Method Furnace	Solid Test Method Furnace
Antimony	200.9	7041
Arsenic	200.9	7060A
Cadmium	200.9	7131A
Lead	200.9	7421
Selenium	200.9	7740
Thallium	200.9	7841

Cyanide:

Water samples are analyzed for cyanide using EPA Method 335.3. Cyanide is determined in solid samples as specified in the EPA Contract Laboratory Program IFB dated July 1988, revised February 1989.

Phenols:

Water samples are analyzed for total phenols using EPA Method 420.2. Total phenols are determined in water and solid samples by preparing the sample as outlined in the EPA Contract Laboratory Program IFB for cyanide, followed by a phenols determination using EPA Method 420.1.

Hexavalent Chromium:

Water samples are analyzed using EPA Method 7196A, EPA Method 7199 or (upon request) USGS –1230-35. Soil samples are subjected to alkaline digestion via EPA Method 3060A prior to analysis by EPA Method 7196A or EPA Method 7199.

Cleanup of Semivolatile Extracts:

Upon request Method 3611B Alumina Column Cleanup and/or Method 3650B Acid-Base Partition Cleanup are performed to improve detection limits by the removal of saturated hydrocarbon interferences.

Hazardous Waste Characteristics:

Samples for hazardous waste characteristics are analyzed as specified in the U.S. EPA publication “Test Methods for Evaluating Solid Waste” (SW-846, 3rd Edition). Specific method references are as follows:

Ignitability	- Method 1020A
Corrosivity	- Water pH Method 9040B Soil pH Method 9045C
Reactivity	- Chapter 7, Section 7.3.3 and 7.3.4 respectively for hydrogen cyanide and hydrogen sulfide release
Toxicity	- TCLP Method 1311

Miscellaneous Parameters:

Additional analyses performed on both aqueous and solid samples are in accordance with methods published in the following references:

- Test Methods for Evaluating Solid Wastes, SW-846 3rd Edition, November 1986.

- Standard Methods for the Examination of Water and Wastewater, 18th Edition.

- Methods for Chemical Analysis of Water and Wastes, EPA-600/4-79-020, 1979.

Data Reporting Qualifiers

DATA REPORTING QUALIFIERS

ND - The compound was not detected at the indicated concentration.

J - Mass spectral data indicates the presence of a compound that meets the identification criteria. The result is less than the specified detection limit but greater than zero. The concentration given is an approximate value.

B - The analyte was found in the laboratory blank as well as the sample. This indicates possible laboratory contamination of the environmental sample.

P - For dual column analysis, the percent difference between the quantitated concentrations on the two columns is greater than 40%.

* - For dual column analysis, the lowest quantitated concentration is being reported due to coeluting interference.

Non-Conformance Summary

SEVERN TRENT STL

Nonconformance Summary

STL Edison Job Number: X772

Client: Weston Solutions, Inc.

Date: 10/16/2006

Sample Receipt:

Sample delivery conforms with requirements.

Volatile Organic Analysis (GC/MS):

All data conforms with method requirements.

I certify that the test results contained in this data package meet all requirements of NELAC both technically and for completeness, for other than the conditions detailed above. Release of the data contained in this package has been authorized by the Laboratory Manager or his designee, as verified by the following signature.

Michael J. Urban

Michael J.Urban
Laboratory Manager

GC/MS Forms and Data (Volatiles)

Results Summary and Chromatograms

Client ID: **GW8-MW-59**
Site: Raritan Arsenal

Lab Sample No: **774588**
Lab Job No: X772

Date Sampled: 10/02/06
Date Received: 10/02/06
Date Analyzed: 10/06/06
GC Column: DB624
Instrument ID: VOAMS3.i
Lab File ID: cal4049.d

Matrix: WATER
Level: LOW
Purge Volume: 5.0 ml
Dilution Factor: 2.0

VOLATILE ORGANICS - GC/MS
METHOD 624

Parameter	Analytical Result Units: ug/l	Method Detection Limit Units: ug/l
Chloromethane	ND	0.6
Bromomethane	ND	0.6
Vinyl Chloride	ND	0.6
Chloroethane	ND	0.5
Methylene Chloride	ND	1.0
Acetone	ND	2.5
Carbon Disulfide	ND	0.7
1,1-Dichloroethene	ND	0.7
1,1-Dichloroethane	0.8	0.6
trans-1,2-Dichloroethene	ND	0.9
cis-1,2-Dichloroethene	ND	0.9
Chloroform	ND	1.0
1,2-Dichloroethane	ND	0.6
2-Butanone	ND	1.9
1,1,1-Trichloroethane	ND	0.7
Carbon Tetrachloride	ND	0.6
Bromodichloromethane	ND	0.6
1,2-Dichloropropane	ND	0.6
cis-1,3-Dichloropropene	ND	0.5
Trichloroethene	ND	0.7
Dibromochloromethane	ND	0.5
1,1,2-Trichloroethane	ND	0.7
Benzene	3.2	0.7
trans-1,3-Dichloropropene	ND	0.5
Bromoform	ND	0.4
4-Methyl-2-Pentanone	ND	1.0
2-Hexanone	ND	1.0
Tetrachloroethene	ND	0.9
1,1,2,2-Tetrachloroethane	ND	0.7
Toluene	ND	0.8
Chlorobenzene	230	0.9
Ethylbenzene	ND	0.9
Styrene	ND	0.8
Xylene (Total)	ND	0.8

Client ID: **GW8-MW-59**
Site: Raritan Arsenal

Lab Sample No: **774588**
Lab Job No: X772

Date Sampled: 10/02/06
Date Received: 10/02/06
Date Analyzed: 10/06/06
GC Column: DB624
Instrument ID: VOAMS3.i
Lab File ID: ca14049.d

Matrix: WATER
Level: LOW
Purge Volume: 5.0 ml
Dilution Factor: 2.0

VOLATILE ORGANICS - GC/MS
TENTATIVELY IDENTIFIED COMPOUNDS
METHOD 624

COMPOUND NAME	RT	EST. CONC. ug/l	Q
1. NO VOLATILE ORGANIC COMPOUNDS FOUND			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
13.			
14.			
15.			
16.			
17.			
18.			
19.			
20.			
21.			
22.			
23.			
24.			
25.			
26.			
27.			
28.			
29.			
30.			

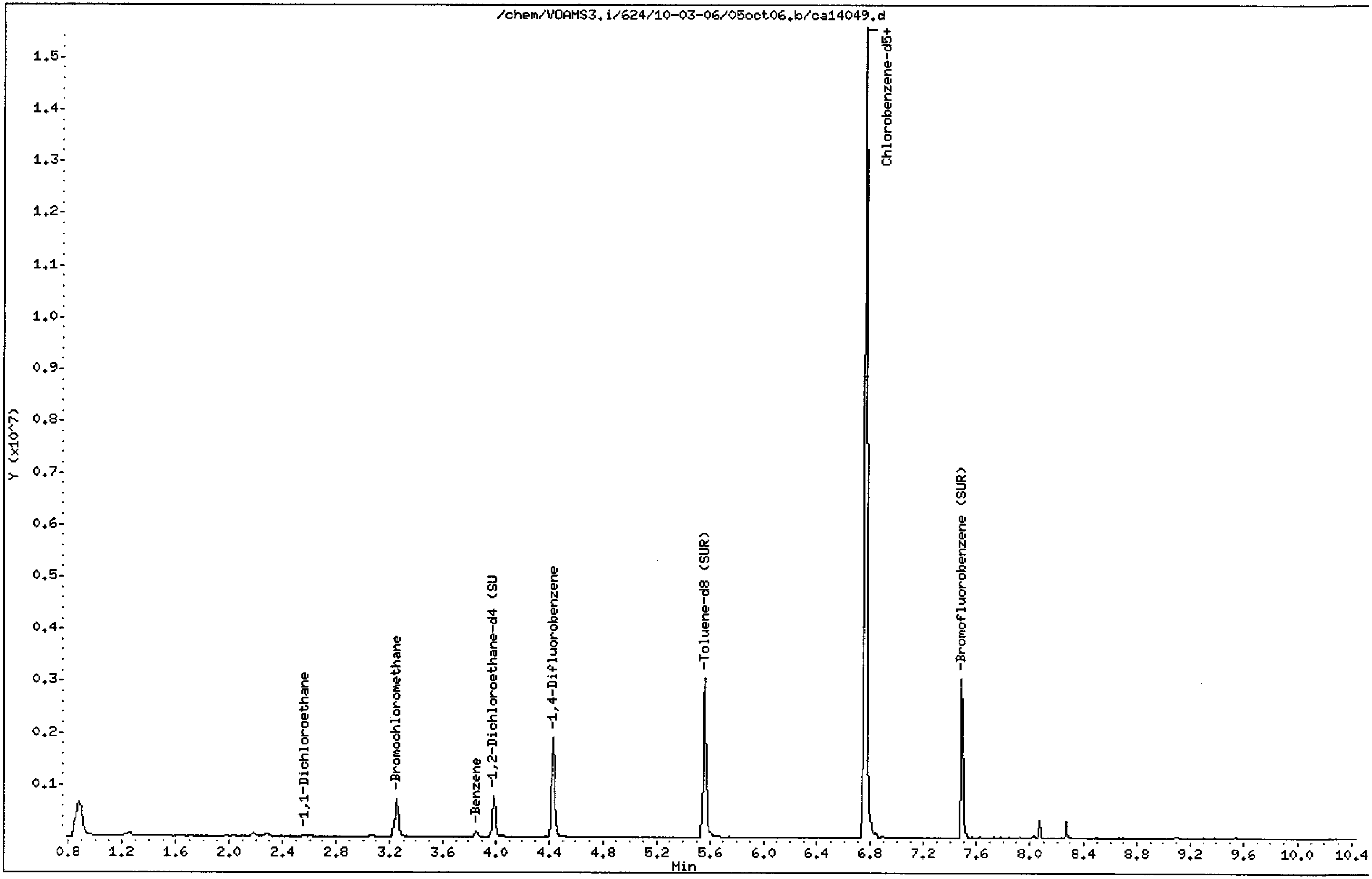
TOTAL ESTIMATED CONCENTRATION 0.0

```
Data File: /chem/VOAMS3.i/624/10-03-06/05oct06.b/ca14049.d
Report Date: 11-Oct-2006 18:28


                                        STL Edison

                             VOLATILE ORGANIC COMPOUND ANALYSIS
Data file : /chem/VOAMS3.i/624/10-03-06/05oct06.b/ca14049.d
Lab Smp Id: 774588                        Client Smp ID: GW8-MW-59
Inj Date  : 06-OCT-2006 14:11
Operator  :                               Inst ID: VOAMS3.i
Smp Info  : 774588;2
Misc Info : X772;3601;;KLB
Comment   :
Method    : /chem/VOAMS3.i/624/10-03-06/05oct06.b/624_05.m
Meth Date : 05-Oct-2006 19:30 ken         Quant Type: ISTD
Cal Date  : 04-OCT-2006 00:49             Cal File: ca13890.d
Als bottle: 46
Dil Factor: 2.00000
Integrator: HP RTE                        Compound Sublist: HSLVOAv.sub
Target Version:  3.50


Concentration Formula: Amt * DF * 5/Vo * CpndVariable

     Name        Value          Description
-------------- -------------- ----------------------
     DF         2.00000         Dilution Factor
     Vo         5.00000        Sample Volume

Cpnd Variable                  Local Compound Variable



                                                                              CONCENTRATIONS
                                         QUANT SIG                            ON-COLUMN   FINAL
Compounds                                  MASS      RT    EXP RT REL RT   RESPONSE   ( ug/L)   ( ug/L)
=========================                  ====      ==    ====== ======   ========   =======   =======
    11 1,1-Dichloroethane                    63    2.561   2.562 (0.788)     12212    0.41683      0.83
 *   2 Bromochloromethane                   128    3.249   3.249 (1.000)    204232    30.0000
 $  16 1,2-Dichloroethane-d4 (SUR)          104    3.985   3.985 (0.898)     70449    30.8732        31
    28 Benzene                               78    3.857   3.851 (0.870)     94714    1.60987       3.2
 *  19 1,4-Difluorobenzene                  114    4.435   4.429 (1.000)   1433448    30.0000
 $  37 Toluene-d8 (SUR)                      98    5.561   5.561 (0.824)   1630775    29.2743        29
 *  32 Chlorobenzene-d5                     117    6.747   6.747 (1.000)   1466132    30.0000
    39 Chlorobenzene                        112    6.759   6.759 (1.002)   5387782    116.724       230
 $  41 Bromofluorobenzene (SUR)             174    7.489   7.489 (1.110)    530833    26.1897        26
```

Data File: /chem/VOAMS3.i/624/10-03-06/05oct06.b/ca14049.d
Date : 06-OCT-2006 14:11
Client ID: GW8-MW-59
Sample Info: 774588;2
Purge Volume: 5.0
Column phase: DB624

Instrument: VOAMS3.i

Operator:
Column diameter: 0.18



Data File: /chem/VOAMS3.i/624/10-03-06/05oct06.b/ca14049.d

Date : 06-OCT-2006 14:11

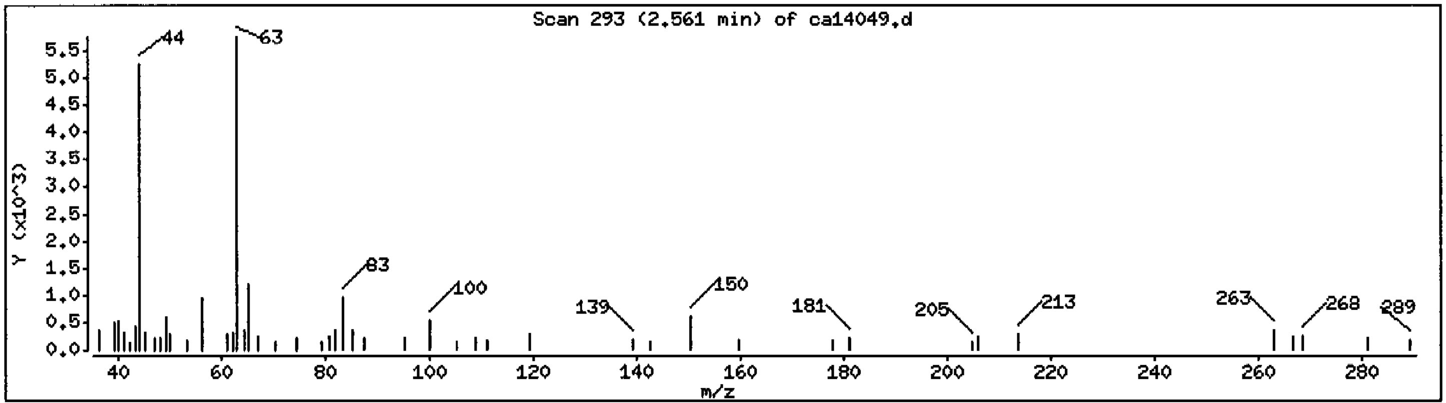
Client ID: GW8-MW-59 Instrument: VOAMS3.i

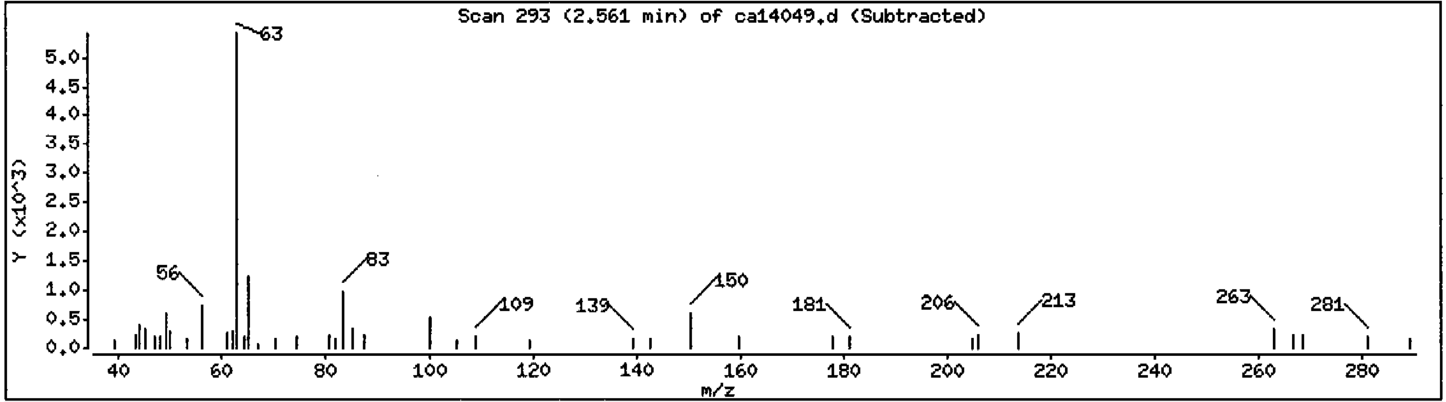
Sample Info: 774588;2

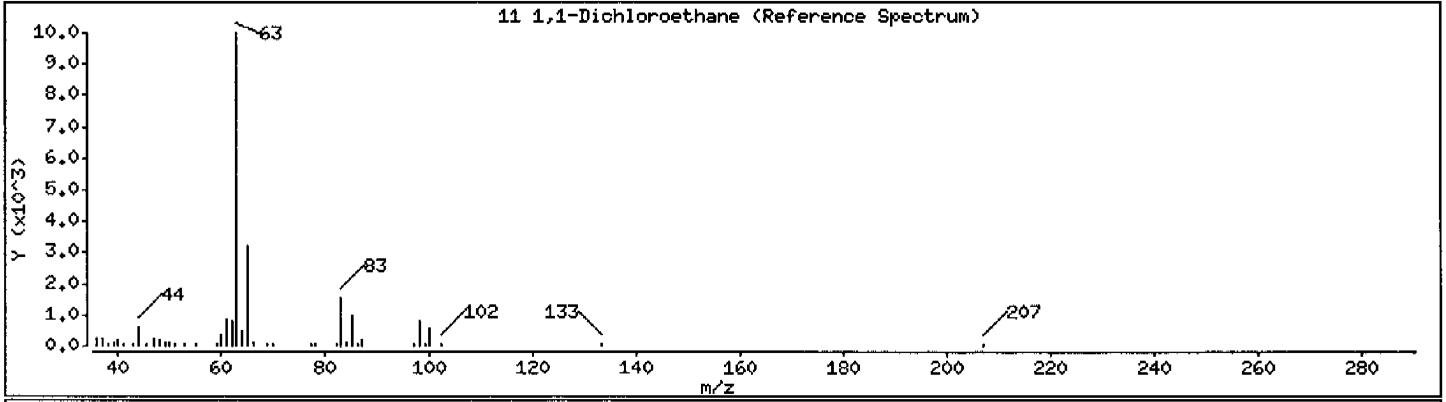
Purge Volume: 5.0 Operator:

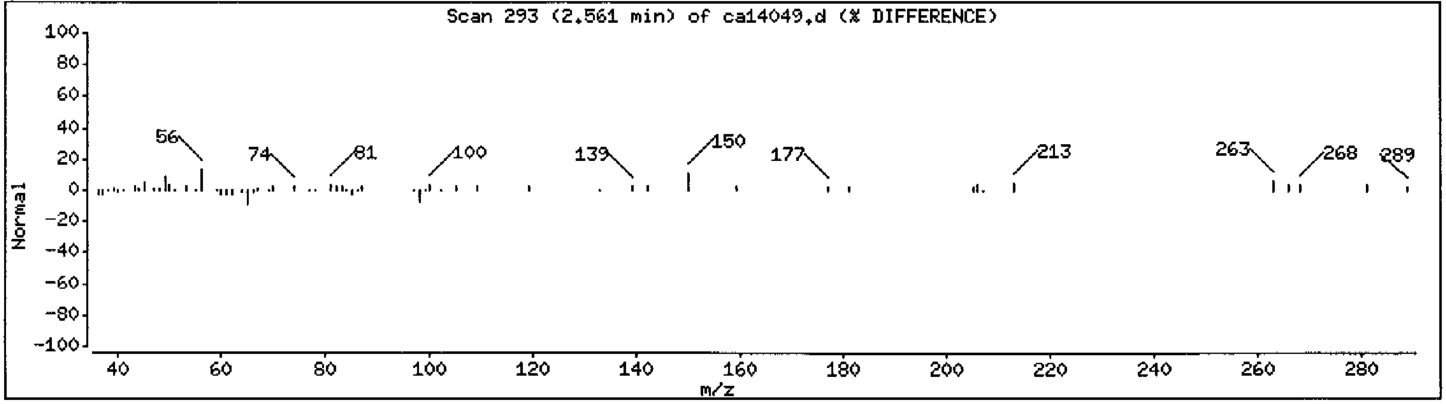
Column phase: DB624 Column diameter: 0.18

11 1,1-Dichloroethane Concentration: 0.83 ug/L


Scan 293 (2.561 min) of ca14049.d


Scan 293 (2.561 min) of ca14049.d (Subtracted)


11 1,1-Dichloroethane (Reference Spectrum)


Scan 293 (2.561 min) of ca14049.d (% DIFFERENCE)

Data File: /chem/VOAMS3.i/624/10-03-06/05oct06.b/ca14049.d

Date : 06-OCT-2006 14:11

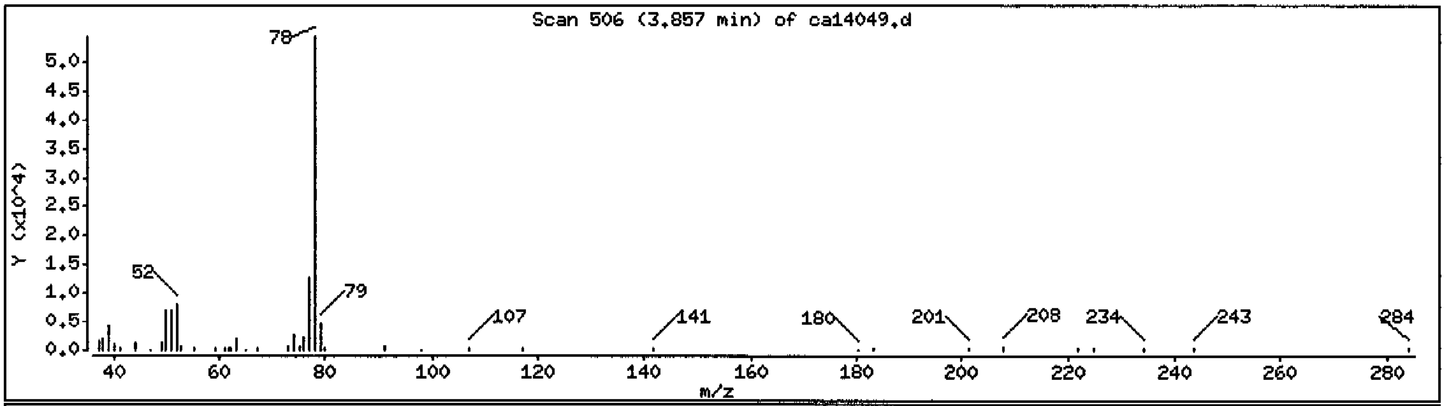
Client ID: GW8-MW-59 Instrument: VOAMS3.i

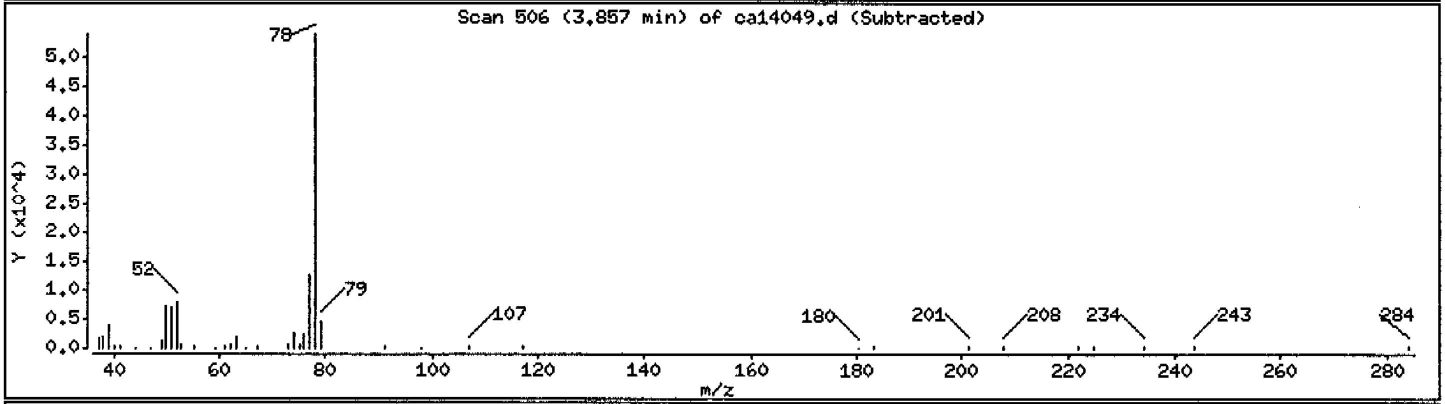
Sample Info: 774588;2

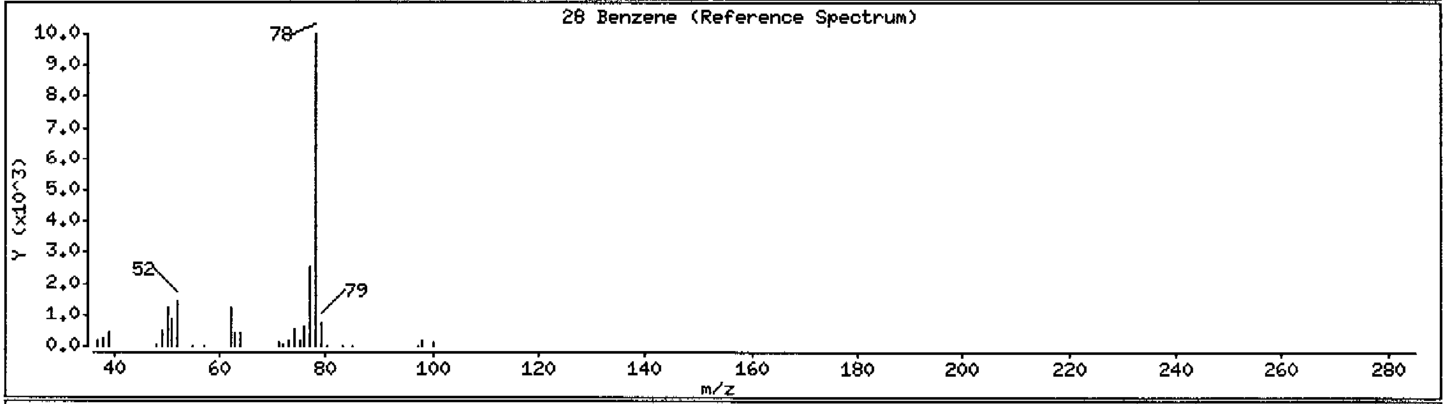
Purge Volume: 5.0 Operator:

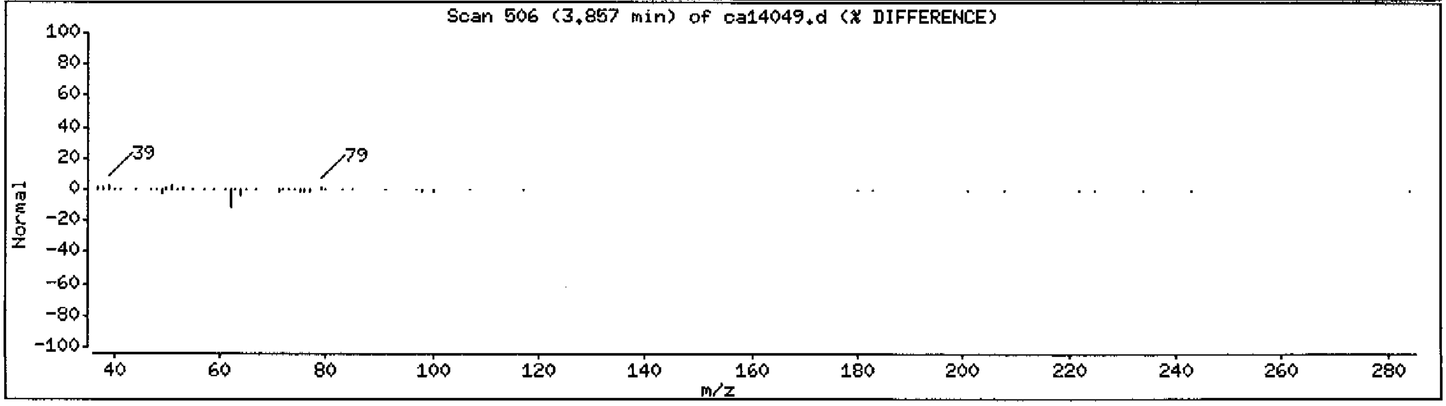
Column phase: DB624 Column diameter: 0.18

28 Benzene Concentration: 3.2 ug/L


Scan 506 (3.857 min) of ca14049.d


Scan 506 (3.857 min) of ca14049.d (Subtracted)


28 Benzene (Reference Spectrum)


Scan 506 (3.857 min) of ca14049.d (% DIFFERENCE)

Data File: /chem/VOAMS3.i/624/10-03-06/05oct06.b/ca14049.d

Date : 06-OCT-2006 14:11

Client ID: GW8-MW-59

Instrument: VOAMS3.i

Sample Info: 774588;2

Purge Volume: 5.0

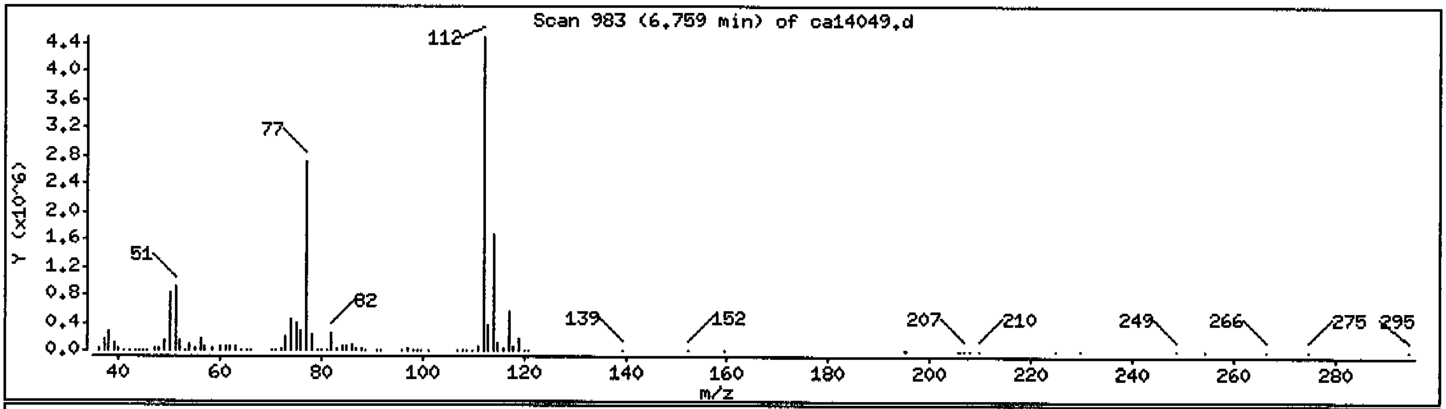
Operator:

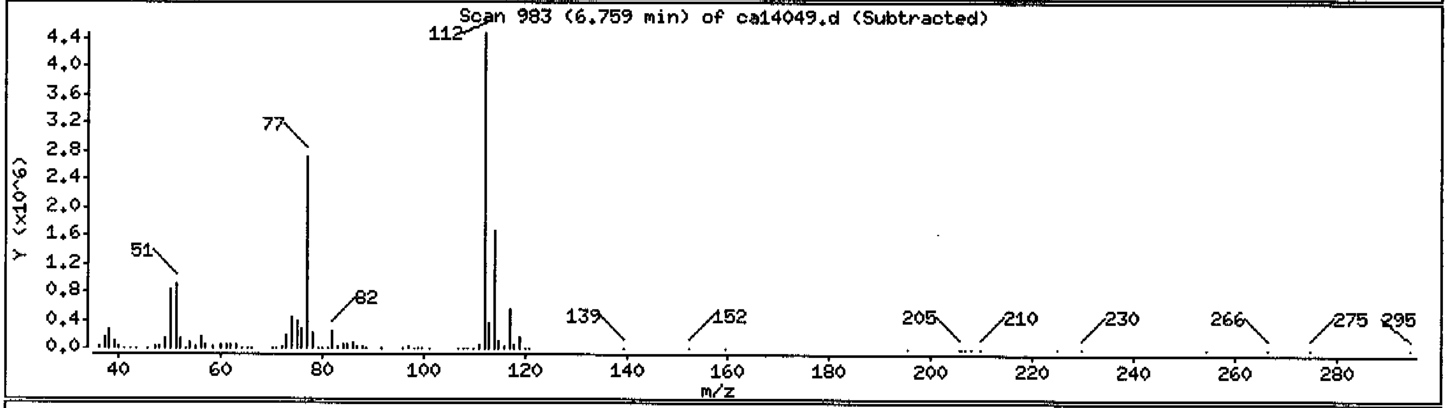
Column phase: DB624

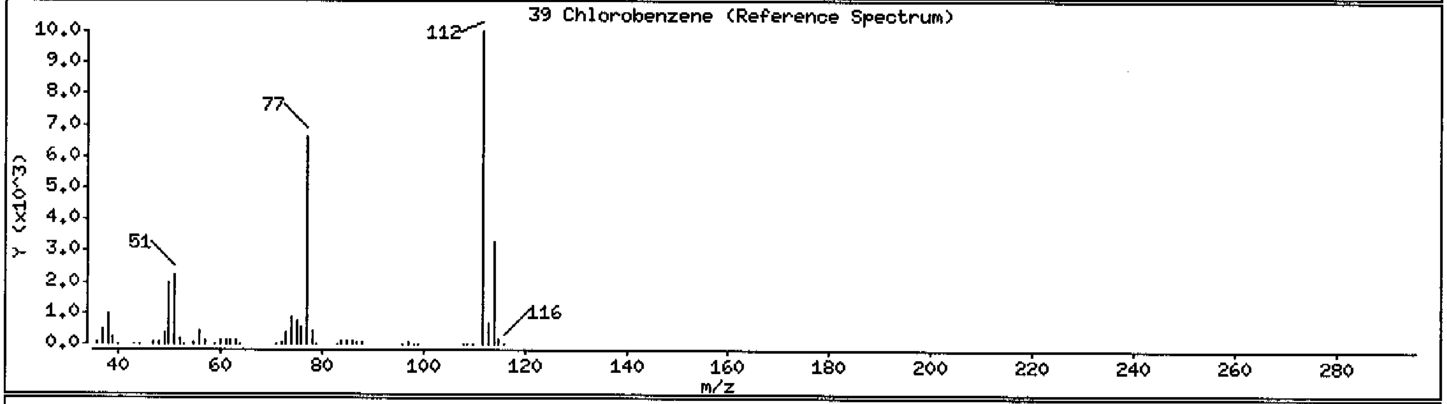
Column diameter: 0.18

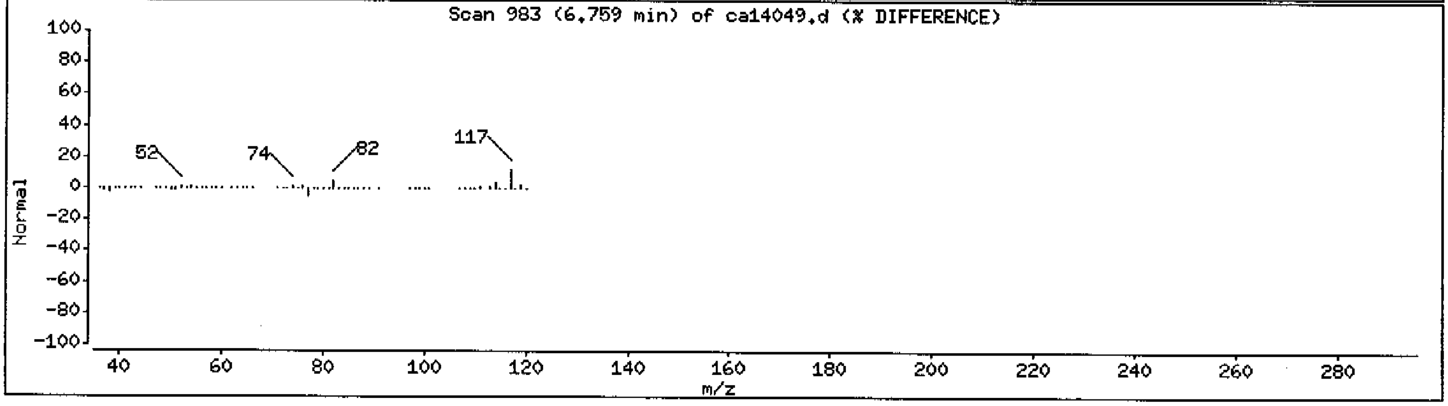
39 Chlorobenzene

Concentration: 230 ug/L









Client ID: **GW8-MW-59-Z**
Site: Raritan Arsenal

Lab Sample No: **774589**
Lab Job No: X772

Date Sampled: 10/02/06
Date Received: 10/02/06
Date Analyzed: 10/07/06
GC Column: DB624
Instrument ID: VOAMS3.i
Lab File ID: ca14068.d

Matrix: WATER
Level: LOW
Purge Volume: 5.0 ml
Dilution Factor: 2.0

VOLATILE ORGANICS - GC/MS
METHOD 624

Parameter	Analytical Result Units: ug/l	Method Detection Limit Units: ug/l
Chloromethane	ND	0.6
Bromomethane	ND	0.6
Vinyl Chloride	ND	0.6
Chloroethane	ND	0.5
Methylene Chloride	ND	1.0
Acetone	ND	2.5
Carbon Disulfide	ND	0.7
1,1-Dichloroethene	ND	0.7
1,1-Dichloroethane	0.9	0.6
trans-1,2-Dichloroethene	ND	0.9
cis-1,2-Dichloroethene	ND	0.9
Chloroform	ND	1.0
1,2-Dichloroethane	1.0	0.6
2-Butanone	ND	1.9
1,1,1-Trichloroethane	ND	0.7
Carbon Tetrachloride	ND	0.6
Bromodichloromethane	ND	0.6
1,2-Dichloropropane	ND	0.6
cis-1,3-Dichloropropene	ND	0.5
Trichloroethene	ND	0.7
Dibromochloromethane	ND	0.5
1,1,2-Trichloroethane	ND	0.7
Benzene	3.2	0.7
trans-1,3-Dichloropropene	ND	0.5
Bromoform	ND	0.4
4-Methyl-2-Pentanone	ND	1.0
2-Hexanone	ND	1.0
Tetrachloroethene	ND	0.9
1,1,2,2-Tetrachloroethane	ND	0.7
Toluene	ND	0.8
Chlorobenzene	250	0.9
Ethylbenzene	ND	0.9
Styrene	ND	0.8
Xylene (Total)	ND	0.8

Client ID: **GW8-MW-59-Z**
Site: Raritan Arsenal

Lab Sample No: **774589**
Lab Job No: X772

Date Sampled: 10/02/06
Date Received: 10/02/06
Date Analyzed: 10/07/06
GC Column: DB624
Instrument ID: VOAMS3.i
Lab File ID: ca14068.d

Matrix: WATER
Level: LOW
Purge Volume: 5.0 ml
Dilution Factor: 2.0

VOLATILE ORGANICS - GC/MS
TENTATIVELY IDENTIFIED COMPOUNDS
METHOD 624

COMPOUND NAME	RT	EST. CONC. ug/l	Q
1. NO VOLATILE ORGANIC COMPOUNDS FOUND			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
13.			
14.			
15.			
16.			
17.			
18.			
19.			
20.			
21.			
22.			
23.			
24.			
25.			
26.			
27.			
28.			
29.			
30.			

TOTAL ESTIMATED CONCENTRATION 0.0

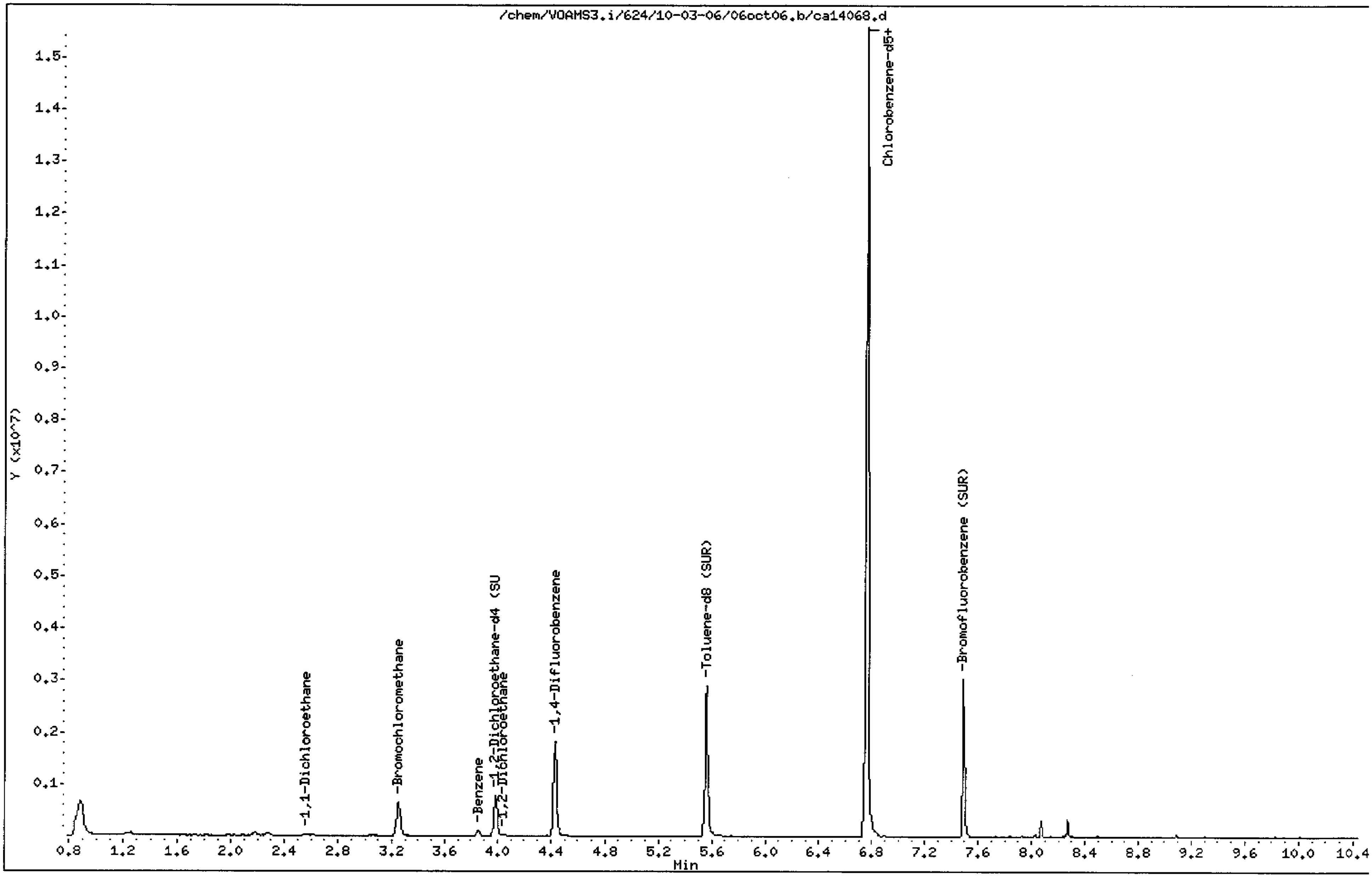
```
Data File: /chem/VOAMS3.i/624/10-03-06/06oct06.b/cal4068.d
Report Date: 12-Oct-2006 16:27


                              STL Edison

                    VOLATILE ORGANIC COMPOUND ANALYSIS
Data file : /chem/VOAMS3.i/624/10-03-06/06oct06.b/cal4068.d
Lab Smp Id: 774589                    Client Smp ID: GW8-MW-59-Z
Inj Date  : 07-OCT-2006 04:03
Operator  :                           Inst ID: VOAMS3.i
Smp Info  : 774589;2
Misc Info : X772;3601;;KLB
Comment   :
Method    : /chem/VOAMS3.i/624/10-03-06/06oct06.b/624_05.m
Meth Date : 07-Oct-2006 01:06 ken     Quant Type: ISTD
Cal Date  : 04-OCT-2006 00:49         Cal File: cal3890.d
Als bottle: 16
Dil Factor: 2.00000
Integrator: HP RTE                    Compound Sublist: HSLVOAv.sub
Target Version:  3.50

Concentration Formula: Amt * DF * 5/Vo * CpndVariable

     Name         Value         Description
-------------- -------------- ----------------------
     DF         2.00000        Dilution Factor
     Vo         5.00000       Sample Volume

Cpnd Variable                  Local Compound Variable
```

```
                                                                                      CONCENTRATIONS
                                       QUANT SIG                                    ON-COLUMN   FINAL
Compounds                                MASS      RT     EXP RT REL RT   RESPONSE    ( ug/L)   ( ug/L)
==========================              ====      ==     ====== ======   ========    =======   =======
   11 1,1-Dichloroethane                   63    2.561   2.561 (0.788)     12746    0.45226      0.90
*   2 Bromochloromethane                  128    3.249   3.249 (1.000)    196465    30.0000
$  16 1,2-Dichloroethane-d4 (SUR)         104    3.985   3.985 (0.900)     63326    28.8706        29
   28 Benzene                              78    3.851   3.851 (0.870)     91125    1.61131       3.2
   17 1,2-Dichloroethane                   62    4.046   4.040 (0.913)     10169    0.50846       1.0
*  19 1,4-Difluorobenzene                 114    4.429   4.429 (1.000)   1377895    30.0000
$  37 Toluene-d8 (SUR)                     98    5.561   5.561 (0.824)   1548756    29.8786        30
*  32 Chlorobenzene-d5                    117    6.747   6.747 (1.000)   1364230    30.0000
   39 Chlorobenzene                       112    6.759   6.759 (1.002)   5376770    125.186       250
$  41 Bromofluorobenzene (SUR)            174    7.489   7.489 (1.110)    517447    27.4362        27
```

Data File: /chem/VOAMS3.i/624/10-03-06/06oct06.b/ca14068.d
Date : 07-OCT-2006 04:03
Client ID: GW8-MW-59-Z
Sample Info: 774589;2
Purge Volume: 5.0
Column phase: DB624

Instrument: VOAMS3.i

Operator:
Column diameter: 0.18



Data File: /chem/VOAMS3.i/624/10-03-06/06oct06.b/ca14068.d

Date : 07-OCT-2006 04:03

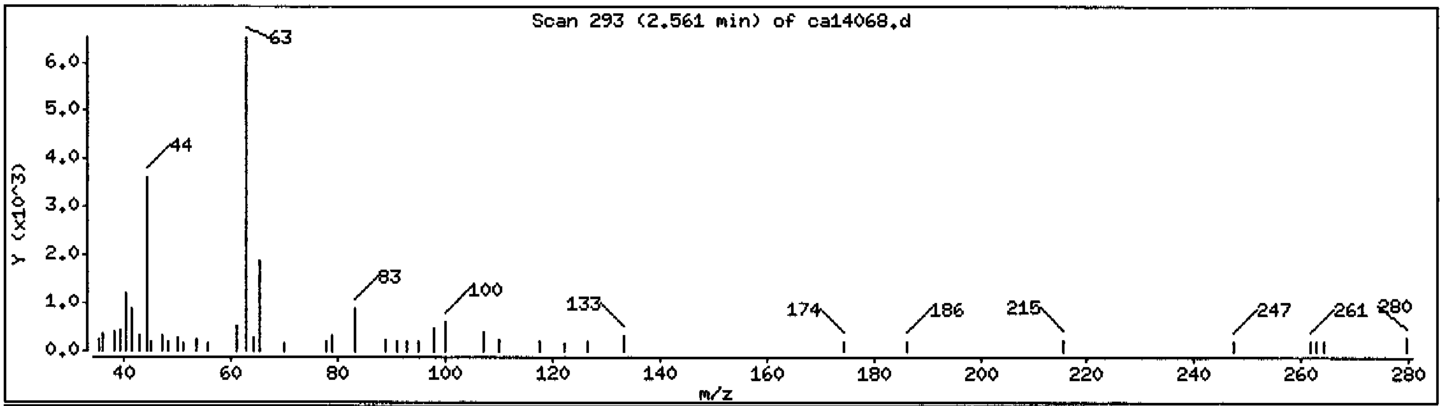
Client ID: GW8-MW-59-Z Instrument: VOAMS3.i

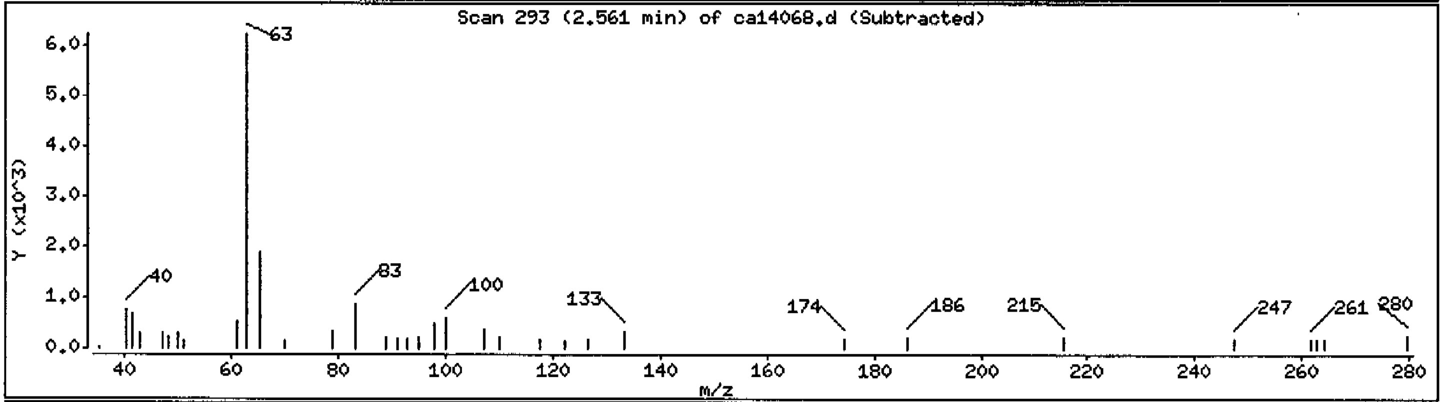
Sample Info: 774589;2

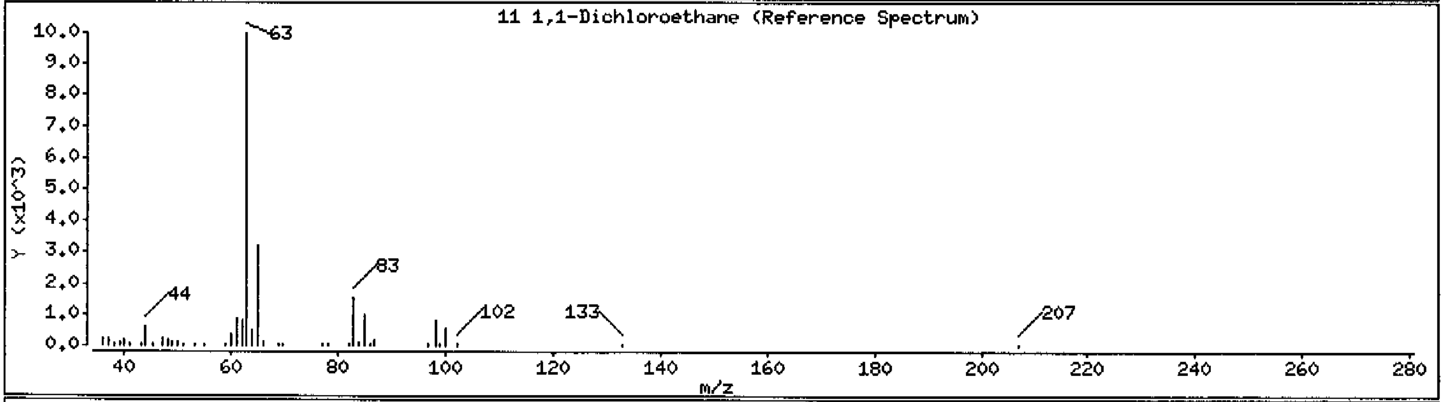
Purge Volume: 5.0 Operator:

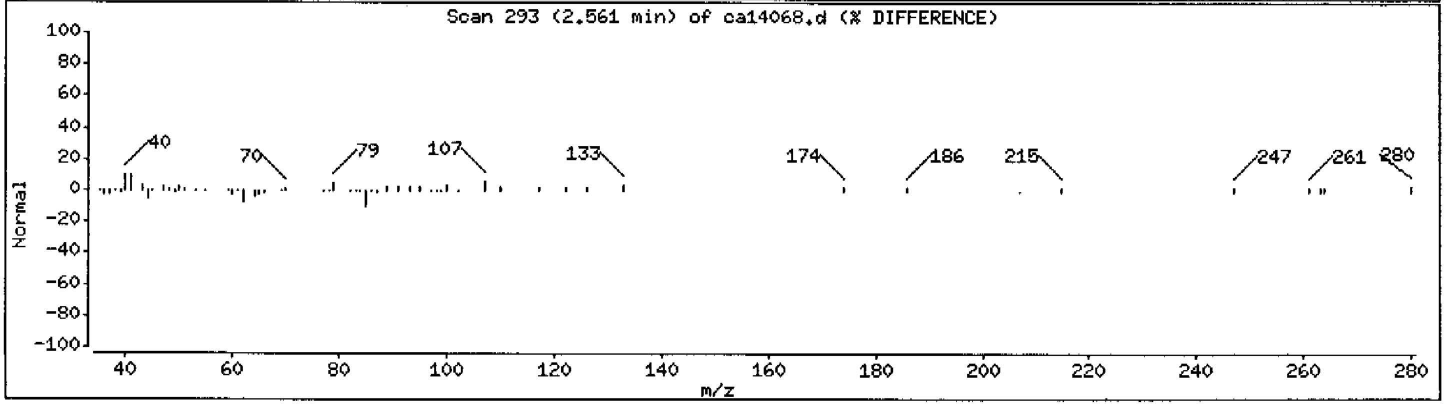
Column phase: DB624 Column diameter: 0.18

11 1,1-Dichloroethane Concentration: 0.90 ug/L


Scan 293 (2.561 min) of ca14068.d


Scan 293 (2.561 min) of ca14068.d (Subtracted)


11 1,1-Dichloroethane (Reference Spectrum)


Scan 293 (2.561 min) of ca14068.d (% DIFFERENCE)

Data File: /chem/VOAMS3.i/624/10-03-06/06oct06.b/ca14068.d

Date : 07-OCT-2006 04:03

Client ID: GW8-MW-59-Z

Instrument: VOAMS3.i

Sample Info: 774589;2

Purge Volume: 5.0

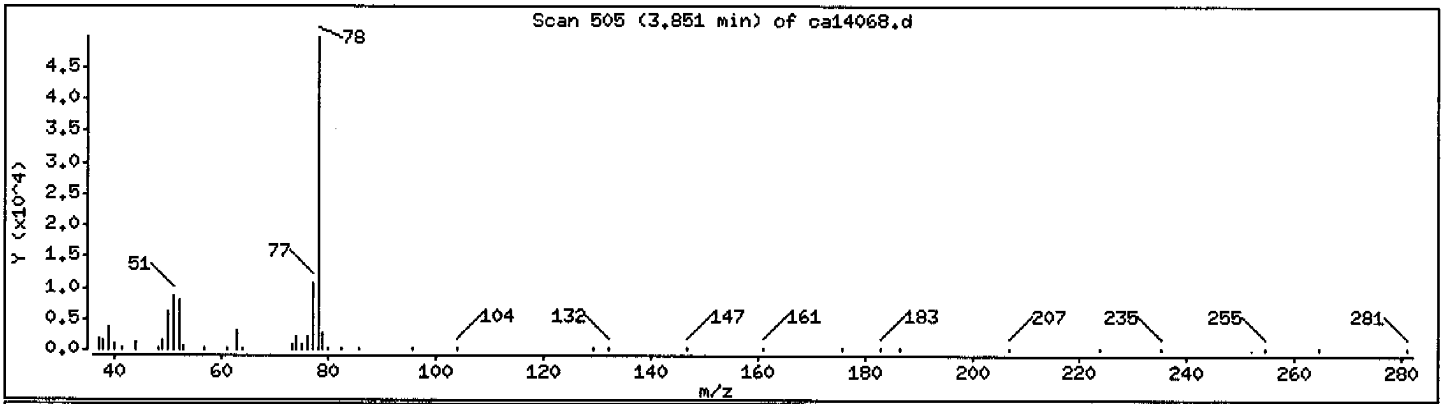
Operator:

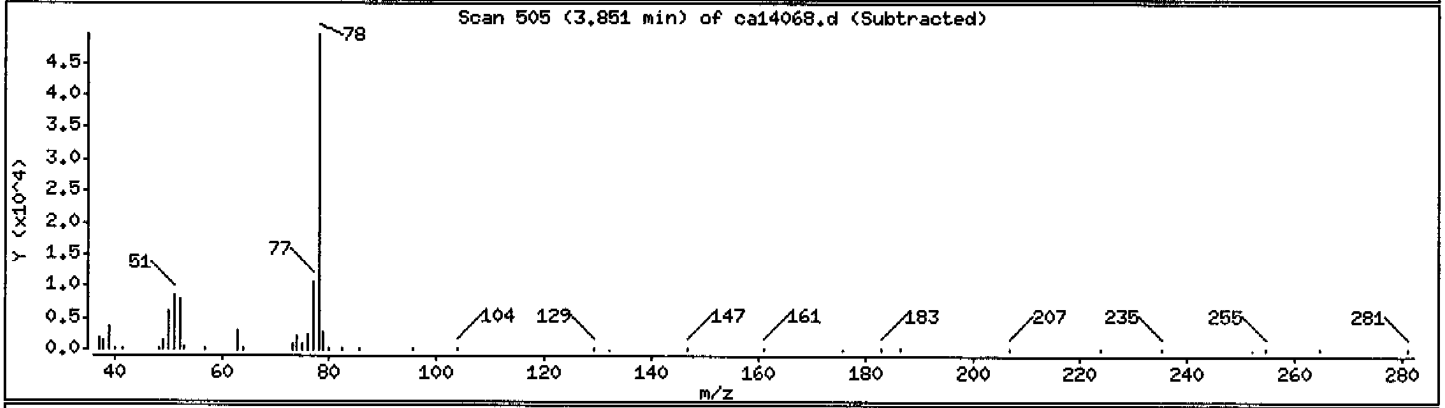
Column phase: DB624

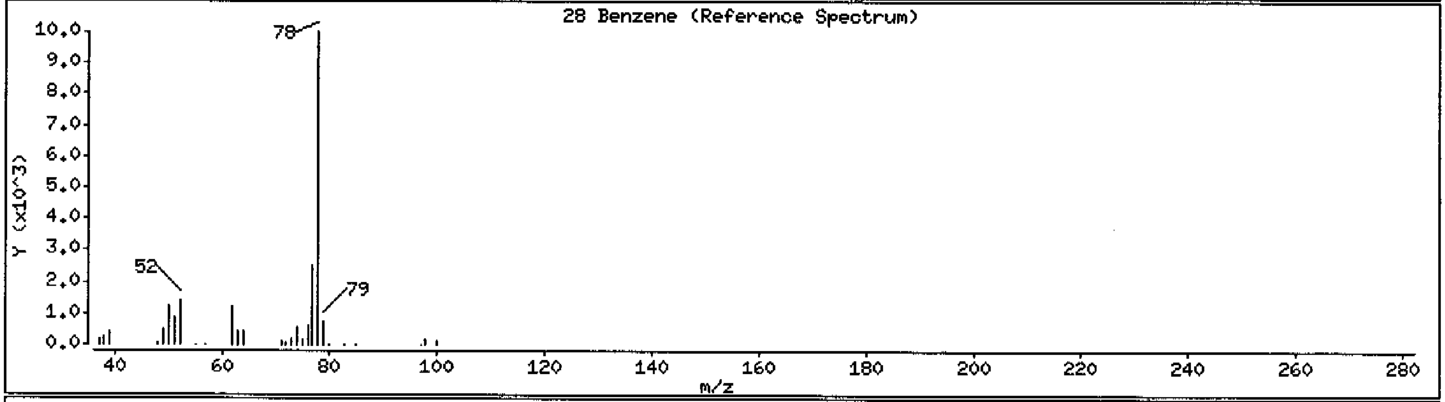
Column diameter: 0.18

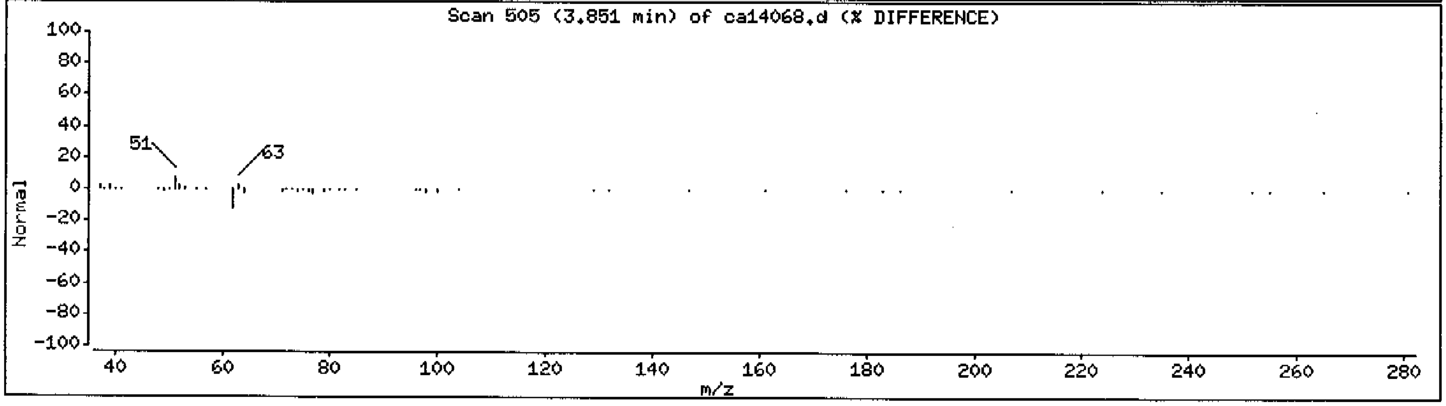
28 Benzene

Concentration: 3.2 ug/L


Scan 505 (3.851 min) of ca14068.d


Scan 505 (3.851 min) of ca14068.d (Subtracted)


28 Benzene (Reference Spectrum)


Scan 505 (3.851 min) of ca14068.d (% DIFFERENCE)

Data File: /chem/VOAMS3.i/624/10-03-06/06oct06.b/ca14068.d

Date : 07-OCT-2006 04:03

Client ID: GW8-MW-59-Z

Instrument: VOAMS3.i

Sample Info: 774589;2

Purge Volume: 5.0

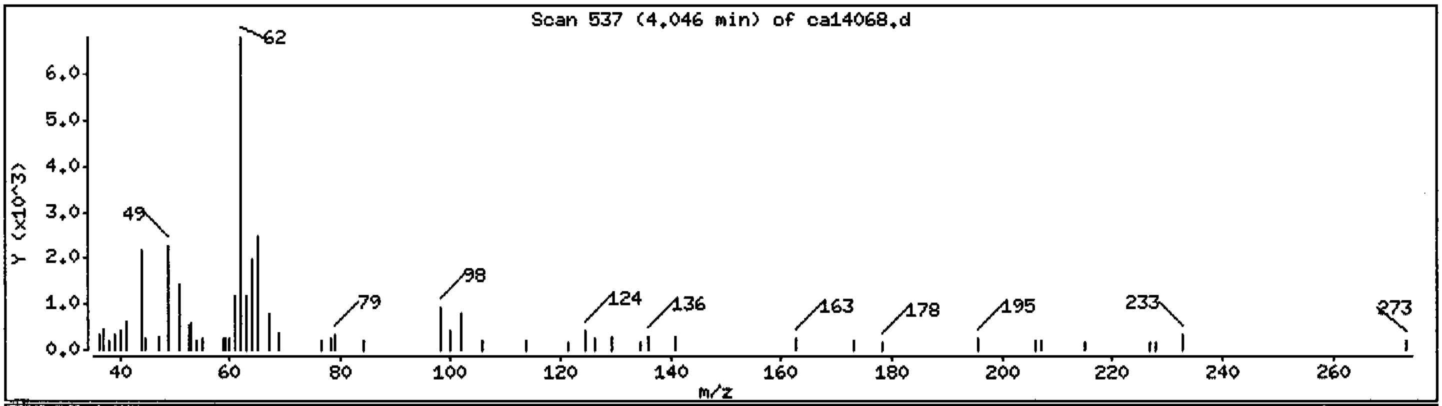
Operator:

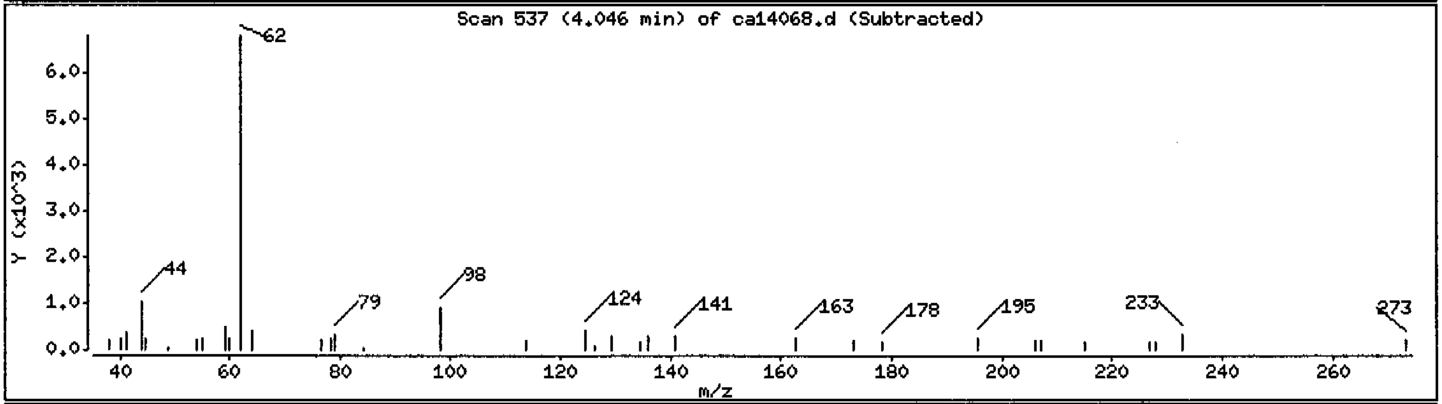
Column phase: DB624

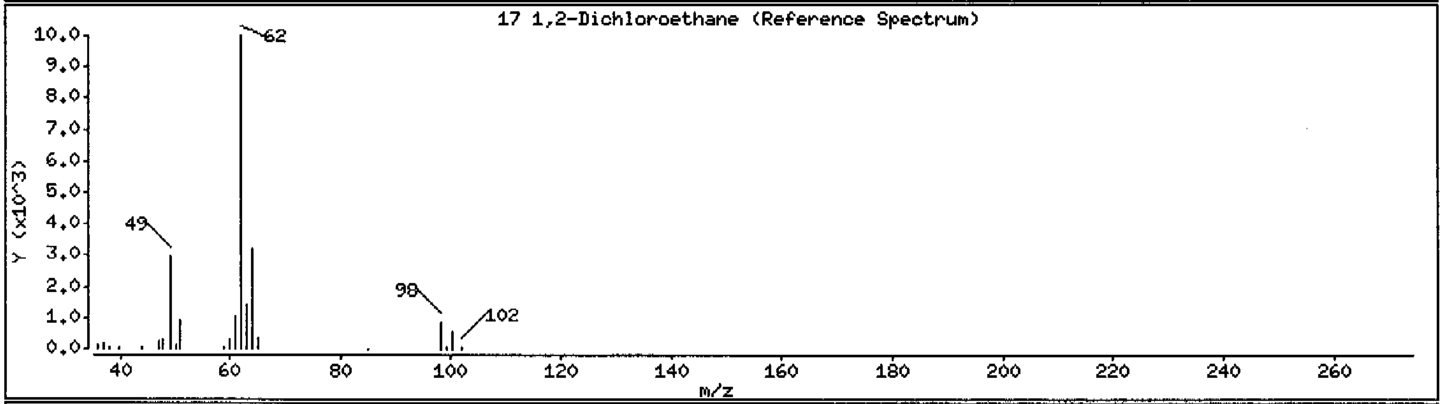
Column diameter: 0.18

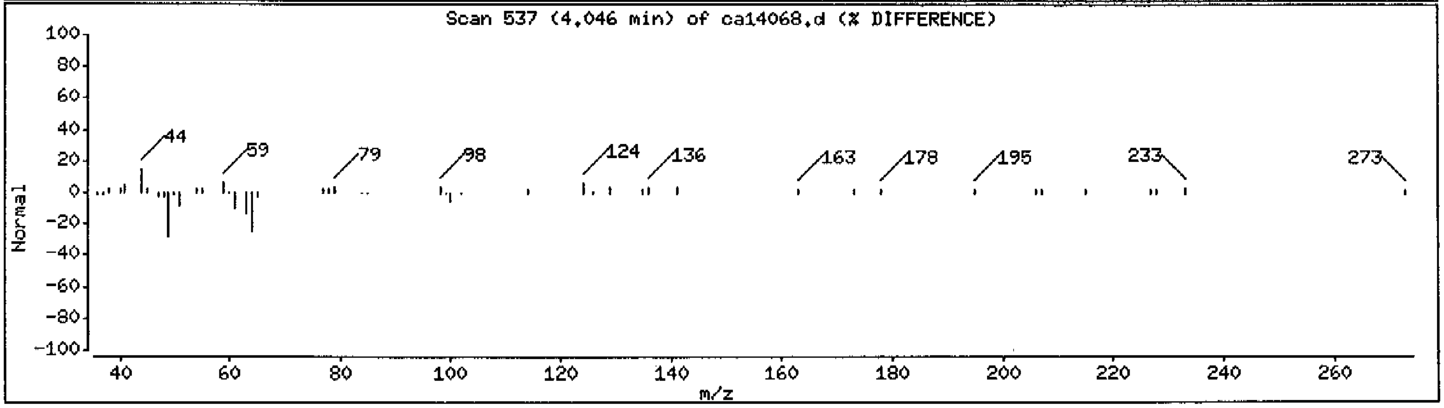
17 1,2-Dichloroethane

Concentration: 1.0 ug/L


Scan 537 (4.046 min) of ca14068.d


Scan 537 (4.046 min) of ca14068.d (Subtracted)


17 1,2-Dichloroethane (Reference Spectrum)


Scan 537 (4.046 min) of ca14068.d (% DIFFERENCE)

Data File: /chem/VOAMS3.i/624/10-03-06/06oct06.b/ca14068.d

Date : 07-OCT-2006 04:03

Client ID: GW8-MW-59-Z

Instrument: VOAMS3.i

Sample Info: 774589;2

Purge Volume: 5.0

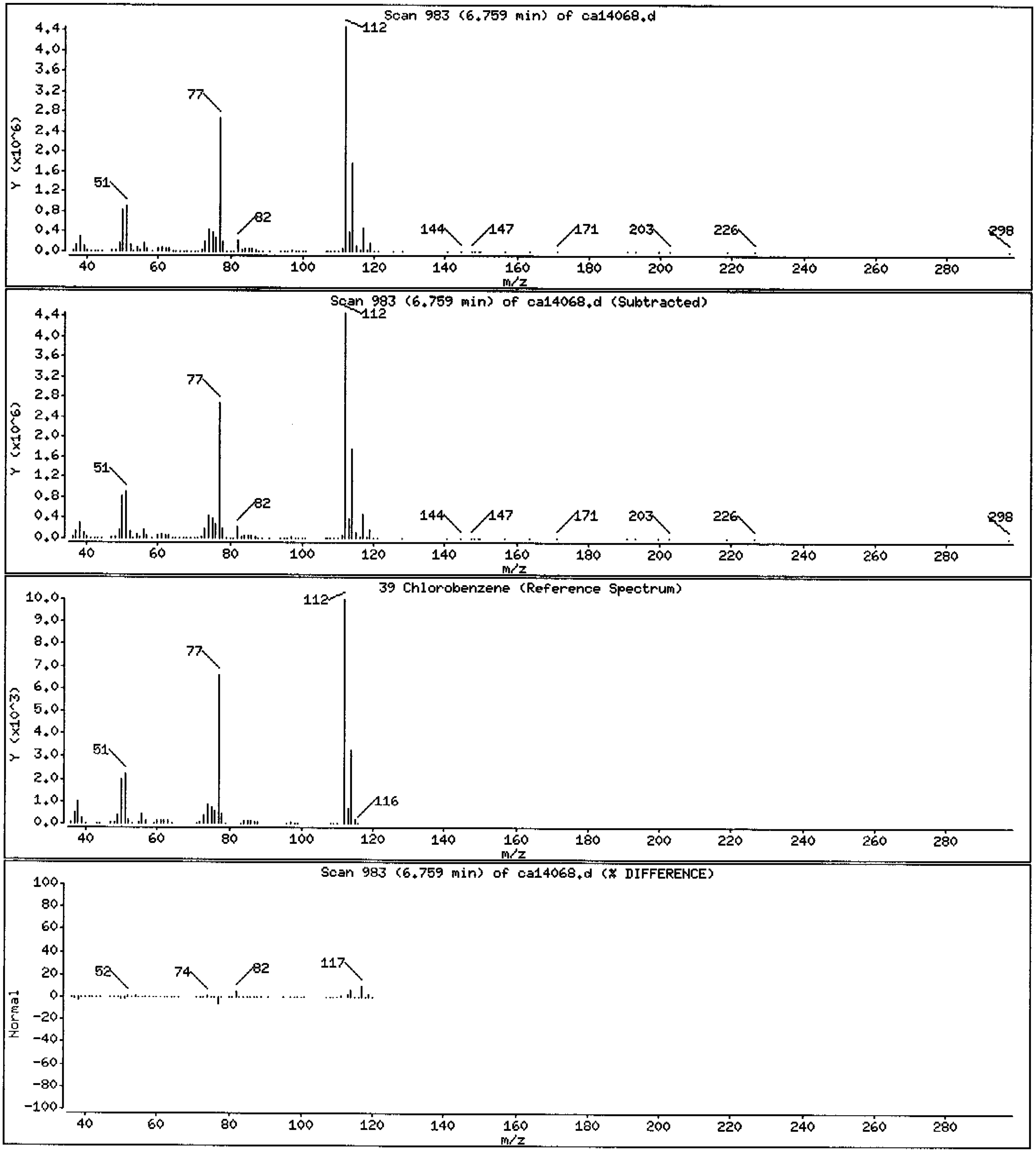
Operator:

Column phase: DB624

Column diameter: 0.18

39 Chlorobenzene

Concentration: 250 ug/L



Client ID: **TB**
Site: Raritan Arsenal

Lab Sample No: **774590**
Lab Job No: X772

Date Sampled: 09/29/06
Date Received: 10/02/06
Date Analyzed: 10/07/06
GC Column: DB624
Instrument ID: VOAMS3.i
Lab File ID: ca14061.d

Matrix: WATER
Level: LOW
Purge Volume: 5.0 ml
Dilution Factor: 1.0

VOLATILE ORGANICS - GC/MS
METHOD 624

Parameter	Analytical Result Units: ug/l	Method Detection Limit Units: ug/l
Chloromethane	ND	0.3
Bromomethane	ND	0.3
Vinyl Chloride	ND	0.3
Chloroethane	ND	0.2
Methylene Chloride	ND	0.5
Acetone	ND	1.3
Carbon Disulfide	ND	0.3
1,1-Dichloroethene	ND	0.4
1,1-Dichloroethane	ND	0.3
trans-1,2-Dichloroethene	ND	0.4
cis-1,2-Dichloroethene	ND	0.4
Chloroform	ND	0.5
1,2-Dichloroethane	ND	0.3
2-Butanone	ND	0.9
1,1,1-Trichloroethane	ND	0.3
Carbon Tetrachloride	ND	0.3
Bromodichloromethane	ND	0.3
1,2-Dichloropropane	ND	0.3
cis-1,3-Dichloropropene	ND	0.2
Trichloroethene	ND	0.4
Dibromochloromethane	ND	0.3
1,1,2-Trichloroethane	ND	0.3
Benzene	ND	0.3
trans-1,3-Dichloropropene	ND	0.2
Bromoform	ND	0.2
4-Methyl-2-Pentanone	ND	0.5
2-Hexanone	ND	0.5
Tetrachloroethene	ND	0.4
1,1,2,2-Tetrachloroethane	ND	0.3
Toluene	ND	0.4
Chlorobenzene	ND	0.4
Ethylbenzene	ND	0.5
Styrene	ND	0.4
Xylene (Total)	ND	0.4

Client ID: **TB**
Site: Raritan Arsenal

Lab Sample No: **774590**
Lab Job No: X772

Date Sampled: 09/29/06
Date Received: 10/02/06
Date Analyzed: 10/07/06
GC Column: DB624
Instrument ID: VOAMS3.i
Lab File ID: ca14061.d

Matrix: WATER
Level: LOW
Purge Volume: 5.0 ml
Dilution Factor: 1.0

VOLATILE ORGANICS - GC/MS
TENTATIVELY IDENTIFIED COMPOUNDS
METHOD 624

COMPOUND NAME	RT	EST. CONC. ug/l	Q
1. NO VOLATILE ORGANIC COMPOUNDS FOUND			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
13.			
14.			
15.			
16.			
17.			
18.			
19.			
20.			
21.			
22.			
23.			
24.			
25.			
26.			
27.			
28.			
29.			
30.			

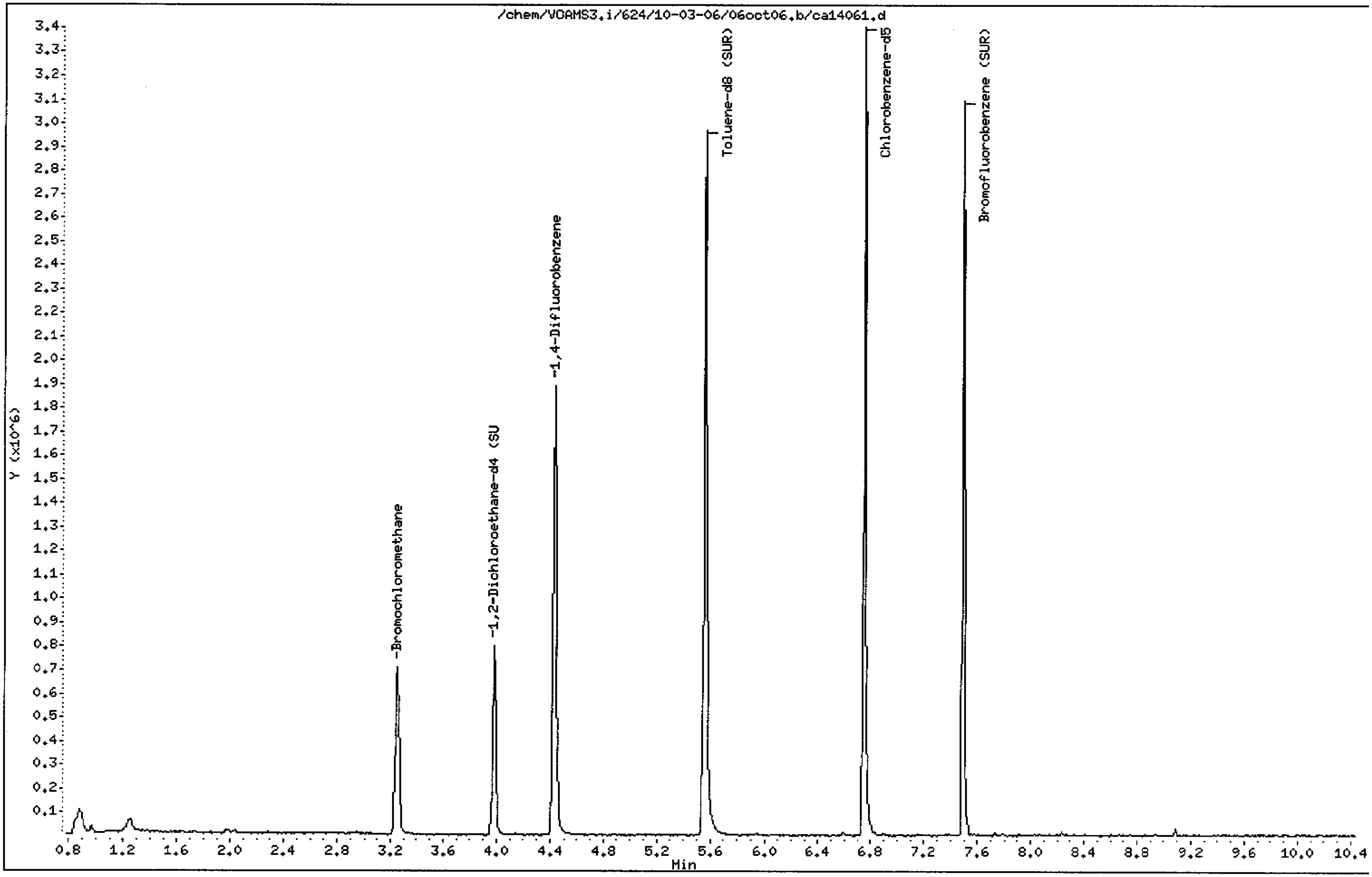
TOTAL ESTIMATED CONCENTRATION 0.0

```
Data File: /chem/VOAMS3.i/624/10-03-06/06oct06.b/ca14061.d
Report Date: 12-Oct-2006 16:27


                                      STL Edison

                             VOLATILE ORGANIC COMPOUND ANALYSIS
Data file : /chem/VOAMS3.i/624/10-03-06/06oct06.b/ca14061.d
Lab Smp Id: 774590                         Client Smp ID: TB
Inj Date  : 07-OCT-2006 01:04
Operator  :                                Inst ID: VOAMS3.i
Smp Info  : 774590
Misc Info : X772;3601;;KLB
Comment   :
Method    : /chem/VOAMS3.i/624/10-03-06/06oct06.b/624_05.m
Meth Date : 07-Oct-2006 01:06 ken          Quant Type: ISTD
Cal Date  : 04-OCT-2006 00:49              Cal File: ca13890.d
Als bottle: 9
Dil Factor: 1.00000
Integrator: HP RTE                         Compound Sublist: HSLVOAv.sub
Target Version:  3.50

Concentration Formula: Amt * DF * 5/Vo * CpndVariable

     Name         Value          Description
-------------- -------------- -----------------------
     DF         1.00000        Dilution Factor
     Vo         5.00000       Sample Volume

Cpnd Variable                  Local Compound Variable



                                                                                    CONCENTRATIONS
                                             QUANT SIG                              ON-COLUMN     FINAL
Compounds                                      MASS       RT    EXP RT REL RT  RESPONSE   ( ug/L)   ( ug/L)
=========================                      ====       ==    ====== ======  ========   =======   =======
*   2 Bromochloromethane                        128     3.249   3.249 (1.000)    208223   30.0000
$  16 1,2-Dichloroethane-d4 (SUR)               104     3.985   3.985 (0.900)     70187   30.0419        30
*  19 1,4-Difluorobenzene                       114     4.429   4.429 (1.000)   1467637   30.0000
$  37 Toluene-d8 (SUR)                           98     5.561   5.561 (0.824)   1665440   30.8099        31
*  32 Chlorobenzene-d5                          117     6.747   6.747 (1.000)   1422667   30.0000
$  41 Bromofluorobenzene (SUR)                  174     7.489   7.489 (1.110)    528907   26.8920        27
```

Data File: /chem/VOAMS3.i/624/10-03-06/06oct06.b/ca14061.d
Date : 07-OCT-2006 01:04
Client ID: TB
Sample Info: 774590
Purge Volume: 5.0
Column phase: DB624

Instrument: VOAMS3.i

Operator:
Column diameter: 0.18



Tuning Results Summary

VOLATILE ORGANIC INSTRUMENT PERFORMANCE CHECK
BROMOFLUOROBENZENE (BFB)

Lab File ID: CA13882 BFB Injection Date: 10/03/06

Instrument ID: VOAMS3 BFB Injection Time: 2132

m/e	ION ABUNDANCE CRITERIA	% RELATIVE ABUNDANCE
50	15.0 - 40.0% of mass 95	17.5
75	30.0 - 60.0% of mass 95	46.8
95	Base Peak, 100% relative abundance	100.0
96	5.0 - 9.0% of mass 95	6.0
173	Less than 2.0% of mass 174	0.4 (0.5)1
174	50.0 - 100.0% of mass 95	80.3
175	5.0 - 9.0% of mass 174	6.0 (7.5)1
176	95.0 - 101.0% of mass 174	77.7 (96.8)1
177	5.0 - 9.0% of mass 176	5.3 (6.8)2

1-Value is % mass 174 2-Value is % mass 176

THIS CHECK APPLIES TO THE FOLLOWING SAMPLES, MS, MSD, BLANKS, AND STANDARDS:

	CLIENT ID	LAB SAMPLE No.	LAB FILE ID	DATE ANALYZED	TIME ANALYZED
01	CASTD020	CASTD020	CA13885	10/03/06	2252
02	CASTD010	CASTD010	CA13886	10/03/06	2327
03	CASTD005	CASTD005	CA13887	10/03/06	2347
04	CASTD050	CASTD050	CA13889	10/04/06	0028
05	CASTD200	CASTD200	CA13890	10/04/06	0049
06					
07					
08					
09					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					
21					
22					

page 1 of 1

Data File: /chem/VOAMS3.i/624/10-03-06/03oct06.b/ca13882.d

Date : 03-OCT-2006 21:32

Client ID:

Instrument: VOAMS3.i

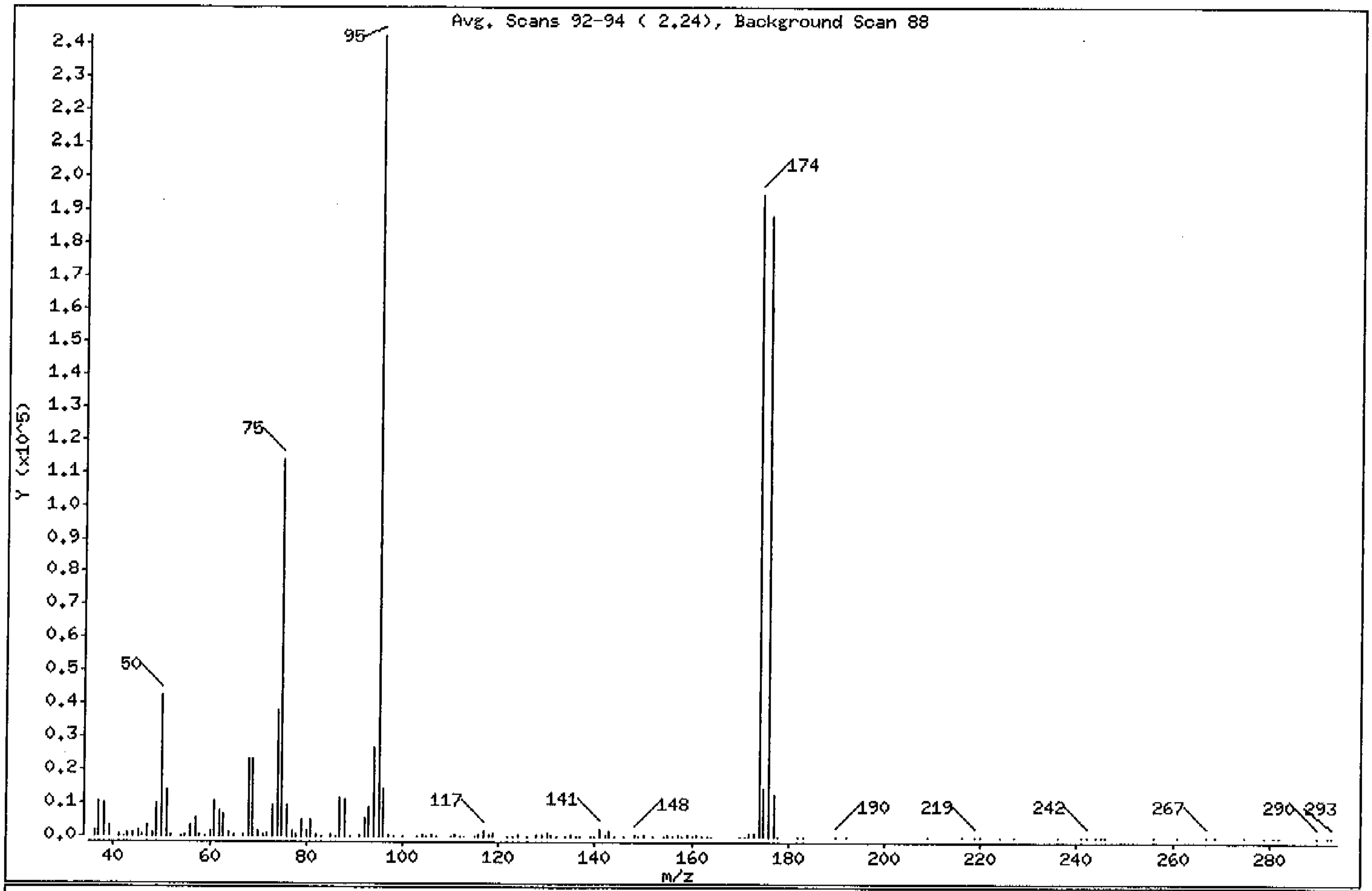
Sample Info: CABFB276

Operator: VOAMS 1

Column phase: DB-624

Column diameter: 0.53

1 Bromofluorobenzene



m/e	ION ABUNDANCE CRITERIA	% RELATIVE ABUNDANCE
95	Base Peak, 100% relative abundance	100.00
50	15.00 - 40.00% of mass 95	17.53
75	30.00 - 60.00% of mass 95	46.80
96	5.00 - 9.00% of mass 95	6.00
173	Less than 2.00% of mass 174	0.40 (0.49)
174	50.00 - 100.00% of mass 95	80.34
175	5.00 - 9.00% of mass 174	6.02 (7.50)
176	95.00 - 101.00% of mass 174	77.73 (96.76)
177	5.00 - 9.00% of mass 176	5.31 (6.83)

Data File: /chem/VOAMS3.i/624/10-03-06/03oct06.b/ca13882.d

Date : 03-OCT-2006 21:32

Client ID: Instrument: VOAMS3.i

Sample Info: CABFB276

Operator: VOAMS 1

Column phase: DB-624 Column diameter: 0.53

```
                Data File: ca13882.d
                 Spectrum: Avg. Scans 92-94 ( 2.24), Background Scan 88
      Location of Maximum:  95.00
         Number of points: 144

     m/z          Y     m/z          Y     m/z          Y     m/z          Y
+------------------+------------------+------------------+------------------+
|   36.00     1517 |   76.00     9735 |  123.00       98 |  173.00      963 |
|   37.00    10385 |   77.00     1584 |  124.00      369 |  174.00   194816 |
|   38.00    10063 |   78.00      757 |  126.00      252 |  175.00    14607 |
|   39.00     3379 |   79.00     5077 |  128.00      572 |  176.00   188480 |
|   41.00      484 |   80.00     1654 |  129.00      547 |  177.00    12869 |
+------------------+------------------+------------------+------------------+
|   42.00      160 |   81.00     5059 |  130.00     1130 |  178.00       89 |
|   43.00      852 |   82.00      695 |  131.00      603 |  182.00       55 |
|   44.00     1037 |   83.00      112 |  132.00      115 |  183.00       70 |
|   45.00     1915 |   85.00      321 |  134.00      199 |  190.00       60 |
|   46.00      399 |   86.00      141 |  135.00      282 |  192.00       50 |
+------------------+------------------+------------------+------------------+
|   47.00     3165 |   87.00    11806 |  136.00       61 |  209.00      114 |
|   48.00     1116 |   88.00    11397 |  137.00       33 |  216.00       92 |
|   49.00     9988 |   89.00       77 |  139.00       82 |  219.00      139 |
|   50.00    42496 |   91.00      652 |  140.00      222 |  220.00       54 |
|   51.00    13700 |   92.00     5484 |  141.00     2041 |  224.00       51 |
+------------------+------------------+------------------+------------------+
|   52.00      351 |   93.00     9051 |  142.00      421 |  227.00       87 |
|   54.00      108 |   94.00    26488 |  143.00     1901 |  236.00       51 |
|   55.00      549 |   95.00   242496 |  144.00       68 |  241.00       69 |
|   56.00     3364 |   96.00    14546 |  146.00      245 |  242.00       99 |
|   57.00     5454 |   97.00      693 |  148.00      631 |  244.00       94 |
+------------------+------------------+------------------+------------------+
|   58.00      352 |   98.00       72 |  149.00      143 |  245.00       66 |
|   59.00       60 |  100.00       60 |  150.00      338 |  246.00       72 |
|   60.00     1898 |  103.00      110 |  152.00      142 |  256.00       71 |
|   61.00    10463 |  104.00      498 |  154.00       90 |  261.00       50 |
|   62.00     8078 |  105.00      194 |  155.00      555 |  267.00       80 |
+------------------+------------------+------------------+------------------+
|   63.00     6767 |  106.00      643 |  156.00      217 |  269.00       52 |
|   64.00     1175 |  107.00       65 |  157.00      330 |  275.00       77 |
|   65.00      541 |  110.00      126 |  158.00      237 |  279.00       98 |
|   67.00      446 |  111.00      412 |  159.00      492 |  281.00       68 |
|   68.00    23400 |  112.00      162 |  160.00       53 |  282.00       62 |
+------------------+------------------+------------------+------------------+
|   69.00    23240 |  113.00      121 |  161.00      292 |  290.00      129 |
|   70.00     1802 |  115.00      225 |  162.00       74 |  292.00      117 |
|   71.00      511 |  116.00      543 |  163.00       67 |  293.00       70 |
|   72.00     1328 |  117.00     1524 |  164.00       56 |                  |
|   73.00     9602 |  118.00      483 |  170.00      123 |                  |
```

Data File: /chem/VOAMS3.i/624/10-03-06/03oct06.b/ca13882.d

Date : 03-OCT-2006 21:32

Client ID:

Instrument: VOAMS3.i

Sample Info: CABFB276

Operator: VOAMS 1

Column phase: DB-624

Column diameter: 0.53

```
                 Data File: ca13882.d
                  Spectrum: Avg. Scans 92-94 ( 2.24), Background Scan 88
       Location of Maximum:  95.00
          Number of points: 144

     m/z          Y     m/z           Y     m/z           Y     m/z           Y
+------------------+------------------+------------------+------------------+
|  74.00      38016 | 119.00      1036 | 171.00       151 |                  |
|  75.00     113496 | 122.00       122 | 172.00      1172 |                  |
+------------------+------------------+------------------+------------------+
```

Data File: /chem/VOAMS3.i/624/10-03-06/03oct06.b/ca13882.d

Date : 03-OCT-2006 21:32

Client ID:

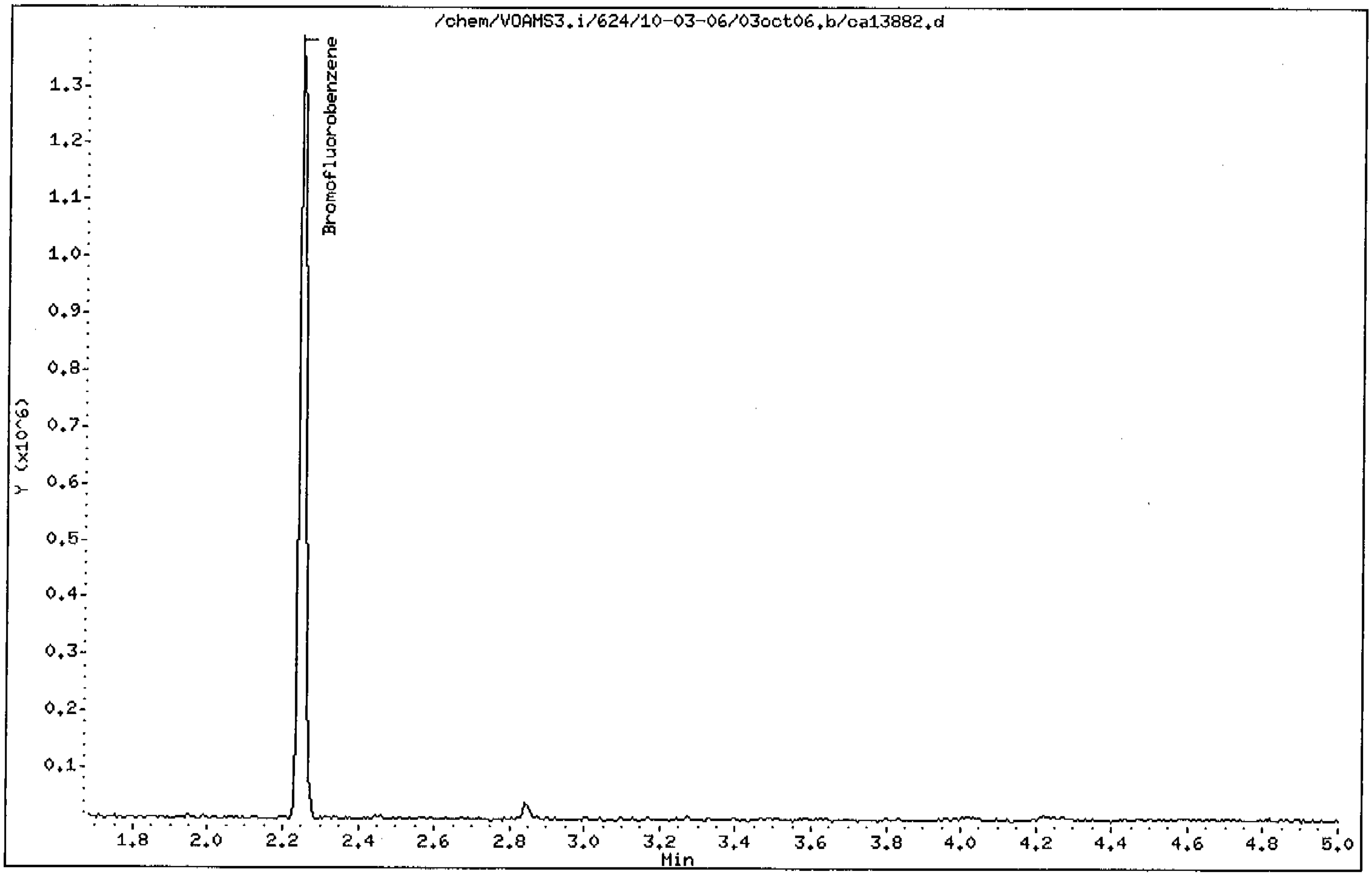
Instrument: VOAMS3.i

Sample Info: CABFB276

Operator: VOAMS 1

Column phase: DB-624

Column diameter: 0.53



VOLATILE ORGANIC INSTRUMENT PERFORMANCE CHECK
BROMOFLUOROBENZENE (BFB)

Lab File ID: CA13994

BFB Injection Date: 10/05/06

Instrument ID: VOAMS3

BFB Injection Time: 1730

m/e	ION ABUNDANCE CRITERIA	% RELATIVE ABUNDANCE
50	15.0 - 40.0% of mass 95	16.2
75	30.0 - 60.0% of mass 95	46.5
95	Base Peak, 100% relative abundance	100.0
96	5.0 - 9.0% of mass 95	6.6
173	Less than 2.0% of mass 174	1.0 (1.1)1
174	50.0 - 100.0% of mass 95	85.9
175	5.0 - 9.0% of mass 174	5.1 (5.9)1
176	95.0 - 101.0% of mass 174	81.7 (95.1)1
177	5.0 - 9.0% of mass 176	6.1 (7.4)2

1-Value is % mass 174 2-Value is % mass 176

THIS CHECK APPLIES TO THE FOLLOWING SAMPLES, MS, MSD, BLANKS, AND STANDARDS:

	CLIENT ID	LAB SAMPLE No.	LAB FILE ID	DATE ANALYZED	TIME ANALYZED
01	CASTD278	CASTD278	CA13997	10/05/06	1837
02	CAV278B	CAV278B	CA14033	10/06/06	0841
03	GW8-MW-59	774588	CA14049	10/06/06	1411
04					
05					
06					
07					
08					
09					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					
21					
22					

page 1 of 1

Data File: /chem/VOAMS3.i/624/10-03-06/05oct06.b/ca13994.d

Date : 05-OCT-2006 17:30

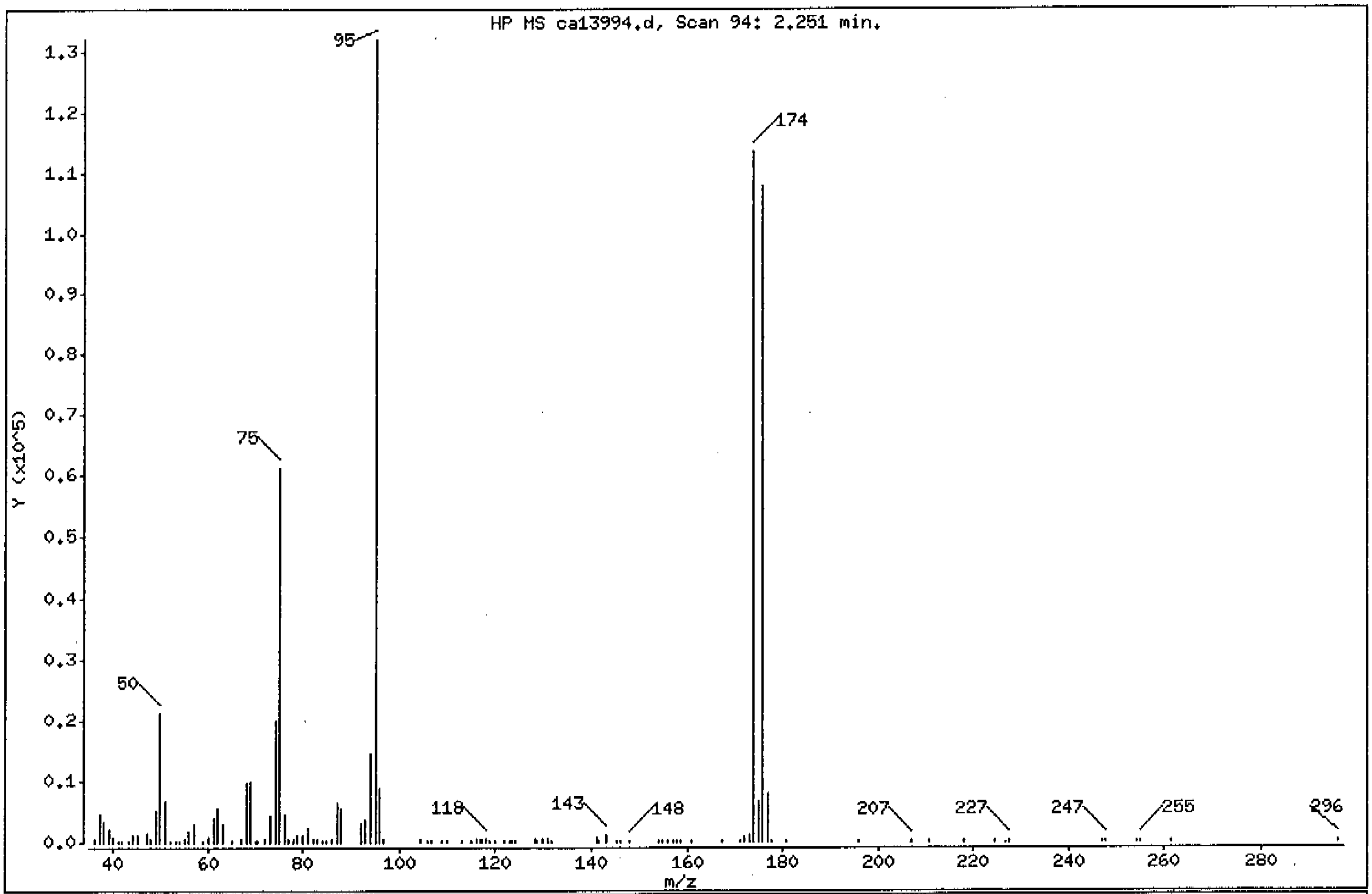
Client ID: Instrument: VOAMS3.i

Sample Info: CABFB278

Operator: VOAMS 1

Column phase: DB-624 Column diameter: 0.53

1 Bromofluorobenzene



```
                                                      % RELATIVE
 m/e        ION ABUNDANCE CRITERIA                    ABUNDANCE
+-----+---------------------------------------------+---------------------+
|     |                                             |                     |
|  95 | Base Peak, 100% relative abundance          |   100.00            |
|  50 | 15.00 - 40.00% of mass 95                   |    16.17            |
|  75 | 30.00 - 60.00% of mass 95                   |    46.51            |
|  96 |  5.00 -  9.00% of mass 95                   |     6.63            |
| 173 | Less than  2.00% of mass 174                |     0.96 (  1.12)   |
| 174 | 50.00 - 100.00% of mass 95                  |    85.90            |
| 175 |  5.00 -  9.00% of mass 174                  |     5.07 (  5.90)   |
| 176 | 95.00 - 101.00% of mass 174                 |    81.68 ( 95.09)   |
| 177 |  5.00 -  9.00% of mass 176                  |     6.06 (  7.42)   |
+-----+---------------------------------------------+---------------------+
```

Data File: /chem/VOAMS3.i/624/10-03-06/05oct06.b/ca13994.d

Date : 05-OCT-2006 17:30

Client ID:

Instrument: VOAMS3.i

Sample Info: CABFB278

Operator: VOAMS 1

Column phase: DB-624

Column diameter: 0.53

```
                Data File: ca13994.d
                 Spectrum: HP MS ca13994.d, Scan 94: 2.251 min.
      Location of Maximum:  95.00
         Number of points: 113

     m/z          Y    m/z          Y    m/z          Y    m/z          Y
  +-----------------+-----------------+-----------------+-----------------+
  |  36.00      560 |  69.00     9896 | 108.80      279 | 157.90      227 |
  |  37.10     4416 |  69.90      280 | 110.10      363 | 158.80      216 |
  |  38.10     3192 |  70.20      236 | 112.90      161 | 160.90      423 |
  |  39.10     2043 |  71.90      482 | 114.80      242 | 167.40      233 |
  |  40.00      932 |  73.00     4298 | 115.90      610 | 171.20      281 |
  +-----------------+-----------------+-----------------+-----------------+
  |  41.20      324 |  74.00    20072 | 116.90      571 | 172.00      955 |
  |  41.90      162 |  75.00    61408 | 117.10      556 | 172.90     1265 |
  |  43.20      286 |  76.10     4588 | 118.00      750 | 173.90   113416 |
  |  44.00     1089 |  76.90      521 | 118.80      162 | 174.90     6689 |
  |  45.10     1348 |  78.00      534 | 119.80      157 | 175.90   107848 |
  +-----------------+-----------------+-----------------+-----------------+
  |  47.20     1499 |  78.90     1196 | 121.80      191 | 176.90     8005 |
  |  48.10      467 |  79.90     1248 | 123.00      202 | 177.80      438 |
  |  49.10     5226 |  81.10     2309 | 123.30      275 | 180.60      159 |
  |  50.00    21344 |  82.10      715 | 124.10      245 | 196.10      161 |
  |  51.10     6787 |  83.00      490 | 128.10      456 | 206.80      273 |
  +-----------------+-----------------+-----------------+-----------------+
  |  52.30      261 |  84.10      161 | 128.60      240 | 210.90      183 |
  |  53.30      378 |  84.90      413 | 129.80      567 | 218.00      260 |
  |  54.10      395 |  86.10      600 | 130.80      456 | 224.40      169 |
  |  55.10      458 |  87.00     6346 | 131.80      208 | 226.90      150 |
  |  56.10     1706 |  87.90     5599 | 141.00      812 | 227.50      280 |
  +-----------------+-----------------+-----------------+-----------------+
  |  56.90     2888 |  92.00     3128 | 141.70      196 | 246.90      153 |
  |  59.10      321 |  92.90     3695 | 142.90     1304 | 247.50      258 |
  |  60.00      860 |  94.00    14682 | 145.20      173 | 254.00      177 |
  |  61.10     4017 |  95.00   132032 | 146.20      281 | 254.90      231 |
  |  62.00     5398 |  96.00     8748 | 147.90      446 | 261.40      165 |
  +-----------------+-----------------+-----------------+-----------------+
  |  63.10     2928 |  96.80      565 | 154.20      206 | 296.10      266 |
  |  65.10      200 | 104.10      585 | 154.80      153 |                 |
  |  66.80      562 | 105.70      323 | 156.10      179 |                 |
  |  68.10     9850 | 106.70      307 | 157.00      338 |                 |
  +-----------------+-----------------+-----------------+-----------------+
```

Data File: /chem/VOAMS3.i/624/10-03-06/05oct06.b/ca13994.d

Date : 05-OCT-2006 17:30

Client ID:

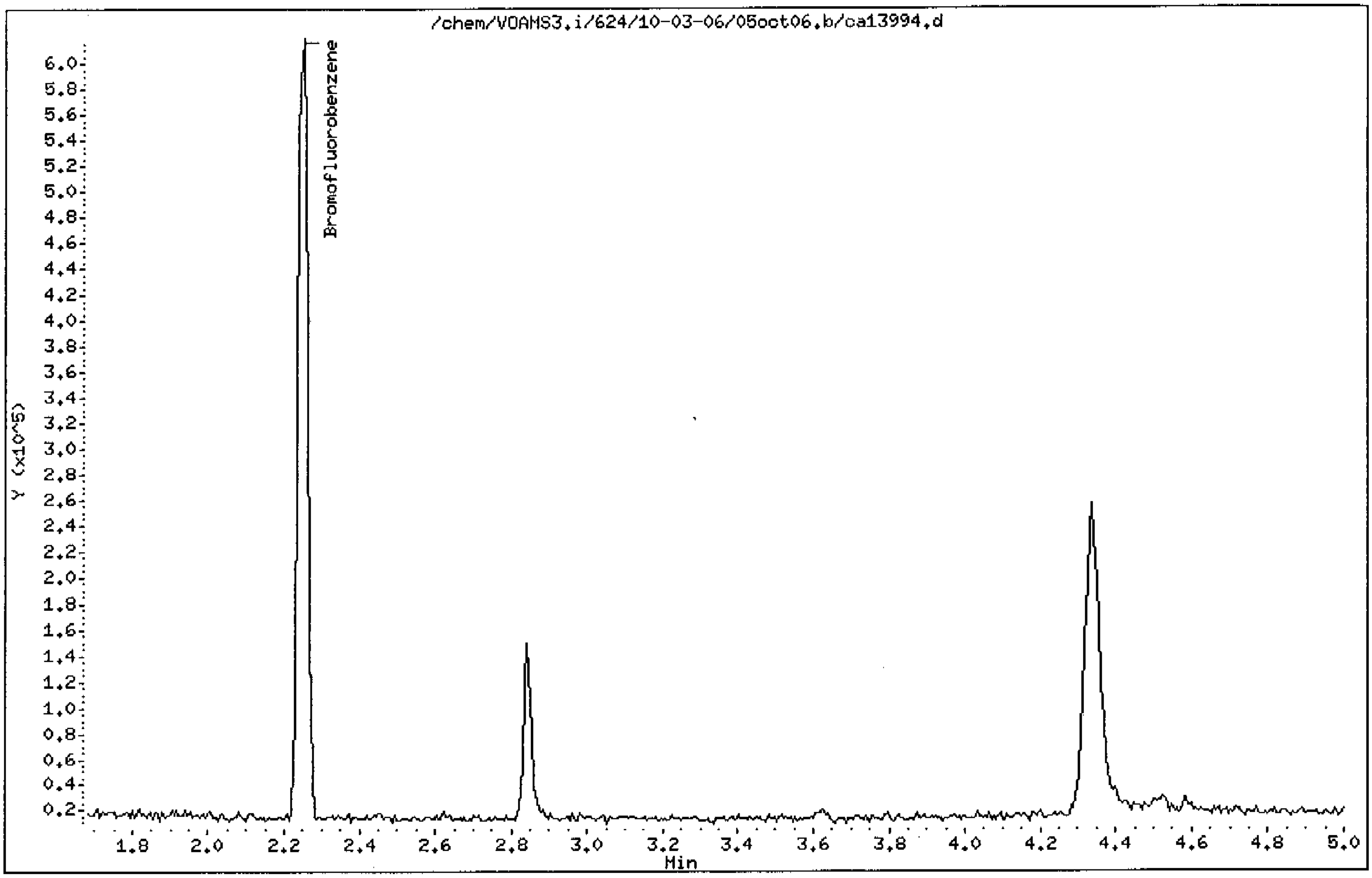
Instrument: VOAMS3.i

Sample Info: CABFB278

Operator: VOAMS 1

Column phase: DB-624

Column diameter: 0.53



VOLATILE ORGANIC INSTRUMENT PERFORMANCE CHECK
BROMOFLUOROBENZENE (BFB)

Lab File ID: CA14052

BFB Injection Date: 10/06/06

Instrument ID: VOAMS3

BFB Injection Time: 2119

m/e	ION ABUNDANCE CRITERIA	% RELATIVE ABUNDANCE
50	15.0 - 40.0% of mass 95	16.5
75	30.0 - 60.0% of mass 95	44.1
95	Base Peak, 100% relative abundance	100.0
96	5.0 - 9.0% of mass 95	5.8
173	Less than 2.0% of mass 174	0.6 (0.8)1
174	50.0 - 100.0% of mass 95	77.3
175	5.0 - 9.0% of mass 174	5.1 (6.5)1
176	95.0 - 101.0% of mass 174	74.7 (96.7)1
177	5.0 - 9.0% of mass 176	5.0 (6.7)2

1-Value is % mass 174 2-Value is % mass 176

THIS CHECK APPLIES TO THE FOLLOWING SAMPLES, MS, MSD, BLANKS, AND STANDARDS:

	CLIENT ID	LAB SAMPLE No.	LAB FILE ID	DATE ANALYZED	TIME ANALYZED
01	CASTD279	CASTD279	CA14053	10/06/06	2141
02	CAV279A	CAV279A	CA14057	10/06/06	2311
03	TB	774590	CA14061	10/07/06	0104
04	GW8-MW-59-Z	774589	CA14068	10/07/06	0403
05					
06					
07					
08					
09					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					
21					
22					

page 1 of 1

Data File: /chem/VOAMS3.i/624/10-03-06/06oct06.b/ca14052.d

Date : 06-OCT-2006 21:19

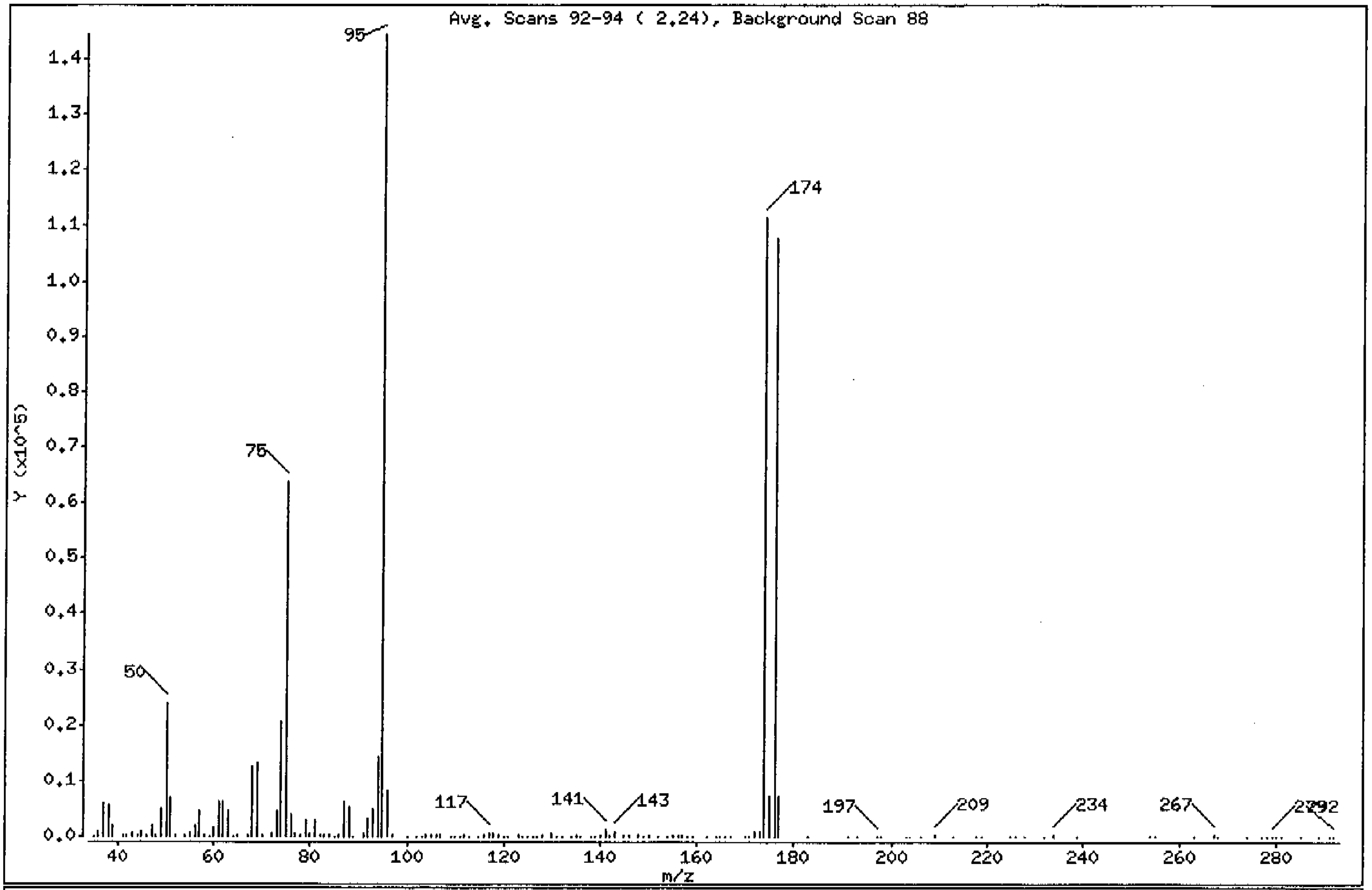
Client ID: Instrument: VOAMS3.i

Sample Info: CABFB279

Operator: VOAMS 1

Column phase: DB-624 Column diameter: 0.53

1 Bromofluorobenzene



```
                                                        % RELATIVE
     m/e        ION ABUNDANCE CRITERIA                   ABUNDANCE
  +-----+--------------------------------------------+--------------------+
  |     |                                            |                    |
  |  95 | Base Peak, 100% relative abundance         |  100.00            |
  |  50 | 15.00 - 40.00% of mass 95                  |   16.52            |
  |  75 | 30.00 - 60.00% of mass 95                  |   44.13            |
  |  96 |  5.00 -  9.00% of mass 95                  |    5.83            |
  | 173 | Less than  2.00% of mass 174               |    0.64 (  0.83)   |
  | 174 | 50.00 - 100.00% of mass 95                 |   77.26            |
  | 175 |  5.00 -  9.00% of mass 174                 |    5.06 (  6.55)   |
  | 176 | 95.00 - 101.00% of mass 174                |   74.68 ( 96.66)   |
  | 177 |  5.00 -  9.00% of mass 176                 |    4.97 (  6.66)   |
  +-----+--------------------------------------------+--------------------+
```

```
Data File: /chem/VOAMS3.i/624/10-03-06/06oct06.b/ca14052.d
Date : 06-OCT-2006 21:19
Client ID:                                        Instrument: VOAMS3.i
Sample Info: CABFB279
                                                  Operator: VOAMS 1
Column phase: DB-624                              Column diameter:  0.53
```

```
                Data File: ca14052.d
                 Spectrum: Avg. Scans 92-94 ( 2.24), Background Scan 88
      Location of Maximum:  95.00
         Number of points: 153

       m/z          Y      m/z          Y      m/z          Y      m/z          Y
  +-----------------+-----------------+-----------------+-----------------+
  |   35.00        86 |   78.00       325 | 124.00       119 | 175.00      7300 |
  |   36.00      1080 |   79.00      2985 | 125.00       124 | 176.00    107800 |
  |   37.00      5990 |   80.00       678 | 126.00        52 | 177.00      7178 |
  |   38.00      5583 |   81.00      3057 | 127.00        56 | 183.00        66 |
  |   39.00      1870 |   82.00       255 | 128.00       449 | 191.00       101 |
  +-----------------+-----------------+-----------------+-----------------+
  |   41.00       399 |   83.00       190 | 130.00       617 | 193.00        65 |
  |   42.00       287 |   84.00       324 | 131.00       130 | 197.00       141 |
  |   43.00       728 |   85.00       107 | 132.00       112 | 198.00        68 |
  |   44.00       469 |   86.00       449 | 134.00       161 | 203.00       100 |
  |   45.00       948 |   87.00      6179 | 135.00       220 | 204.00        89 |
  +-----------------+-----------------+-----------------+-----------------+
  |   46.00       230 |   88.00      5179 | 136.00        79 | 206.00        55 |
  |   47.00      2141 |   89.00       109 | 138.00       131 | 209.00       180 |
  |   48.00       228 |   91.00       550 | 139.00       158 | 213.00        62 |
  |   49.00      4954 |   92.00      3328 | 140.00       253 | 218.00        66 |
  |   50.00     23840 |   93.00      4969 | 141.00      1368 | 219.00       141 |
  +-----------------+-----------------+-----------------+-----------------+
  |   51.00      7074 |   94.00     14240 | 142.00       241 | 225.00        74 |
  |   52.00       380 |   95.00    144320 | 143.00      1080 | 226.00       141 |
  |   54.00       320 |   96.00      8410 | 145.00       261 | 228.00       146 |
  |   55.00       552 |   97.00       217 | 146.00       216 | 232.00        73 |
  |   56.00      1941 |  100.00        59 | 148.00       250 | 234.00       192 |
  +-----------------+-----------------+-----------------+-----------------+
  |   57.00      4601 |  102.00        74 | 149.00        83 | 239.00        72 |
  |   58.00       336 |  103.00        10 | 150.00       168 | 254.00        81 |
  |   59.00       140 |  104.00       433 | 152.00       102 | 255.00        71 |
  |   60.00      1813 |  105.00       367 | 154.00        91 | 263.00       149 |
  |   61.00      6446 |  106.00       443 | 155.00       483 | 267.00       278 |
  +-----------------+-----------------+-----------------+-----------------+
  |   62.00      6167 |  107.00       208 | 156.00       174 | 268.00        71 |
  |   63.00      4654 |  109.00        80 | 157.00       408 | 274.00        60 |
  |   64.00       148 |  110.00        34 | 158.00       122 | 277.00        76 |
  |   65.00       225 |  111.00       119 | 159.00       107 | 278.00        63 |
  |   67.00       369 |  112.00       207 | 162.00       126 | 279.00       141 |
  +-----------------+-----------------+-----------------+-----------------+
  |   68.00     12732 |  113.00        95 | 164.00        59 | 280.00        58 |
  |   69.00     13137 |  115.00        62 | 165.00        92 | 281.00        90 |
  |   70.00       496 |  116.00       442 | 166.00        91 | 285.00        61 |
  |   72.00       547 |  117.00       770 | 167.00       143 | 289.00       109 |
  |   73.00      4777 |  118.00       519 | 170.00       114 | 291.00       126 |
```

```
Data File: /chem/VOAMS3.i/624/10-03-06/06oct06.b/ca14052.d

Date : 06-OCT-2006 21:19

Client ID:                                        Instrument: VOAMS3.i

Sample Info: CABFB279

                                                  Operator: VOAMS 1

Column phase: DB-624                              Column diameter:  0.53
```

```
            Data File: ca14052.d
             Spectrum: Avg. Scans 92-94 ( 2.24), Background Scan 88
  Location of Maximum:  95.00
     Number of points: 153

     m/z          Y       m/z          Y       m/z          Y       m/z          Y
+-------------------+-------------------+-------------------+-------------------+
|  74.00      20592 | 119.00        449 | 171.00         51 | 292.00         55 |
|  75.00      63696 | 120.00         51 | 172.00        956 |                   |
|  76.00       4015 | 121.00         79 | 173.00        929 |                   |
|  77.00        572 | 123.00        170 | 174.00     111520 |                   |
+-------------------+-------------------+-------------------+-------------------+
```

Data File: /chem/VOAMS3.i/624/10-03-06/06oct06.b/ca14052.d

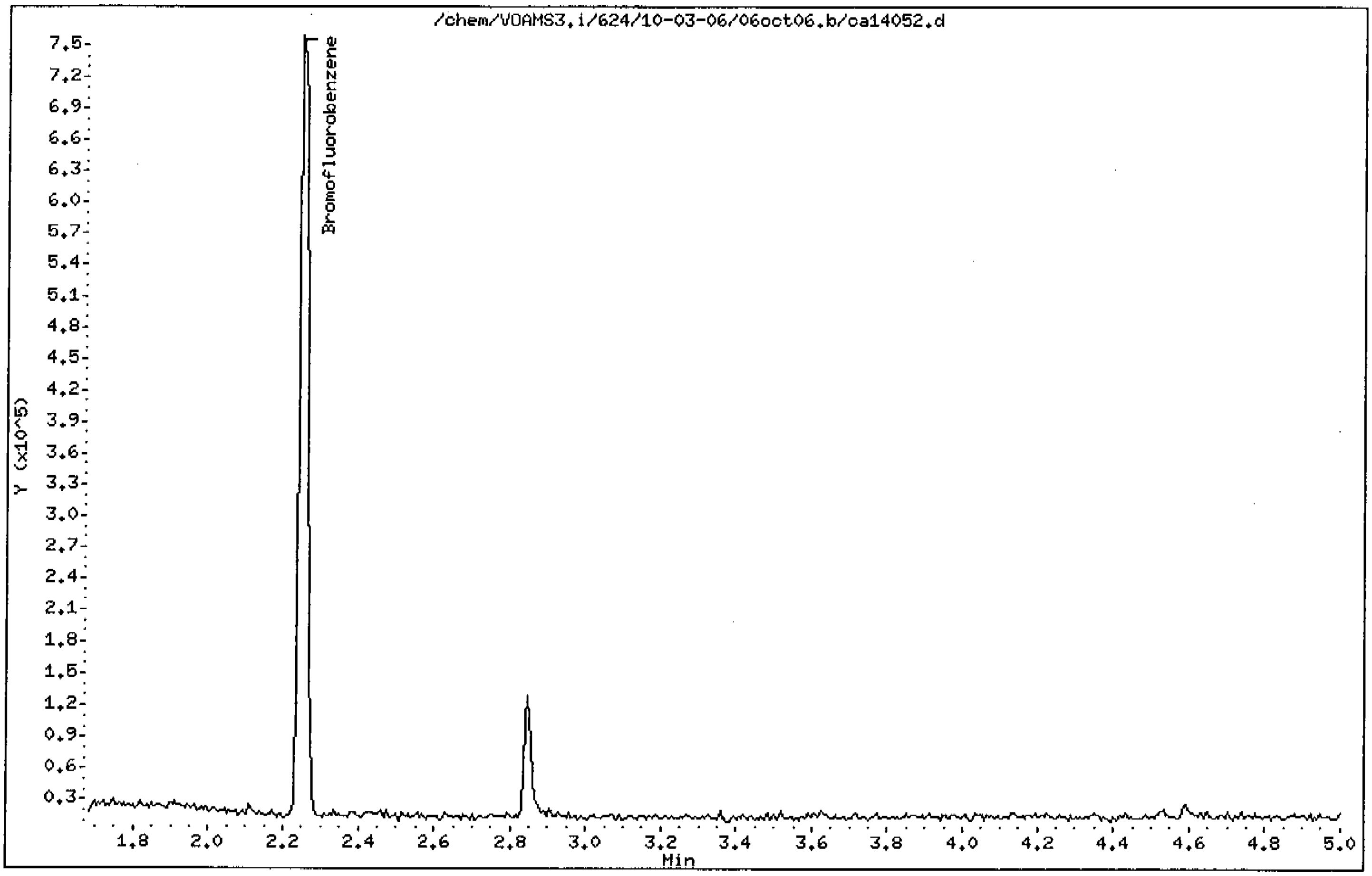
Date : 06-OCT-2006 21:19

Client ID: Instrument: VOAMS3.i

Sample Info: CABFB279

Operator: VOAMS 1

Column phase: DB-624 Column diameter: 0.53



Method Blank Results Summary

LAB SAMPLE NO.

CAV278B

VOLATILE METHOD BLANK SUMMARY

Matrix: WATER

Level: LOW

Lab File ID: CA14033

Instrument ID: VOAMS3

Date Analyzed: 10/06/06

Time Analyzed: 0841

Heated Purge (Y/N) N

THIS METHOD BLANK APPLIES TO THE FOLLOWING SAMPLES, MS and MSD:

	CLIENT ID.	LAB SAMPLE NO	LAB FILE ID	TIME ANALYZED
01	GW8-MW-59	774588	CA14049	1411
02				
03				
04				
05				
06				
07				
08				
09				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				
21				
22				
23				
24				
25				
26				
27				
28				
29				
30				

COMMENTS:

page 1 of 1

Client ID: **CAV278B**
Site:

Lab Sample No: **CAV278B**
Lab Job No: X772

Date Sampled: ________
Date Received: ________
Date Analyzed: 10/06/06
GC Column: DB624
Instrument ID: VOAMS3.i
Lab File ID: ca14033.d

Matrix: WATER
Level: LOW
Purge Volume: 5.0 ml
Dilution Factor: 1.0

VOLATILE ORGANICS - GC/MS
METHOD 624

Parameter	Analytical Result Units: ug/l	Method Detection Limit Units: ug/l
Chloromethane	ND	0.3
Bromomethane	ND	0.3
Vinyl Chloride	ND	0.3
Chloroethane	ND	0.2
Methylene Chloride	ND	0.5
Acetone	ND	1.3
Carbon Disulfide	ND	0.3
Trichlorofluoromethane	ND	0.2
1,1-Dichloroethene	ND	0.4
1,1-Dichloroethane	ND	0.3
trans-1,2-Dichloroethene	ND	0.4
cis-1,2-Dichloroethene	ND	0.4
Chloroform	ND	0.5
1,2-Dichloroethane	ND	0.3
2-Butanone	ND	0.9
1,1,1-Trichloroethane	ND	0.3
Carbon Tetrachloride	ND	0.3
Bromodichloromethane	ND	0.3
1,2-Dichloropropane	ND	0.3
cis-1,3-Dichloropropene	ND	0.2
Trichloroethene	ND	0.4
Dibromochloromethane	ND	0.3
1,1,2-Trichloroethane	ND	0.3
Benzene	ND	0.3
trans-1,3-Dichloropropene	ND	0.2
2-Chloroethyl Vinyl Ether	ND	0.4
Bromoform	ND	0.2
4-Methyl-2-Pentanone	ND	0.5
2-Hexanone	ND	0.5
Tetrachloroethene	ND	0.4
1,1,2,2-Tetrachloroethane	ND	0.3
Toluene	ND	0.4
Chlorobenzene	ND	0.4
Ethylbenzene	ND	0.5

Client ID: **CAV278B**
Site:

Lab Sample No: **CAV278B**
Lab Job No: X772

Date Sampled: ________
Date Received: ________
Date Analyzed: 10/06/06
GC Column: DB624
Instrument ID: VOAMS3.i
Lab File ID: ca14033.d

Matrix: WATER
Level: LOW
Purge Volume: 5.0 ml
Dilution Factor: 1.0

VOLATILE ORGANICS - GC/MS (cont'd)
METHOD 624

Parameter	Analytical Result Units: ug/l	Method Detection Limit Units: ug/l
Styrene	ND	0.4
Xylene (Total)	ND	0.4
Ethyl Ether	ND	0.2
Acrolein	ND	4.6
Freon TF	ND	0.4
Isopropanol	ND	500
Acetonitrile	ND	100
TBA	ND	4.4
Acrylonitrile	ND	1.8
MTBE	ND	0.2
Hexane	ND	0.4
DIPE	ND	0.3
Ethyl Acetate	ND	0.7
Vinyl Acetate	ND	0.3
Tetrahydrofuran	ND	5.0
Cyclohexane	ND	0.3
Isobutanol	ND	500
Isopropyl Acetate	ND	0.4
n-Heptane	ND	1.0
n-Butanol	ND	48
Propyl Acetate	ND	0.5
Butyl Acetate	ND	0.4
1,2-Dibromoethane	ND	0.4
1,3-Dichlorobenzene	ND	0.4
1,4-Dichlorobenzene	ND	0.5
1,2-Dichlorobenzene	ND	0.4
Naphthalene	ND	0.4
Methylnaphthalene (total)	ND	1.0
Dimethylnaphthalene (total)	ND	1.0
Dichlorodifluoromethane	ND	0.5
1,4-Dioxane	ND	56
n-Pentane	ND	0.4
5-Methyl-2-Hexanone	ND	5.0
Isopropylbenzene	ND	0.5

Client ID: **CAV278B**	Lab Sample No: **CAV278B**
Site:	Lab Job No: X772
Date Sampled: ________	Matrix: WATER
Date Received: ________	Level: LOW
Date Analyzed: 10/06/06	Purge Volume: 5.0 ml
GC Column: DB624	Dilution Factor: 1.0
Instrument ID: VOAMS3.i	
Lab File ID: ca14033.d	

VOLATILE ORGANICS - GC/MS (cont'd)
METHOD 624

Parameter	Analytical Result Units: ug/l	Method Detection Limit Units: ug/l
1,2,4-Trimethylbenzene	ND	0.4
Cyclohexanone	ND	100
1,2,4-Trichlorobenzene	ND	0.4
Methyl Methacrylate	ND	0.7
Allyl Alcohol	ND	1000
Epichlorohydrin	ND	4.8
Allyl Chloride	ND	5.0
Benzyl Chloride	ND	0.4
Isoprene	ND	0.4
1,1,1,2-Tetrachloroethane	ND	0.4
Camphene (total)	ND	20
Camphor	ND	20
1,3,5-Trimethylbenzene	ND	0.4
1,2,3-Trichlorobenzene	ND	0.3
n-Butylbenzene	ND	0.3
sec-Butylbenzene	ND	0.4
tert-Butylbenzene	ND	0.4
p-Isopropyltoluene	ND	0.4
n-Propylbenzene	ND	0.4
m+p-Ethyltoluene	ND	1.0
o-Ethyltoluene	ND	1.0
Methyl Acetate	ND	0.3
Methyl cyclohexane	ND	0.3
1,2-Dibromo-3-chloropropane	ND	0.3
Cyclohexene	ND	1.0
1,2-Dichlorotrifluoroethane	ND	1.0
n-Propanol	ND	500
3-Methyl-1-Pentyn-3-ol	ND	250
Propylene Oxide	ND	50
Ethanol	ND	500
Chlorotrifluoroethane	ND	1.0
Dichlorofluoromethane	ND	1.0
Ethylene Oxide	ND	500
Methyl Formate	ND	500

Client ID: **CAV278B**
Site:

Lab Sample No: **CAV278B**
Lab Job No: X772

Date Sampled: ________
Date Received: ________
Date Analyzed: 10/06/06
GC Column: DB624
Instrument ID: VOAMS3.i
Lab File ID: ca14033.d

Matrix: WATER
Level: LOW
Purge Volume: 5.0 ml
Dilution Factor: 1.0

VOLATILE ORGANICS - GC/MS (cont'd)
METHOD 624

Parameter	Analytical Result Units: ug/l	Method Detection Limit Units: ug/l
Isobutyraldehyde	ND	5.0
Amyl Acetate	ND	0.3
1,2,3-Trichloropropane	ND	0.5
Chlorodifluoromethane	ND	1.0
1,3-Dichloropropane	ND	0.4
Dibromomethane	ND	0.3
1-Propene	ND	0.4
2-Chloropropane	ND	0.3
1-Chloropropane	ND	0.3
Hexachlorobutadiene	ND	5.0

Client ID: **CAV278B**
Site:

Lab Sample No: **CAV278B**
Lab Job No: X772

Date Sampled: ________
Date Received: ________
Date Analyzed: 10/06/06
GC Column: DB624
Instrument ID: VOAMS3.i
Lab File ID: cal4033.d

Matrix: WATER
Level: LOW
Purge Volume: 5.0 ml
Dilution Factor: 1.0

VOLATILE ORGANICS - GC/MS
TENTATIVELY IDENTIFIED COMPOUNDS
METHOD 624

COMPOUND NAME	RT	EST. CONC. ug/l	Q
1. NO VOLATILE ORGANIC COMPOUNDS FOUND			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
13.			
14.			
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16.			
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22.			
23.			
24.			
25.			
26.			
27.			
28.			
29.			
30.			

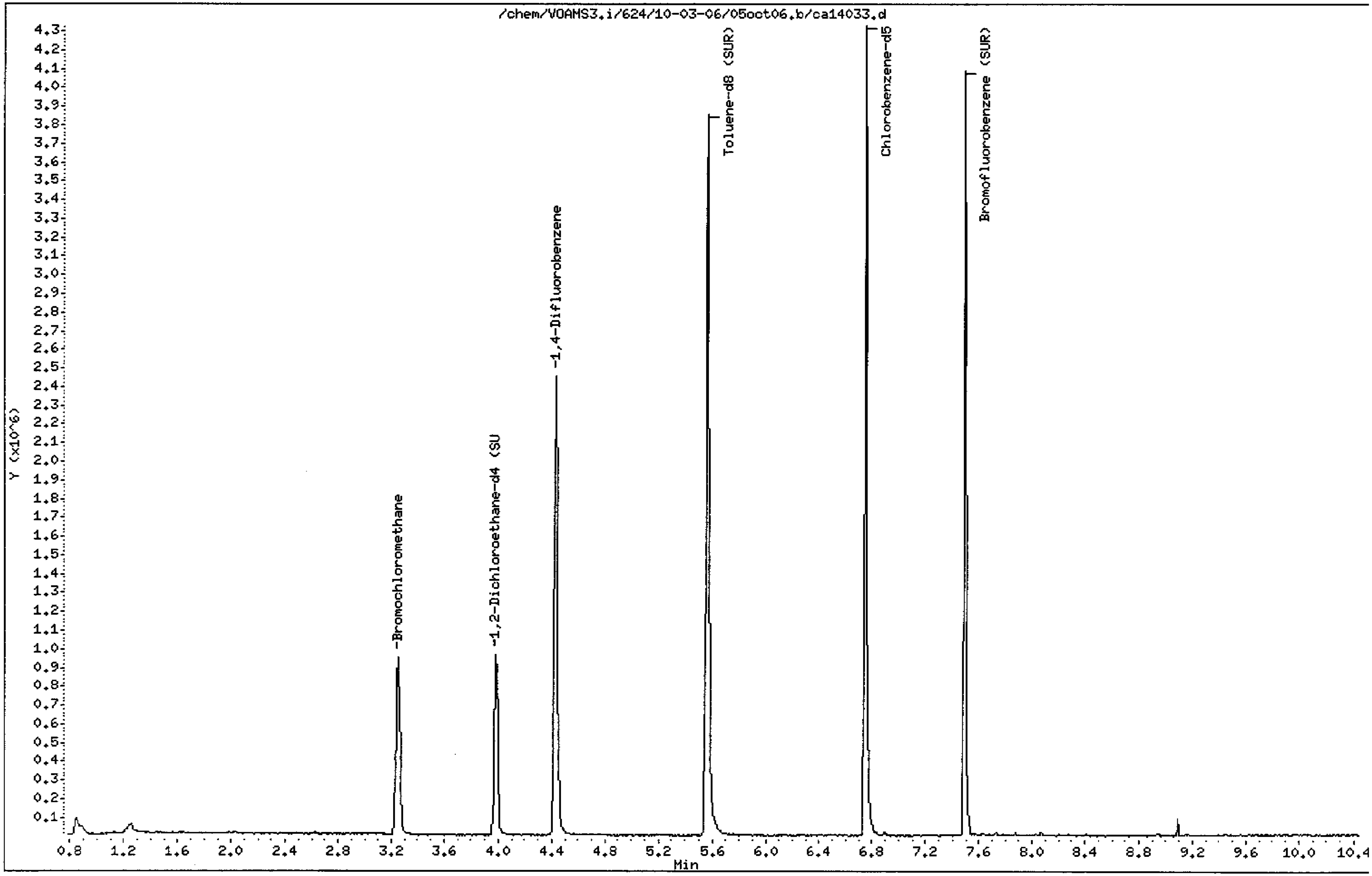
TOTAL ESTIMATED CONCENTRATION	0.0

```
Data File: /chem/VOAMS3.i/624/10-03-06/05oct06.b/ca14033.d
Report Date: 11-Oct-2006 18:27


                                 STL Edison

                       VOLATILE ORGANIC COMPOUND ANALYSIS
Data file : /chem/VOAMS3.i/624/10-03-06/05oct06.b/ca14033.d
Lab Smp Id: CAV278B                          Client Smp ID: CAV278B
Inj Date  : 06-OCT-2006 08:41
Operator  :                                  Inst ID: VOAMS3.i
Smp Info  : CAV278B
Misc Info :
Comment   :
Method    : /chem/VOAMS3.i/624/10-03-06/05oct06.b/624_05.m
Meth Date : 05-Oct-2006 19:30 ken            Quant Type: ISTD
Cal Date  : 04-OCT-2006 00:49                Cal File: ca13890.d
Als bottle: 31                               QC Sample: BLANK
Dil Factor: 1.00000
Integrator: HP RTE                           Compound Sublist: all.sub
Target Version:  3.50

Concentration Formula: Amt * DF * 5/Vo * CpndVariable

     Name         Value           Description
-------------- -------------- -----------------------
     DF        1.00000         Dilution Factor
     Vo        5.00000        Sample Volume

Cpnd Variable                  Local Compound Variable



                                                                              CONCENTRATIONS
                                         QUANT SIG                                        ON-COLUMN    FINAL
Compounds                                   MASS        RT    EXP RT REL RT    RESPONSE   ( ug/L)    ( ug/L)
=========================                   ====        ==    ====== ======    ========   =======    =======
*   2 Bromochloromethane                     128     3.249    3.249 (1.000)     301140    30.0000
$  16 1,2-Dichloroethane-d4 (SUR)            104     3.985    3.985 (0.898)      92955    29.5503         30
*  19 1,4-Difluorobenzene                    114     4.435    4.429 (1.000)    1976060    30.0000
$  37 Toluene-d8 (SUR)                        98     5.561    5.561 (0.824)    2235869    31.4176         31
*  32 Chlorobenzene-d5                       117     6.747    6.747 (1.000)    1873004    30.0000
$  41 Bromofluorobenzene (SUR)               174     7.489    7.489 (1.110)     751121    29.0080         29
```

Data File: /chem/VOAMS3.i/624/10-03-06/05oct06.b/ca14033.d
Date : 06-OCT-2006 08:41
Client ID: CAV278B
Sample Info: CAV278B
Purge Volume: 5.0
Column phase: DB624

Instrument: VOAMS3.i

Operator:
Column diameter: 0.18



LAB SAMPLE NO.

VOLATILE METHOD BLANK SUMMARY

CAV279A

Matrix: WATER

Level: LOW

Lab File ID: CA14057

Instrument ID: VOAMS3

Date Analyzed: 10/06/06

Time Analyzed: 2311

Heated Purge (Y/N) N

THIS METHOD BLANK APPLIES TO THE FOLLOWING SAMPLES, MS and MSD:

	CLIENT ID.	LAB SAMPLE NO	LAB FILE ID	TIME ANALYZED
01	TB	774590	CA14061	0104
02	GW8-MW-59-Z	774589	CA14068	0403
03				
04				
05				
06				
07				
08				
09				
10				
11				
12				
13				
14				
15				
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23				
24				
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28				
29				
30				

COMMENTS:

page 1 of 1

Client ID: **CAV279A**
Site:

Lab Sample No: **CAV279A**
Lab Job No: X772

Date Sampled: ________
Date Received: ________
Date Analyzed: 10/06/06
GC Column: DB624
Instrument ID: VOAMS3.i
Lab File ID: ca14057.d

Matrix: WATER
Level: LOW
Purge Volume: 5.0 ml
Dilution Factor: 1.0

VOLATILE ORGANICS - GC/MS
METHOD 624

Parameter	Analytical Result Units: ug/l	Method Detection Limit Units: ug/l
Chloromethane	ND	0.3
Bromomethane	ND	0.3
Vinyl Chloride	ND	0.3
Chloroethane	ND	0.2
Methylene Chloride	ND	0.5
Acetone	ND	1.3
Carbon Disulfide	ND	0.3
Trichlorofluoromethane	ND	0.2
1,1-Dichloroethene	ND	0.4
1,1-Dichloroethane	ND	0.3
trans-1,2-Dichloroethene	ND	0.4
cis-1,2-Dichloroethene	ND	0.4
Chloroform	ND	0.5
1,2-Dichloroethane	ND	0.3
2-Butanone	ND	0.9
1,1,1-Trichloroethane	ND	0.3
Carbon Tetrachloride	ND	0.3
Bromodichloromethane	ND	0.3
1,2-Dichloropropane	ND	0.3
cis-1,3-Dichloropropene	ND	0.2
Trichloroethene	ND	0.4
Dibromochloromethane	ND	0.3
1,1,2-Trichloroethane	ND	0.3
Benzene	ND	0.3
trans-1,3-Dichloropropene	ND	0.2
2-Chloroethyl Vinyl Ether	ND	0.4
Bromoform	ND	0.2
4-Methyl-2-Pentanone	ND	0.5
2-Hexanone	ND	0.5
Tetrachloroethene	ND	0.4
1,1,2,2-Tetrachloroethane	ND	0.3
Toluene	ND	0.4
Chlorobenzene	ND	0.4
Ethylbenzene	ND	0.5

Client ID: **CAV279A**
Site:

Lab Sample No: **CAV279A**
Lab Job No: X772

Date Sampled: ________
Date Received: ________
Date Analyzed: 10/06/06
GC Column: DB624
Instrument ID: VOAMS3.i
Lab File ID: cal4057.d

Matrix: WATER
Level: LOW
Purge Volume: 5.0 ml
Dilution Factor: 1.0

VOLATILE ORGANICS - GC/MS (cont'd)
METHOD 624

Parameter	Analytical Result Units: ug/l	Method Detection Limit Units: ug/l
Styrene	ND	0.4
Xylene (Total)	ND	0.4
Ethyl Ether	ND	0.2
Acrolein	ND	4.6
Freon TF	ND	0.4
Isopropanol	ND	500
Acetonitrile	ND	100
TBA	ND	4.4
Acrylonitrile	ND	1.8
MTBE	ND	0.2
Hexane	ND	0.4
DIPE	ND	0.3
Ethyl Acetate	ND	0.7
Vinyl Acetate	ND	0.3
Tetrahydrofuran	ND	5.0
Cyclohexane	ND	0.3
Isobutanol	ND	500
Isopropyl Acetate	ND	0.4
n-Heptane	ND	1.0
n-Butanol	ND	48
Propyl Acetate	ND	0.5
Butyl Acetate	ND	0.4
1,2-Dibromoethane	ND	0.4
1,3-Dichlorobenzene	ND	0.4
1,4-Dichlorobenzene	ND	0.5
1,2-Dichlorobenzene	ND	0.4
Naphthalene	ND	0.4
Methylnaphthalene (total)	ND	1.0
Dimethylnaphthalene (total)	ND	1.0
Dichlorodifluoromethane	ND	0.5
1,4-Dioxane	ND	56
n-Pentane	ND	0.4
5-Methyl-2-Hexanone	ND	5.0
Isopropylbenzene	ND	0.5

Client ID: **CAV279A**
Site:

Lab Sample No: **CAV279A**
Lab Job No: X772

Date Sampled: ________
Date Received: ________
Date Analyzed: 10/06/06
GC Column: DB624
Instrument ID: VOAMS3.i
Lab File ID: ca14057.d

Matrix: WATER
Level: LOW
Purge Volume: 5.0 ml
Dilution Factor: 1.0

VOLATILE ORGANICS - GC/MS (cont'd)
METHOD 624

Parameter	Analytical Result Units: ug/l	Method Detection Limit Units: ug/l
1,2,4-Trimethylbenzene	ND	0.4
Cyclohexanone	ND	100
1,2,4-Trichlorobenzene	ND	0.4
Methyl Methacrylate	ND	0.7
Allyl Alcohol	ND	1000
Epichlorohydrin	ND	4.8
Allyl Chloride	ND	5.0
Benzyl Chloride	ND	0.4
Isoprene	ND	0.4
1,1,1,2-Tetrachloroethane	ND	0.4
Camphene (total)	ND	20
Camphor	ND	20
1,3,5-Trimethylbenzene	ND	0.4
1,2,3-Trichlorobenzene	ND	0.3
n-Butylbenzene	ND	0.3
sec-Butylbenzene	ND	0.4
tert-Butylbenzene	ND	0.4
p-Isopropyltoluene	ND	0.4
n-Propylbenzene	ND	0.4
m+p-Ethyltoluene	ND	1.0
o-Ethyltoluene	ND	1.0
Methyl Acetate	ND	0.3
Methyl cyclohexane	ND	0.3
1,2-Dibromo-3-chloropropane	ND	0.3
Cyclohexene	ND	1.0
1,2-Dichlorotrifluoroethane	ND	1.0
n-Propanol	ND	500
3-Methyl-1-Pentyn-3-ol	ND	250
Propylene Oxide	ND	50
Ethanol	ND	500
Chlorotrifluoroethane	ND	1.0
Dichlorofluoromethane	ND	1.0
Ethylene Oxide	ND	500
Methyl Formate	ND	500

Client ID: **CAV279A**
Site:

Lab Sample No: **CAV279A**
Lab Job No: X772

Date Sampled: ________
Date Received: ________
Date Analyzed: 10/06/06
GC Column: DB624
Instrument ID: VOAMS3.i
Lab File ID: ca14057.d

Matrix: WATER
Level: LOW
Purge Volume: 5.0 ml
Dilution Factor: 1.0

VOLATILE ORGANICS - GC/MS (cont'd)
METHOD 624

Parameter	Analytical Result Units: ug/l	Method Detection Limit Units: ug/l
Isobutyraldehyde	ND	5.0
Amyl Acetate	ND	0.3
1,2,3-Trichloropropane	ND	0.5
Chlorodifluoromethane	ND	1.0
1,3-Dichloropropane	ND	0.4
Dibromomethane	ND	0.3
1-Propene	ND	0.4
2-Chloropropane	ND	0.3
1-Chloropropane	ND	0.3
Hexachlorobutadiene	ND	5.0

Client ID: **CAV279A**
Site:

Lab Sample No: **CAV279A**
Lab Job No: X772

Date Sampled:
Date Received:
Date Analyzed: 10/06/06
GC Column: DB624
Instrument ID: VOAMS3.i
Lab File ID: ca14057.d

Matrix: WATER
Level: LOW
Purge Volume: 5.0 ml
Dilution Factor: 1.0

VOLATILE ORGANICS - GC/MS
TENTATIVELY IDENTIFIED COMPOUNDS
METHOD 624

COMPOUND NAME	RT	EST. CONC. ug/l	Q
1. NO VOLATILE ORGANIC COMPOUNDS FOUND			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
13.			
14.			
15.			
16.			
17.			
18.			
19.			
20.			
21.			
22.			
23.			
24.			
25.			
26.			
27.			
28.			
29.			
30.			

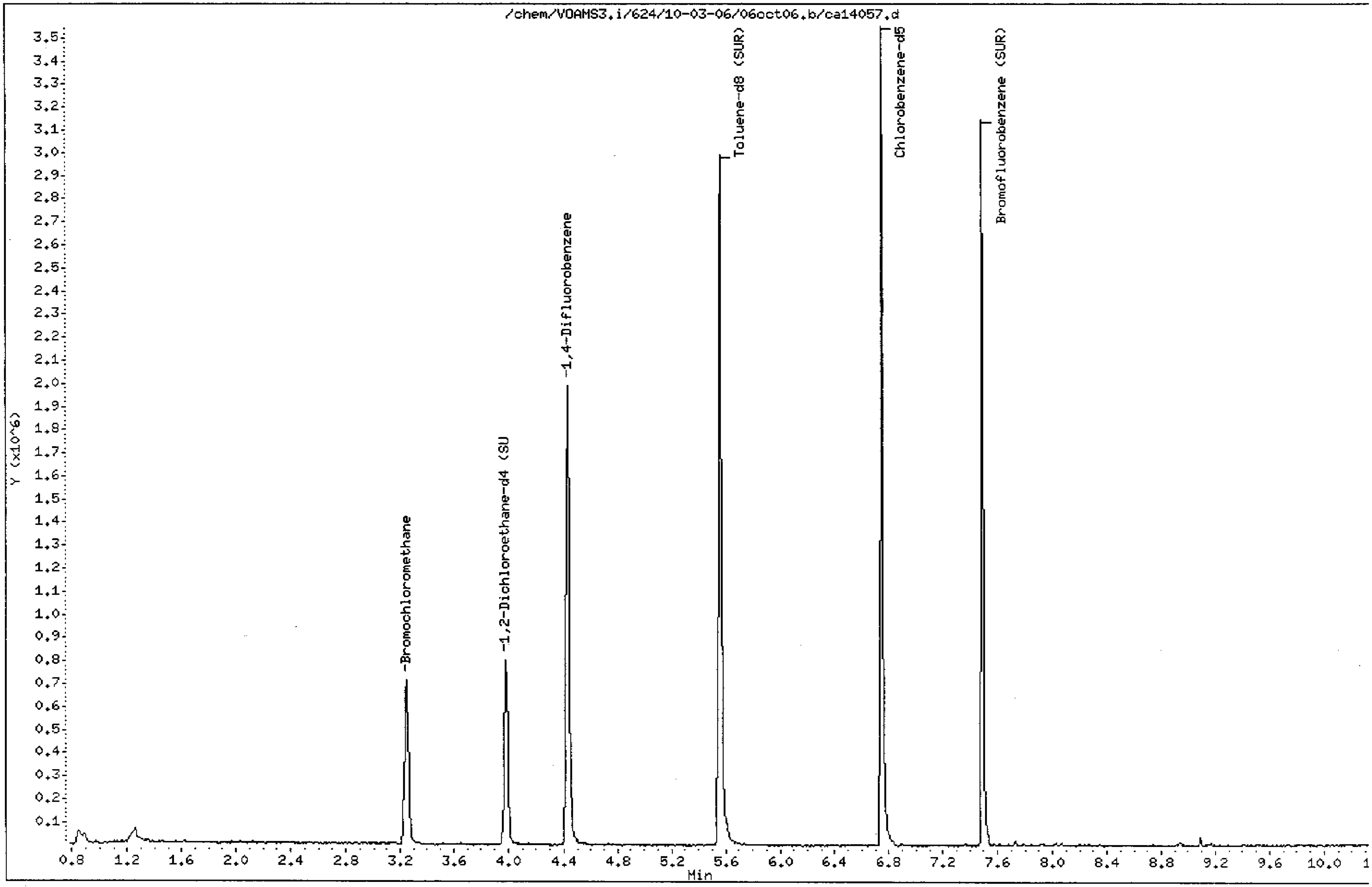
TOTAL ESTIMATED CONCENTRATION 0.0

```
Data File: /chem/VOAMS3.i/624/10-03-06/06oct06.b/ca14057.d
Report Date: 12-Oct-2006 16:27


                              STL Edison

                  VOLATILE ORGANIC COMPOUND ANALYSIS
Data file : /chem/VOAMS3.i/624/10-03-06/06oct06.b/ca14057.d
Lab Smp Id: CAV279A                       Client Smp ID: CAV279A
Inj Date  : 06-OCT-2006 23:11
Operator  :                               Inst ID: VOAMS3.i
Smp Info  : CAV279A
Misc Info :
Comment   :
Method    : /chem/VOAMS3.i/624/10-03-06/06oct06.b/624_05.m
Meth Date : 07-Oct-2006 01:06 ken         Quant Type: ISTD
Cal Date  : 04-OCT-2006 00:49             Cal File: cal3890.d
Als bottle: 6                             QC Sample: BLANK
Dil Factor: 1.00000
Integrator: HP RTE                        Compound Sublist: all.sub
Target Version:  3.50

Concentration Formula: Amt * DF * 5/Vo * CpndVariable

    Name          Value          Description
-------------- -------------- -----------------------
     DF         1.00000        Dilution Factor
     Vo         5.00000       Sample Volume

Cpnd Variable                  Local Compound Variable


                                                                              CONCENTRATIONS
                                       QUANT SIG                           ON-COLUMN    FINAL
Compounds                                MASS       RT    EXP RT REL RT   RESPONSE   ( ug/L)    ( ug/L)
=========================               ====       ==    ====== ======   ========   =======    =======
*   2 Bromochloromethane                 128      3.249   3.249 (1.000)     204241   30.0000
$  16 1,2-Dichloroethane-d4 (SUR)        104      3.985   3.985 (0.900)      72712   30.1924         30
*  19 1,4-Difluorobenzene                114      4.429   4.429 (1.000)    1512856   30.0000
$  37 Toluene-d8 (SUR)                    98      5.561   5.561 (0.824)    1697555   30.7482         31
*  32 Chlorobenzene-d5                   117      6.747   6.747 (1.000)    1453013   30.0000
$  41 Bromofluorobenzene (SUR)           174      7.489   7.489 (1.110)     533016   26.5349         26
```

Data File: /chem/VOAMS3.i/624/10-03-06/06oct06.b/ca14057.d
Date : 06-OCT-2006 23:11
Client ID: CAV279A
Sample Info: CAV279A
Purge Volume: 5.0
Column phase: DB624

Instrument: VOAMS3.i

Operator:
Column diameter: 0.18



Calibration Summary

VOLATILE ORGANICS INITIAL CALIBRATION DATA
METHOD 624

Instrument ID: VOAMS3

Calibration Date(s): 10/03/06 10/04/06

Heated Purge: (Y/N) N

Calibration Time(s): 2252 0049

LAB FILE ID: RRF5: CA13887 RRF10: CA13886 RRF20: CA13885
RRF50: CA13889 RRF200: CA13890

COMPOUND	RRF5	RRF10	RRF20	RRF50	RRF200
Chloromethane	3.048	3.347	3.225	2.525	2.703
Bromomethane	1.634	1.819	1.664	1.408	1.749
Vinyl Chloride	2.807	2.970	2.948	2.236	2.570
Chloroethane	1.348	1.418	1.309	1.192	0.992
Methylene Chloride	2.283	2.586	2.580	2.075	2.625
Acetone	0.886	0.847	0.754	0.663	0.658
Carbon Disulfide	4.114	6.509	6.335	5.425	6.722
Trichlorofluoromethane	4.050	4.306	4.465	3.388	3.707
1,1-Dichloroethene	1.774	2.271	2.266	1.764	2.412
1,1-Dichloroethane	4.085	4.605	4.595	3.952	4.280
trans-1,2-Dichloroethene	1.916	2.285	2.377	1.947	2.516
cis-1,2-Dichloroethene	2.181	2.362	2.306	2.031	2.274
Chloroform	3.628	4.296	4.211	3.544	3.714
1,2-Dichloroethane	0.448	0.456	0.437	0.423	0.414
2-Butanone	0.282	0.345	0.252	0.241	0.288
1,1,1-Trichloroethane	2.960	3.331	3.445	3.050	3.243
Carbon Tetrachloride	2.096	2.706	2.732	2.413	2.669
Bromodichloromethane	0.411	0.403	0.412	0.420	0.448
1,2-Dichloropropane	0.364	0.362	0.365	0.350	0.374
cis-1,3-Dichloropropene	0.515	0.502	0.539	0.541	0.577
Trichloroethene	0.297	0.304	0.313	0.304	0.339
Dibromochloromethane	0.316	0.262	0.281	0.294	0.321
1,1,2-Trichloroethane	0.290	0.258	0.249	0.240	0.249
Benzene	1.233	1.281	1.282	1.232	1.128
trans-1,3-Dichloropropene	0.477	0.456	0.463	0.459	0.452
2-Chloroethyl Vinyl Ether	0.167	0.195	0.189	0.212	0.221
Bromoform	0.193	0.164	0.180	0.198	0.249
4-Methyl-2-Pentanone	0.286	0.318	0.321	0.356	0.346
2-Hexanone	0.297	0.287	0.243	0.248	0.218
Tetrachloroethene	0.330	0.330	0.324	0.313	0.352
1,1,2,2-Tetrachloroethane	0.596	0.417	0.416	0.418	0.372
Toluene	1.438	1.446	1.410	1.331	1.018
Chlorobenzene	1.072	0.977	0.973	0.949	0.751
Ethylbenzene	0.565	0.546	0.535	0.550	0.530
Styrene	1.018	0.946	0.984	0.992	0.732
Xylene (Total)	0.667	0.664	0.673	0.662	0.492
Ethyl Ether	2.090	2.789	2.519	2.084	2.428
Acrolein	0.035	0.046	0.039	0.034	0.044
Freon TF	1.751	2.814	2.696	2.205	2.915

VOLATILE ORGANICS INITIAL CALIBRATION DATA (cont'd)
METHOD 624

Instrument ID: VOAMS3
Calibration Date(s): 10/03/06 10/04/06
Heated Purge: (Y/N) N
Calibration Time(s): 2252 0049

LAB FILE ID: RRF5: CA13887 RRF10: CA13886 RRF20: CA13885
RRF50: CA13889 RRF200: CA13890

COMPOUND	RRF5	RRF10	RRF20	RRF50	RRF200
Isopropanol					
Acetonitrile	0.064	0.075	0.065	0.063	0.064
TBA	0.231	0.243	0.228	0.216	0.225
Acrylonitrile	0.949	0.969	0.966	0.854	0.859
MTBE	6.342	7.464	6.921	6.346	6.824
Hexane	1.342	2.132	2.117	1.768	1.970
DIPE	7.562	9.062	8.514	7.932	7.719
Ethyl Acetate	0.205	0.224	0.245	0.227	0.236
Vinyl Acetate	2.036	2.372	2.107	1.982	1.934
Tetrahydrofuran	0.738	0.779	1.046	0.956	0.955
Cyclohexane	2.858	4.061	3.924	3.814	3.877
Isobutanol					
Isopropyl Acetate	0.589	0.628	0.612	0.655	0.538
n-Heptane					
n-Butanol					
Propyl Acetate	0.465	0.495	0.468	0.514	0.430
Butyl Acetate	0.473	0.521	0.508	0.537	0.379
1,2-Dibromoethane	0.312	0.293	0.285	0.277	0.286
1,3-Dichlorobenzene	0.780	0.678	0.704	0.708	0.570
1,4-Dichlorobenzene	0.754	0.679	0.695	0.703	0.558
1,2-Dichlorobenzene	0.774	0.654	0.684	0.684	0.544
Naphthalene	1.222	0.995	0.957	0.924	0.603
Methylnaphthalene (total)					
Dimethylnaphthalene (total)					
Dichlorodifluoromethane	2.304	2.475	2.494	1.911	2.056
1,4-Dioxane	0.004	0.004	0.004	0.004	0.004
n-Pentane	0.427	0.696	0.620	0.501	0.592
5-Methyl-2-Hexanone					
Isopropylbenzene	1.494	1.482	1.531	1.525	0.899
1,2,4-Trimethylbenzene	1.223	1.146	1.183	1.198	0.755
Cyclohexanone					
1,2,4-Trichlorobenzene	0.336	0.330	0.342	0.317	0.345
Methyl Methacrylate	0.088	0.082	0.076	0.089	0.093
Allyl Alcohol					
Epichlorohydrin	0.036	0.036	0.035	0.038	0.034
Allyl Chloride					
Benzyl Chloride	1.480	1.649	1.717	1.709	1.006
Isoprene	2.769	4.605	4.384	3.457	4.101
1,1,1,2-Tetrachloroethane	0.360	0.308	0.319	0.315	0.349

VOLATILE ORGANICS INITIAL CALIBRATION DATA (cont'd)
METHOD 624

Instrument ID: VOAMS3

Heated Purge: (Y/N) N

Calibration Date(s): 10/03/06 10/04/06

Calibration Time(s): 2252 0049

LAB FILE ID: RRF5: CA13887 RRF10: CA13886 RRF20: CA13885
RRF50: CA13889 RRF200: CA13890

COMPOUND	RRF5	RRF10	RRF20	RRF50	RRF200
Camphene (total)					
Camphor					
1,3,5-Trimethylbenzene	1.199	1.180	1.200	1.227	0.777
1,2,3-Trichlorobenzene	0.345	0.316	0.335	0.297	0.314
n-Butylbenzene	1.480	1.649	1.717	1.709	1.006
sec-Butylbenzene	1.403	1.358	1.361	1.330	0.830
tert-Butylbenzene	1.011	0.929	0.979	0.985	0.726
p-Isopropyltoluene	1.163	1.138	1.180	1.166	0.745
n-Propylbenzene	1.859	1.748	1.784	1.745	0.952
m+p-Ethyltoluene					
o-Ethyltoluene					
Methyl Acetate	4.780	5.389	5.217	4.708	6.070
Methyl cyclohexane	0.403	0.543	0.528	0.559	0.595
1,2-Dibromo-3-chloropropane	0.081	0.064	0.064	0.067	0.068
Cyclohexene					
1,2-Dichlorotrifluoroethane					
n-Propanol					
3-Methyl-1-Pentyn-3-ol					
Propylene Oxide					
Ethanol					
Chlorotrifluoroethane					
Dichlorofluoromethane					
Ethylene Oxide					
Methyl Formate					
Isobutyraldehyde					
Amyl Acetate					
1,2,3-Trichloropropane	0.171	0.133	0.129	0.131	0.142
Chlorodifluoromethane					
1,3-Dichloropropane	0.596	0.536	0.526	0.519	0.491
Dibromomethane	0.203	0.174	0.192	0.181	0.200
1-Propene					
2-Chloropropane					
1-Chloropropane					
Hexachlorobutadiene	0.126	0.152	0.152	0.114	0.134
1,2-Dichloroethane-d4 (SUR)	0.048	0.046	0.048	0.048	0.049
Toluene-d8 (SUR)	1.205	1.186	1.153	1.094	1.061
Bromofluorobenzene (SUR)	0.406	0.411	0.428	0.420	0.409

VOLATILE ORGANICS INITIAL CALIBRATION DATA (cont'd)
METHOD 624

Instrument ID: VOAMS3

Calibration Date(s): 10/03/06 10/04/06

Heated Purge: (Y/N) N

Calibration Time(s): 2252 0049

COMPOUND	CURVE	COEFFICENT A1	%RSD OR R^2
Chloromethane	AVRG	2.96964668	11.7*
Bromomethane	AVRG	1.65466392	9.4*
Vinyl Chloride	AVRG	2.70613541	11.4*
Chloroethane	AVRG	1.25191314	13.3*
Methylene Chloride	AVRG	2.42975622	9.9*
Acetone	AVRG	0.76154284	13.7*
Carbon Disulfide	AVRG	5.82110633	18.4*
Trichlorofluoromethane	AVRG	3.98336282	11.0*
1,1-Dichloroethene	AVRG	2.09729022	14.6*
1,1-Dichloroethane	AVRG	4.30349312	6.8*
trans-1,2-Dichloroethene	AVRG	2.20826592	12.0*
cis-1,2-Dichloroethene	AVRG	2.23089049	5.8*
Chloroform	AVRG	3.87860197	9.0*
1,2-Dichloroethane	AVRG	0.43544212	4.0*
2-Butanone	AVRG	0.28157445	14.3*
1,1,1-Trichloroethane	AVRG	3.20584842	6.2*
Carbon Tetrachloride	AVRG	2.52324936	10.7*
Bromodichloromethane	AVRG	0.41899144	4.2*
1,2-Dichloropropane	AVRG	0.36324264	2.4*
cis-1,3-Dichloropropene	AVRG	0.53482274	5.4*
Trichloroethene	AVRG	0.31143815	5.3*
Dibromochloromethane	AVRG	0.29468702	8.4*
1,1,2-Trichloroethane	AVRG	0.25715039	7.6*
Benzene	AVRG	1.23129858	5.1*
trans-1,3-Dichloropropene	AVRG	0.46163275	2.0*
2-Chloroethyl Vinyl Ether	AVRG	0.19702381	10.7*
Bromoform	AVRG	0.19682566	16.4*
4-Methyl-2-Pentanone	AVRG	0.32542312	8.4*
2-Hexanone	AVRG	0.25868105	12.6*
Tetrachloroethene	AVRG	0.32987036	4.3*
1,1,2,2-Tetrachloroethane	AVRG	0.44379633	19.7*
Toluene	AVRG	1.32835771	13.5*
Chlorobenzene	AVRG	0.94449459	12.5*
Ethylbenzene	AVRG	0.54523288	2.5*
Styrene	AVRG	0.93423647	12.4*
Xylene (Total)	AVRG	0.63183364	12.3*
Ethyl Ether	AVRG	2.38215867	12.6*
Acrolein	AVRG	0.03957052	13.3*
Freon TF	AVRG	2.47634128	19.7*

* Compound with required maximum % RSD value.
** Compound with required minimum RRF value.

VOLATILE ORGANICS INITIAL CALIBRATION DATA (cont'd)
METHOD 624

Instrument ID: VOAMS3 Calibration Date(s): 10/03/06 10/04/06

Heated Purge: (Y/N) N Calibration Time(s): 2252 0049

COMPOUND	CURVE	COEFFICENT A1	%RSD OR R^2
Isopropanol	AVRG		
Acetonitrile	AVRG	0.06611866	7.5*
TBA	AVRG	0.22886323	4.3*
Acrylonitrile	AVRG	0.91938909	6.3*
MTBE	AVRG	6.77929786	6.9*
Hexane	AVRG	1.86589082	17.5*
DIPE	AVRG	8.15760147	7.6*
Ethyl Acetate	AVRG	0.22734569	6.6*
Vinyl Acetate	AVRG	2.08624010	8.2*
Tetrahydrofuran	AVRG	0.89479832	14.6*
Cyclohexane	AVRG	3.70680279	13.0*
Isobutanol	AVRG		
Isopropyl Acetate	AVRG	0.60431102	7.3*
n-Heptane	AVRG		
n-Butanol	AVRG		
Propyl Acetate	AVRG	0.47435161	6.7*
Butyl Acetate	AVRG	0.48368325	13.0*
1,2-Dibromoethane	AVRG	0.29086868	4.5*
1,3-Dichlorobenzene	AVRG	0.68777722	11.0*
1,4-Dichlorobenzene	AVRG	0.67778662	10.7*
1,2-Dichlorobenzene	AVRG	0.66809897	12.4*
Naphthalene	AVRG	0.94011556	23.6*
Methylnaphthalene (total)	AVRG		
Dimethylnaphthalene (total)	AVRG		
Dichlorodifluoromethane	AVRG	2.24814984	11.5*
1,4-Dioxane	AVRG	0.00402550	2.5*
n-Pentane	AVRG	0.56717099	18.5*
5-Methyl-2-Hexanone	AVRG		
Isopropylbenzene	AVRG	1.38628427	19.7*
1,2,4-Trimethylbenzene	AVRG	1.10115632	17.7*
Cyclohexanone	AVRG		
1,2,4-Trichlorobenzene	AVRG	0.33429381	3.3*
Methyl Methacrylate	AVRG	0.08565078	7.9*
Allyl Alcohol	AVRG		
Epichlorohydrin	AVRG	0.03593232	4.4*
Allyl Chloride	AVRG		
Benzyl Chloride	AVRG	1.51207662	19.8*
Isoprene	AVRG	3.86313416	19.4*
1,1,1,2-Tetrachloroethane	AVRG	0.33037687	6.9*

* Compound with required maximum % RSD value.
** Compound with required minimum RRF value.

VOLATILE ORGANICS INITIAL CALIBRATION DATA (cont'd)
METHOD 624

Instrument ID: VOAMS3 Calibration Date(s): 10/03/06 10/04/06

Heated Purge: (Y/N) N Calibration Time(s): 2252 0049

COMPOUND	CURVE	COEFFICENT A1	%RSD OR R^2
Camphene (total)	AVRG		
Camphor	AVRG		
1,3,5-Trimethylbenzene	AVRG	1.11686597	17.1*
1,2,3-Trichlorobenzene	AVRG	0.32153272	5.8*
n-Butylbenzene	AVRG	1.51207662	19.8*
sec-Butylbenzene	AVRG	1.25643650	19.1*
tert-Butylbenzene	AVRG	0.92600629	12.5*
p-Isopropyltoluene	AVRG	1.07858855	17.3*
n-Propylbenzene	AVRG	1.61752055	23.2*
m+p-Ethyltoluene	AVRG		
o-Ethyltoluene	AVRG		
Methyl Acetate	AVRG	5.23289441	10.5*
Methyl cyclohexane	AVRG	0.52578225	13.9*
1,2-Dibromo-3-chloropropane	AVRG	0.06871554	10.3*
Cyclohexene	AVRG		
1,2-Dichlorotrifluoroethane	AVRG		
n-Propanol	AVRG		
3-Methyl-1-Pentyn-3-ol	AVRG		
Propylene Oxide	AVRG		
Ethanol	AVRG		
Chlorotrifluoroethane	AVRG		
Dichlorofluoromethane	AVRG		
Ethylene Oxide	AVRG		
Methyl Formate	AVRG		
Isobutyraldehyde	AVRG		
Amyl Acetate	AVRG		
1,2,3-Trichloropropane	AVRG	0.14138415	12.1*
Chlorodifluoromethane	AVRG		
1,3-Dichloropropane	AVRG	0.53358360	7.2*
Dibromomethane	AVRG	0.19006720	6.5*
1-Propene	AVRG		
2-Chloropropane	AVRG		
1-Chloropropane	AVRG		
Hexachlorobutadiene	AVRG	0.13586603	12.2*
1,2-Dichloroethane-d4 (SUR)	AVRG	0.04775643	2.0*
Toluene-d8 (SUR)	AVRG	1.13987283	5.4*
Bromofluorobenzene (SUR)	AVRG	0.41473903	2.1*

* Compound with required maximum % RSD value.
** Compound with required minimum RRF value.

VOLATILE ORGANICS CONTINUING CALIBRATION CHECK
METHOD 624

Instrument ID: VOAMS3 Calibration Date: 10/05/06 Time: 1837

Lab File ID: CA13997 Init. Calib. Date(s): 10/03/06 10/04/06

Heated Purge: (Y/N) N Init. Calib. Times: 2252 0049

COMPOUND	$\overline{\text{RRF}}$	RRF20	MIN RRF	%D	MAX %D
Chloromethane	2.970	2.174		26.8	104
Bromomethane	1.655	1.166		29.5	86.0
Vinyl Chloride	2.706	2.031		24.9	96.0
Chloroethane	1.252	0.894		28.6	62.0
Methylene Chloride	2.430	2.315		4.7	39.5
Acetone	0.762	0.678		11.0	40.0
Carbon Disulfide	5.821	4.925		15.4	40.0
Trichlorofluoromethane	3.983	3.111		21.9	52.0
1,1-Dichloroethene	2.097	1.802		14.1	49.5
1,1-Dichloroethane	4.303	4.023		6.5	27.5
trans-1,2-Dichloroethene	2.208	2.050		7.2	30.5
cis-1,2-Dichloroethene	2.231	2.255		-1.1	40.0
Chloroform	3.879	3.788		2.3	32.5
1,2-Dichloroethane	0.436	0.380		12.8	32.0
2-Butanone	0.282	0.278		1.4	40.0
1,1,1-Trichloroethane	3.206	3.032		5.4	25.0
Carbon Tetrachloride	2.523	2.457		2.6	27.0
Bromodichloromethane	0.419	0.374		10.7	34.5
1,2-Dichloropropane	0.363	0.349		3.8	66.0
cis-1,3-Dichloropropene	0.535	0.504		5.8	76.0
Trichloroethene	0.311	0.300		3.5	33.5
Dibromochloromethane	0.295	0.280		5.1	32.5
1,1,2-Trichloroethane	0.257	0.256		0.4	29.0
Benzene	1.231	1.291		-4.9	36.0
trans-1,3-Dichloropropene	0.461	0.431		6.5	50.0
2-Chloroethyl Vinyl Ether	0.197	0.191		3.0	124
Bromoform	0.197	0.168		14.7	29.0
4-Methyl-2-Pentanone	0.325	0.306		5.8	40.0
2-Hexanone	0.259	0.232		10.4	40.0
Tetrachloroethene	0.330	0.326		1.2	26.5
1,1,2,2-Tetrachloroethane	0.444	0.407		8.3	39.5
Toluene	1.329	1.432		-7.8	25.5
Chlorobenzene	0.944	0.962		-1.9	34.0
Ethylbenzene	0.545	0.529		2.9	41.0
Styrene	0.934	0.971		-4.0	40.0
Xylene (Total)	0.632	0.643		-1.7	40.0
Ethyl Ether	2.382	2.125		10.8	40.0

page 1 of 4

VOLATILE ORGANICS CONTINUING CALIBRATION CHECK(cont'd)
METHOD 624

Instrument ID: VOAMS3 Calibration Date: 10/05/06 Time: 1837

Lab File ID: CA13997 Init. Calib. Date(s): 10/03/06 10/04/06

Heated Purge: (Y/N) N Init. Calib. Times: 2252 0049

COMPOUND	$\overline{\text{RRF}}$	RRF20	MIN RRF	%D	MAX %D
Acrolein	0.040	0.053		-32.5	40.0
Freon TF	2.476	2.232		9.8	40.0
Isopropanol					40.0
Acetonitrile	0.066	0.062		6.1	40.0
TBA	0.229	0.205		10.5	40.0
Acrylonitrile	0.919	0.864		6.0	40.0
MTBE	6.779	6.312		6.9	40.0
Hexane	1.866	1.434		23.2	40.0
DIPE	8.158	7.769		4.8	40.0
Ethyl Acetate	0.227	0.237		-4.4	40.0
Vinyl Acetate	2.086	1.727		17.2	40.0
Tetrahydrofuran	0.895	0.967		-8.0	40.0
Cyclohexane	3.707	3.864		-4.2	40.0
Isobutanol					40.0
Isopropyl Acetate	0.604	0.581		3.8	40.0
n-Heptane					40.0
n-Butanol					40.0
Propyl Acetate	0.474	0.451		4.8	40.0
Butyl Acetate	0.484	0.510		-5.4	40.0
1,2-Dibromoethane	0.291	0.279		4.1	40.0
1,3-Dichlorobenzene	0.688	0.666		3.2	27.0
1,4-Dichlorobenzene	0.678	0.660		2.6	37.0
1,2-Dichlorobenzene	0.668	0.648		3.0	37.0
Naphthalene	0.940	0.918		2.3	40.0
Methylnaphthalene (total)					40.0
Dimethylnaphthalene (total)					40.0
Dichlorodifluoromethane	2.248	1.649		26.6	40.0
1,4-Dioxane	0.004	0.004		0.0	40.0
n-Pentane	0.567	0.306		46.0	40.0
5-Methyl-2-Hexanone					40.0
Isopropylbenzene	1.386	1.467		-5.8	40.0
1,2,4-Trimethylbenzene	1.101	1.095		0.5	40.0
Cyclohexanone					40.0
1,2,4-Trichlorobenzene	0.334	0.292		12.6	40.0
Methyl Methacrylate	0.086	0.084		2.3	40.0
Allyl Alcohol					40.0
Epichlorohydrin	0.036	0.034		5.6	40.0

VOLATILE ORGANICS CONTINUING CALIBRATION CHECK(cont'd)
METHOD 624

Instrument ID: VOAMS3 Calibration Date: 10/05/06 Time: 1837

Lab File ID: CA13997 Init. Calib. Date(s): 10/03/06 10/04/06

Heated Purge: (Y/N) N Init. Calib. Times: 2252 0049

COMPOUND	$\overline{\text{RRF}}$	RRF20	MIN RRF	%D	MAX %D
Allyl Chloride					40.0
Benzyl Chloride	1.512	1.462		3.3	40.0
Isoprene	3.863	3.380		12.5	40.0
1,1,1,2-Tetrachloroethane	0.330	0.309		6.4	40.0
Camphene (total)					40.0
Camphor					40.0
1,3,5-Trimethylbenzene	1.117	1.133		-1.4	40.0
1,2,3-Trichlorobenzene	0.321	0.271		15.6	40.0
n-Butylbenzene	1.512	1.462		3.3	40.0
sec-Butylbenzene	1.256	1.214		3.3	40.0
tert-Butylbenzene	0.926	0.891		3.8	40.0
p-Isopropyltoluene	1.078	1.052		2.4	40.0
n-Propylbenzene	1.618	1.651		-2.0	40.0
m+p-Ethyltoluene					40.0
o-Ethyltoluene					40.0
Methyl Acetate	5.233	4.221		19.3	40.0
Methyl cyclohexane	0.526	0.534		-1.5	40.0
1,2-Dibromo-3-chloropropane	0.069	0.058		15.9	40.0
Cyclohexene					40.0
1,2-Dichlorotrifluoroethane					40.0
n-Propanol					40.0
3-Methyl-1-Pentyn-3-ol					40.0
Propylene Oxide					40.0
Ethanol					40.0
Chlorotrifluoroethane					40.0
Dichlorofluoromethane					40.0
Ethylene Oxide					40.0
Methyl Formate					40.0
Isobutyraldehyde					40.0
Amyl Acetate					40.0
1,2,3-Trichloropropane	0.141	0.123		12.8	40.0
Chlorodifluoromethane					40.0
1,3-Dichloropropane	0.534	0.520		2.6	40.0
Dibromomethane	0.190	0.178		6.3	40.0
1-Propene					40.0
2-Chloropropane					40.0
1-Chloropropane					40.0

VOLATILE ORGANICS CONTINUING CALIBRATION CHECK(cont'd)
METHOD 624

Instrument ID: VOAMS3 Calibration Date: 10/05/06 Time: 1837

Lab File ID: CA13997 Init. Calib. Date(s): 10/03/06 10/04/06

Heated Purge: (Y/N) N Init. Calib. Times: 2252 0049

COMPOUND	$\overline{RRF}$	RRF20	MIN RRF	%D	MAX %D
Hexachlorobutadiene	0.136	0.100		26.5	40.0
1,2-Dichloroethane-d4 (SUR)	0.048	0.048		0.0	
Toluene-d8 (SUR)	1.140	1.155		-1.3	
Bromofluorobenzene (SUR)	0.415	0.422		-1.7	

page 4 of 4

VOLATILE ORGANICS CONTINUING CALIBRATION CHECK
METHOD 624

Instrument ID: VOAMS3 Calibration Date: 10/06/06 Time: 2141

Lab File ID: CA14053 Init. Calib. Date(s): 10/03/06 10/04/06

Heated Purge: (Y/N) N Init. Calib. Times: 2252 0049

COMPOUND	$\overline{\text{RRF}}$	RRF20	MIN RRF	%D	MAX %D
Chloromethane	2.970	2.469		16.9	104
Bromomethane	1.655	1.252		24.4	86.0
Vinyl Chloride	2.706	2.174		19.7	96.0
Chloroethane	1.252	1.008		19.5	62.0
Methylene Chloride	2.430	2.196		9.6	39.5
Acetone	0.762	0.666		12.6	40.0
Carbon Disulfide	5.821	5.170		11.2	40.0
Trichlorofluoromethane	3.983	3.901		2.0	52.0
1,1-Dichloroethene	2.097	1.805		13.9	49.5
1,1-Dichloroethane	4.303	3.964		7.9	27.5
trans-1,2-Dichloroethene	2.208	2.043		7.5	30.5
cis-1,2-Dichloroethene	2.231	2.168		2.8	40.0
Chloroform	3.879	3.706		4.4	32.5
1,2-Dichloroethane	0.436	0.390		10.6	32.0
2-Butanone	0.282	0.257		8.9	40.0
1,1,1-Trichloroethane	3.206	3.052		4.8	25.0
Carbon Tetrachloride	2.523	2.391		5.2	27.0
Bromodichloromethane	0.419	0.379		9.5	34.5
1,2-Dichloropropane	0.363	0.346		4.7	66.0
cis-1,3-Dichloropropene	0.535	0.509		4.8	76.0
Trichloroethene	0.311	0.303		2.6	33.5
Dibromochloromethane	0.295	0.282		4.4	32.5
1,1,2-Trichloroethane	0.257	0.248		3.5	29.0
Benzene	1.231	1.301		-5.7	36.0
trans-1,3-Dichloropropene	0.461	0.437		5.2	50.0
2-Chloroethyl Vinyl Ether	0.197	0.194		1.5	124
Bromoform	0.197	0.170		13.7	29.0
4-Methyl-2-Pentanone	0.325	0.294		9.5	40.0
2-Hexanone	0.259	0.236		8.9	40.0
Tetrachloroethene	0.330	0.341		-3.3	26.5
1,1,2,2-Tetrachloroethane	0.444	0.416		6.3	39.5
Toluene	1.329	1.432		-7.8	25.5
Chlorobenzene	0.944	1.040		-10.2	34.0
Ethylbenzene	0.545	0.533		2.2	41.0
Styrene	0.934	0.956		-2.4	40.0
Xylene (Total)	0.632	0.661		-4.6	40.0
Ethyl Ether	2.382	1.967		17.4	40.0

page 1 of 4

VOLATILE ORGANICS CONTINUING CALIBRATION CHECK(cont'd)
METHOD 624

Instrument ID: VOAMS3 Calibration Date: 10/06/06 Time: 2141

Lab File ID: CA14053 Init. Calib. Date(s): 10/03/06 10/04/06

Heated Purge: (Y/N) N Init. Calib. Times: 2252 0049

COMPOUND	$\overline{\text{RRF}}$	RRF20	MIN RRF	%D	MAX %D
Acrolein	0.040	0.038		5.0	40.0
Freon TF	2.476	2.249		9.2	40.0
Isopropanol					40.0
Acetonitrile	0.066	0.060		9.1	40.0
TBA	0.229	0.205		10.5	40.0
Acrylonitrile	0.919	0.800		12.9	40.0
MTBE	6.779	6.217		8.3	40.0
Hexane	1.866	1.346		27.9	40.0
DIPE	8.158	7.574		7.2	40.0
Ethyl Acetate	0.227	0.238		-4.8	40.0
Vinyl Acetate	2.086	1.840		11.8	40.0
Tetrahydrofuran	0.895	0.868		3.0	40.0
Cyclohexane	3.707	3.879		-4.6	40.0
Isobutanol					40.0
Isopropyl Acetate	0.604	0.580		4.0	40.0
n-Heptane					40.0
n-Butanol					40.0
Propyl Acetate	0.474	0.456		3.8	40.0
Butyl Acetate	0.484	0.502		-3.7	40.0
1,2-Dibromoethane	0.291	0.285		2.1	40.0
1,3-Dichlorobenzene	0.688	0.693		-0.7	27.0
1,4-Dichlorobenzene	0.678	0.675		0.4	37.0
1,2-Dichlorobenzene	0.668	0.649		2.8	37.0
Naphthalene	0.940	0.881		6.3	40.0
Methylnaphthalene (total)					40.0
Dimethylnaphthalene (total)					40.0
Dichlorodifluoromethane	2.248	1.908		15.1	40.0
1,4-Dioxane	0.004	0.004		0.0	40.0
n-Pentane	0.567	0.372		34.4	40.0
5-Methyl-2-Hexanone					40.0
Isopropylbenzene	1.386	1.465		-5.7	40.0
1,2,4-Trimethylbenzene	1.101	1.099		0.2	40.0
Cyclohexanone					40.0
1,2,4-Trichlorobenzene	0.334	0.305		8.7	40.0
Methyl Methacrylate	0.086	0.084		2.3	40.0
Allyl Alcohol					40.0
Epichlorohydrin	0.036	0.034		5.6	40.0

page 2 of 4

VOLATILE ORGANICS CONTINUING CALIBRATION CHECK(cont'd)
METHOD 624

Instrument ID: VOAMS3 Calibration Date: 10/06/06 Time: 2141

Lab File ID: CA14053 Init. Calib. Date(s): 10/03/06 10/04/06

Heated Purge: (Y/N) N Init. Calib. Times: 2252 0049

COMPOUND	$\overline{\text{RRF}}$	RRF20	MIN RRF	%D	MAX %D
Allyl Chloride					40.0
Benzyl Chloride	1.512	1.549		-2.4	40.0
Isoprene	3.863	3.391		12.2	40.0
1,1,1,2-Tetrachloroethane	0.330	0.319		3.3	40.0
Camphene (total)					40.0
Camphor					40.0
1,3,5-Trimethylbenzene	1.117	1.145		-2.5	40.0
1,2,3-Trichlorobenzene	0.321	0.290		9.6	40.0
n-Butylbenzene	1.512	1.549		-2.4	40.0
sec-Butylbenzene	1.256	1.235		1.7	40.0
tert-Butylbenzene	0.926	0.912		1.5	40.0
p-Isopropyltoluene	1.078	1.068		0.9	40.0
n-Propylbenzene	1.618	1.664		-2.8	40.0
m+p-Ethyltoluene					40.0
o-Ethyltoluene					40.0
Methyl Acetate	5.233	4.175		20.2	40.0
Methyl cyclohexane	0.526	0.562		-6.8	40.0
1,2-Dibromo-3-chloropropane	0.069	0.058		15.9	40.0
Cyclohexene					40.0
1,2-Dichlorotrifluoroethane					40.0
n-Propanol					40.0
3-Methyl-1-Pentyn-3-ol					40.0
Propylene Oxide					40.0
Ethanol					40.0
Chlorotrifluoroethane					40.0
Dichlorofluoromethane					40.0
Ethylene Oxide					40.0
Methyl Formate					40.0
Isobutyraldehyde					40.0
Amyl Acetate					40.0
1,2,3-Trichloropropane	0.141	0.129		8.5	40.0
Chlorodifluoromethane					40.0
1,3-Dichloropropane	0.534	0.518		3.0	40.0
Dibromomethane	0.190	0.180		5.3	40.0
1-Propene					40.0
2-Chloropropane					40.0
1-Chloropropane					40.0

page 3 of 4

VOLATILE ORGANICS CONTINUING CALIBRATION CHECK(cont'd)
METHOD 624

Instrument ID: VOAMS3 Calibration Date: 10/06/06 Time: 2141

Lab File ID: CA14053 Init. Calib. Date(s): 10/03/06 10/04/06

Heated Purge: (Y/N) N Init. Calib. Times: 2252 0049

COMPOUND	$\overline{RRF}$	RRF20	MIN RRF	%D	MAX %D
Hexachlorobutadiene	0.136	0.125		8.1	40.0
1,2-Dichloroethane-d4 (SUR)	0.048	0.047		2.1	
Toluene-d8 (SUR)	1.140	1.162		-1.9	
Bromofluorobenzene (SUR)	0.415	0.431		-3.8	

page 4 of 4

Surrogate Compound Recovery Summary

VOLATILE SYSTEM MONITORING COMPOUND RECOVERY
METHOD 624

Matrix: WATER Level: LOW Lab Job No: X772

	LAB SAMPLE NO.	S1 #	S2 #	S3 #	OTHER	TOT OUT
01	CAV278B	98	105	97		0
02	774588	103	98	87		0
03	CAV279A	101	102	88		0
04	774590	100	103	90		0
05	774589	96	100	91		0
06						
07						
08						
09						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						
21						
22						
23						
24						
25						
26						
27						
28						
29						
30						

QC LIMITS
S1 = 1,2-Dichloroethane-d4 (69-131)
S2 = Toluene-d8 (60-131)
S3 = Bromofluorobenzene (67-128)

Column to be used to flag recovery values

* Values outside of contract required QC limits

D System Monitoring Compound diluted out

page 1 of 1

Spike Recovery Summary

VOLATILE SPIKE RECOVERY SUMMARY
METHOD 624

Matrix: WATER

Level: LOW

Matrix Spike - Lab Sample No.: 774377

MS Sample from Lab Job No: X729

QA Batch: 3601

Compound	MS % REC.	BS % REC.	LIMITS
Chloromethane	75	110	0-273
Bromomethane	60	100	0-242
Vinyl Chloride	75	115	0-251
Chloroethane	65	80	14-230
Methylene Chloride	85	100	0-221
Trichlorofluoromethane	70	100	17-181
1,1-Dichloroethene	75	95	0-234
1,1-Dichloroethane	85	95	59-155
trans-1,2-Dichloroethene	85	95	54-156
Chloroform	90	100	51-138
1,2-Dichloroethane	80	90	49-155
1,1,1-Trichloroethane	85	95	52-162
Carbon Tetrachloride	85	95	70-140
Bromodichloromethane	85	95	35-155
1,2-Dichloropropane	90	100	0-210
cis-1,3-Dichloropropene	85	100	0-227
Trichloroethene	90	100	71-157
Dibromochloromethane	90	105	53-149
1,1,2-Trichloroethane	95	105	52-150
Benzene	90	110	37-151
trans-1,3-Dichloropropene	80	105	17-183
2-Chloroethyl Vinyl Ether	90	90	0-305
Bromoform	80	95	45-169
Tetrachloroethene	95	110	64-148
1,1,2,2-Tetrachloroethane	90	100	46-157
Toluene	50	120	47-150
Chlorobenzene	100	115	37-160
Ethylbenzene	50	115	37-162
1,3-Dichlorobenzene	95	105	59-156
1,4-Dichlorobenzene	95	110	18-190

* Values outside of QC limits

VOLATILE SPIKE RECOVERY SUMMARY
METHOD 624

Matrix: WATER

Level: LOW

Matrix Spike - Lab Sample No.: 774377

MS Sample from Lab Job No: X729

QA Batch: 3601

Compound	MS % REC.	BS % REC.	LIMITS
1,2-Dichlorobenzene	95	105	18-190

* Values outside of QC limits

Spike Recovery: 0 out of 62 outside limits

COMMENTS: ______________________________

Internal Standard Area and RT Summary

VOLATILE INTERNAL STANDARD AREA AND RT SUMMARY

Lab File ID (Standard): CA13997 Date Analyzed: 10/05/06

Instrument ID: VOAMS3 Time Analyzed: 1837

		IS1(BCM) AREA #	RT #	IS2(DFB) AREA #	RT #	IS3(CBZ) AREA #	RT #
	12 HOUR STD	220113	3.25	1625055	4.43	1616006	6.75
	UPPER LIMIT	440226	3.75	3250110	4.93	3232012	7.25
	LOWER LIMIT	110056	2.75	812528	3.93	808003	6.25
	LABORATORY SAMPLE NO.						
01	CAV278B	301140	3.25	1976060	4.44	1873004	6.75
02	774588	204232	3.25	1433448	4.44	1466132	6.75
03							
04							
05							
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20							
21							
22							

IS1 (BCM) = Bromochloromethane
IS2 (DFB) = 1,4-Difluorobenzene
IS3 (CBZ) = Chlorobenzene-d5

AREA UPPER LIMIT = +100% of internal standard area
AREA LOWER LIMIT = - 50% of internal standard area
RT UPPER LIMIT = + 0.50 minutes of internal standard RT
RT LOWER LIMIT = - 0.50 minutes of internal standard RT

Column used to flag values outside QC limits with an asterisk.
* Values outside of QC limits.

page 1 of 1

VOLATILE INTERNAL STANDARD AREA AND RT SUMMARY

Lab File ID (Standard): CA14053　　Date Analyzed: 10/06/06

Instrument ID: VOAMS3　　Time Analyzed: 2141

		IS1(BCM) AREA #	RT #	IS2(DFB) AREA #	RT #	IS3(CBZ) AREA #	RT #
	12 HOUR STD	218593	3.25	1552268	4.43	1546021	6.75
	UPPER LIMIT	437186	3.75	3104536	4.93	3092042	7.25
	LOWER LIMIT	109296	2.75	776134	3.93	773010	6.25
	LABORATORY SAMPLE NO.						
01	CAV279A	204241	3.25	1512856	4.43	1453013	6.75
02	774590	208223	3.25	1467637	4.43	1422667	6.75
03	774589	196465	3.25	1377895	4.43	1364230	6.75
04							
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22							

IS1 (BCM) = Bromochloromethane
IS2 (DFB) = 1,4-Difluorobenzene
IS3 (CBZ) = Chlorobenzene-d5

AREA UPPER LIMIT = +100% of internal standard area
AREA LOWER LIMIT = - 50% of internal standard area
RT UPPER LIMIT = + 0.50 minutes of internal standard RT
RT LOWER LIMIT = - 0.50 minutes of internal standard RT

Column used to flag values outside QC limits with an asterisk.
* Values outside of QC limits.

page 1 of 1

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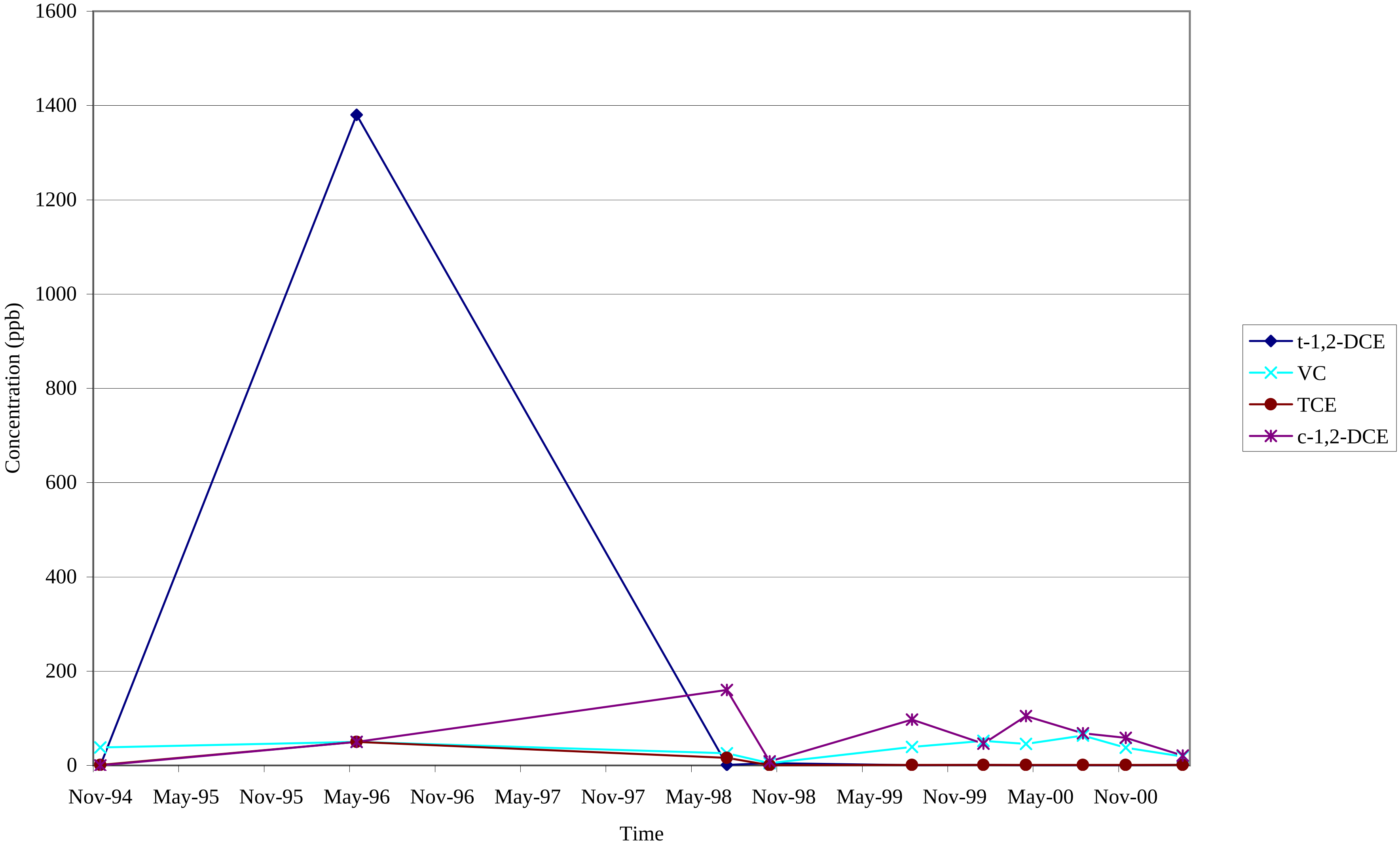
APPENDIX B

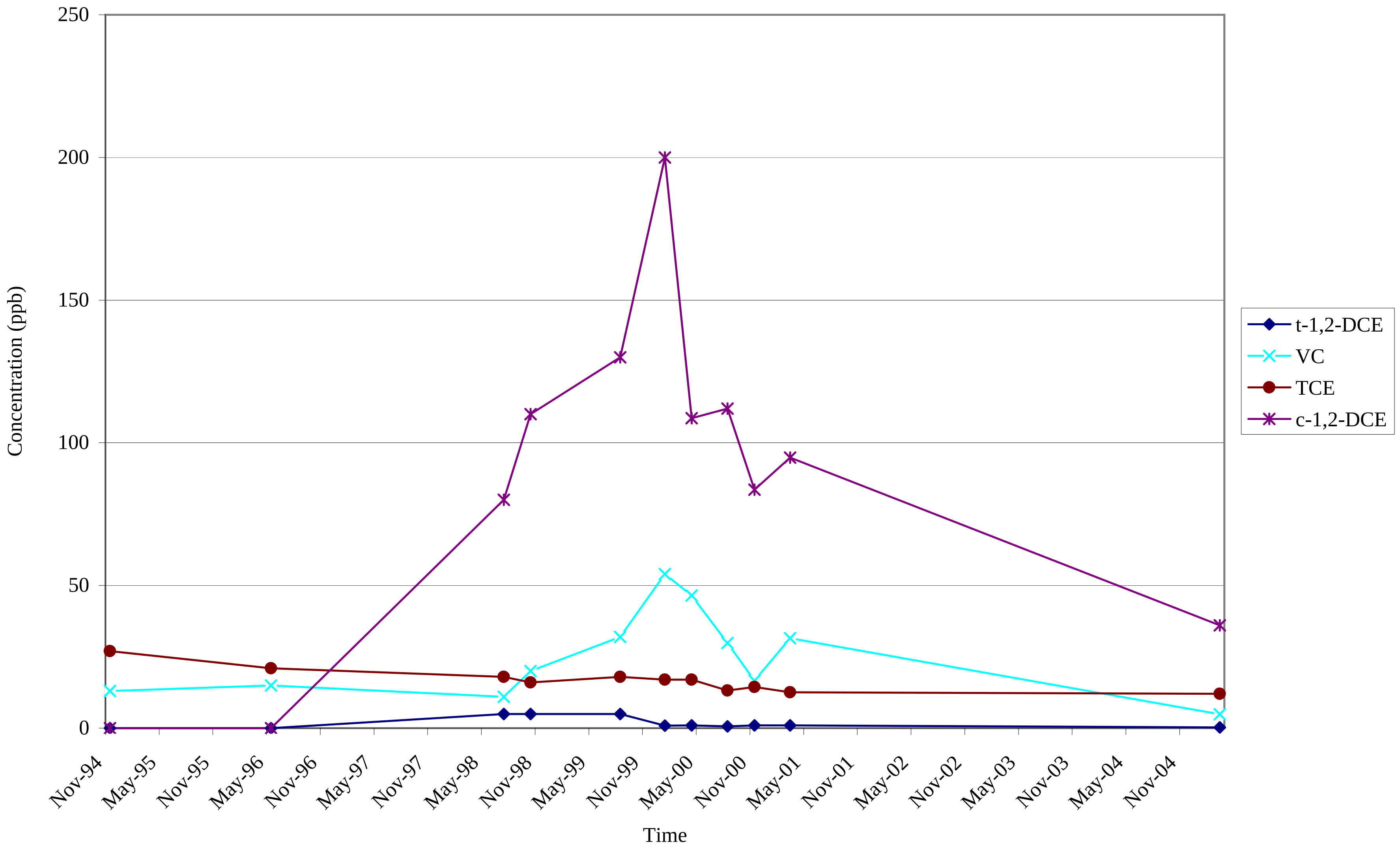
APPENDIX Q
TREND CHART-SELECTED VOCS
DRAFT SUPPLEMENTAL GROUNDWATER DATA REPORT
FORMER RARITAN ARSENAL, EDISON, NEW JERSEY

VOC Trends - AOC 4, MW-EPA-2A



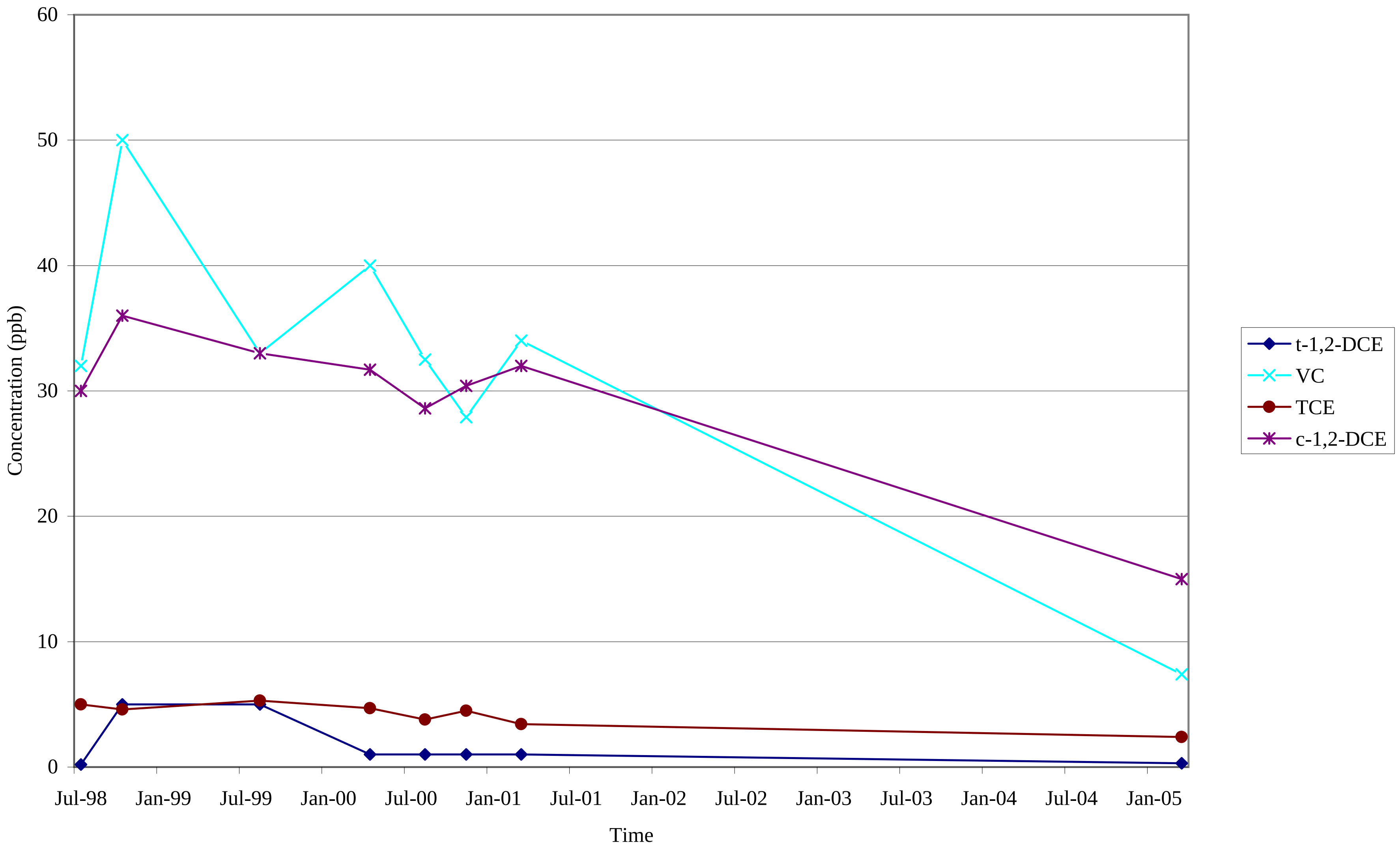
APPENDIX Q
TREND CHART-SELECTED VOCS
DRAFT SUPPLEMENTAL GROUNDWATER DATA REPORT
FORMER RARITAN ARSENAL, EDISON, NEW JERSEY

VOC Trends - AOC 4, MW-46A



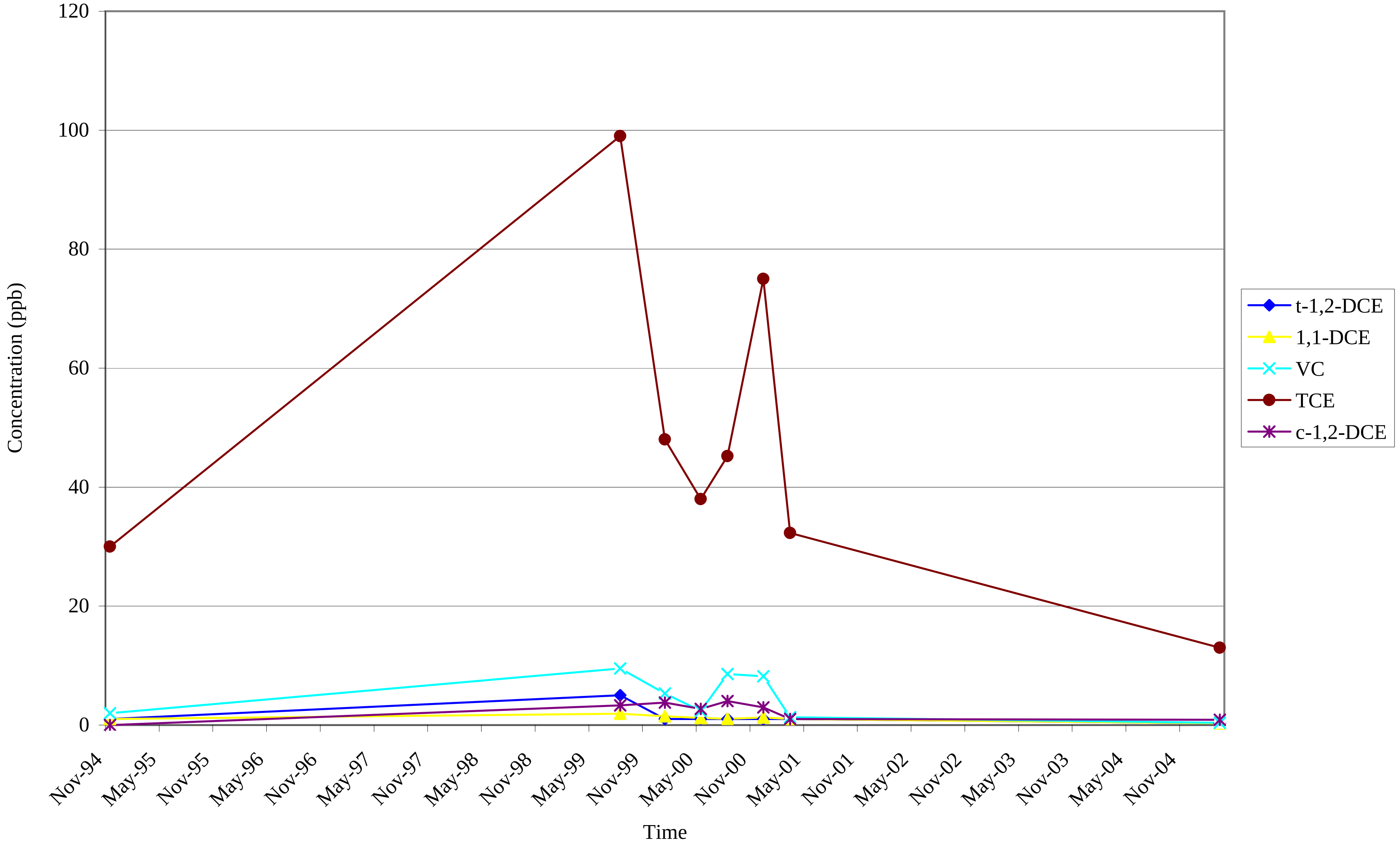
APPENDIX Q
TREND CHART-SELECTED VOCS
DRAFT SUPPLEMENTAL GROUNDWATER DATA REPORT
FORMER RARITAN ARSENAL, EDISON, NEW JERSEY

VOC Trends - AOC 4, MW-120



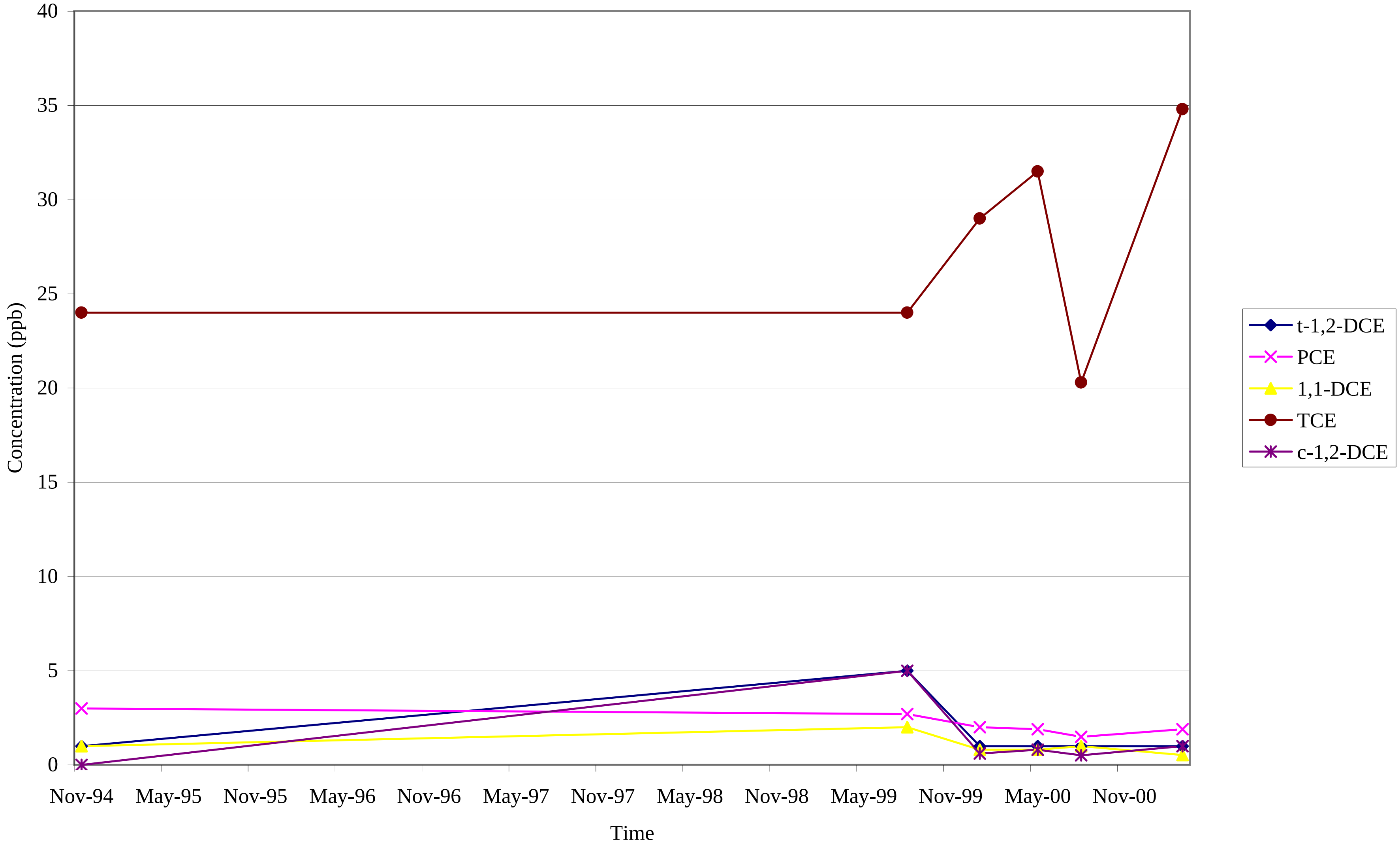
APPENDIX Q
TREND CHART-SELECTED VOCS
DRAFT SUPPLEMENTAL GROUNDWATER DATA REPORT
FORMER RARITAN ARSENAL, EDISON, NEW JERSEY

VOC Trends - AOC 6, MW-47A



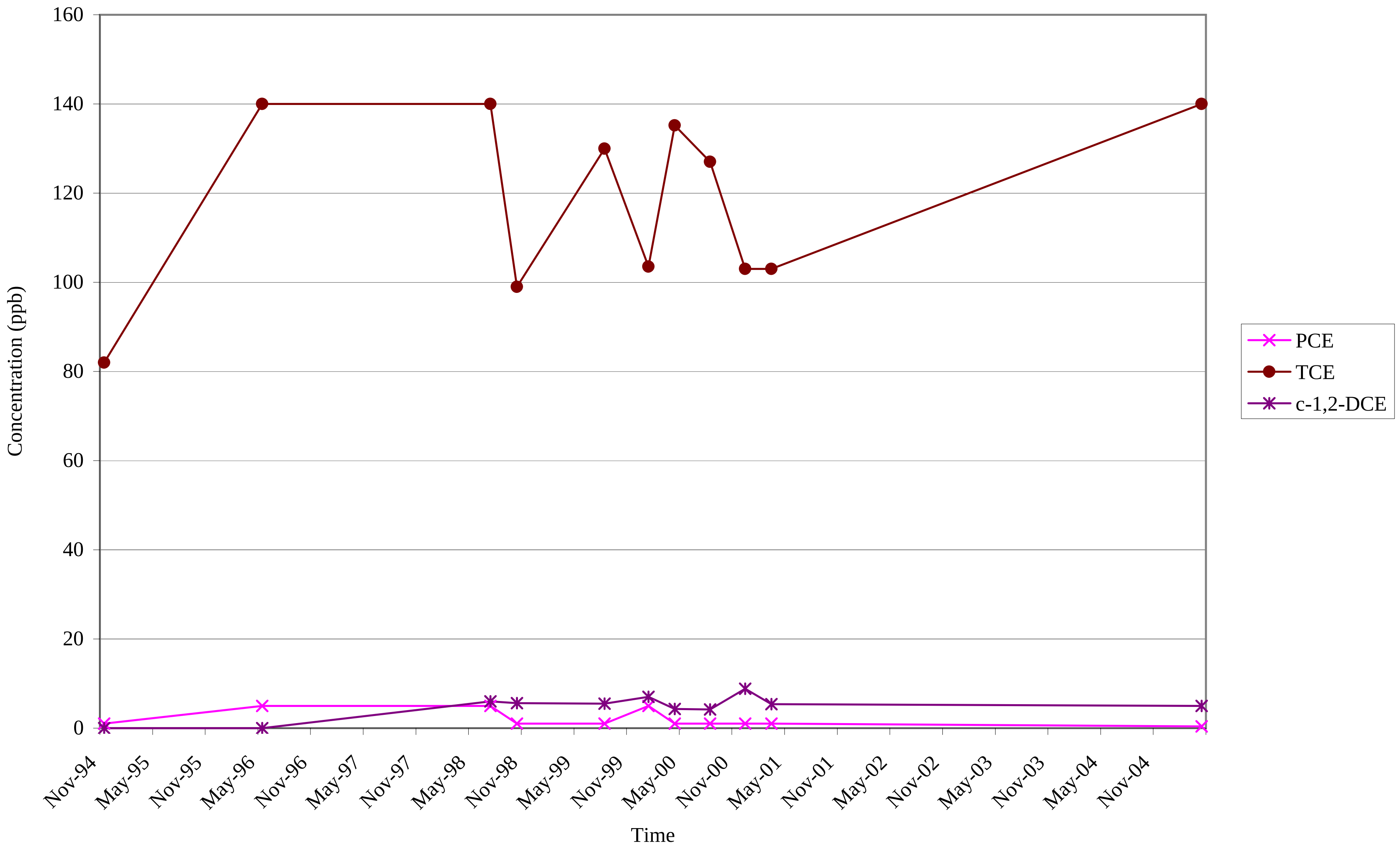
APPENDIX Q
TREND CHART-SELECTED VOCS
DRAFT SUPPLEMENTAL GROUNDWATER DATA REPORT
FORMER RARITAN ARSENAL, EDISON, NEW JERSEY

VOC Trends - AOC 6, MW-48A



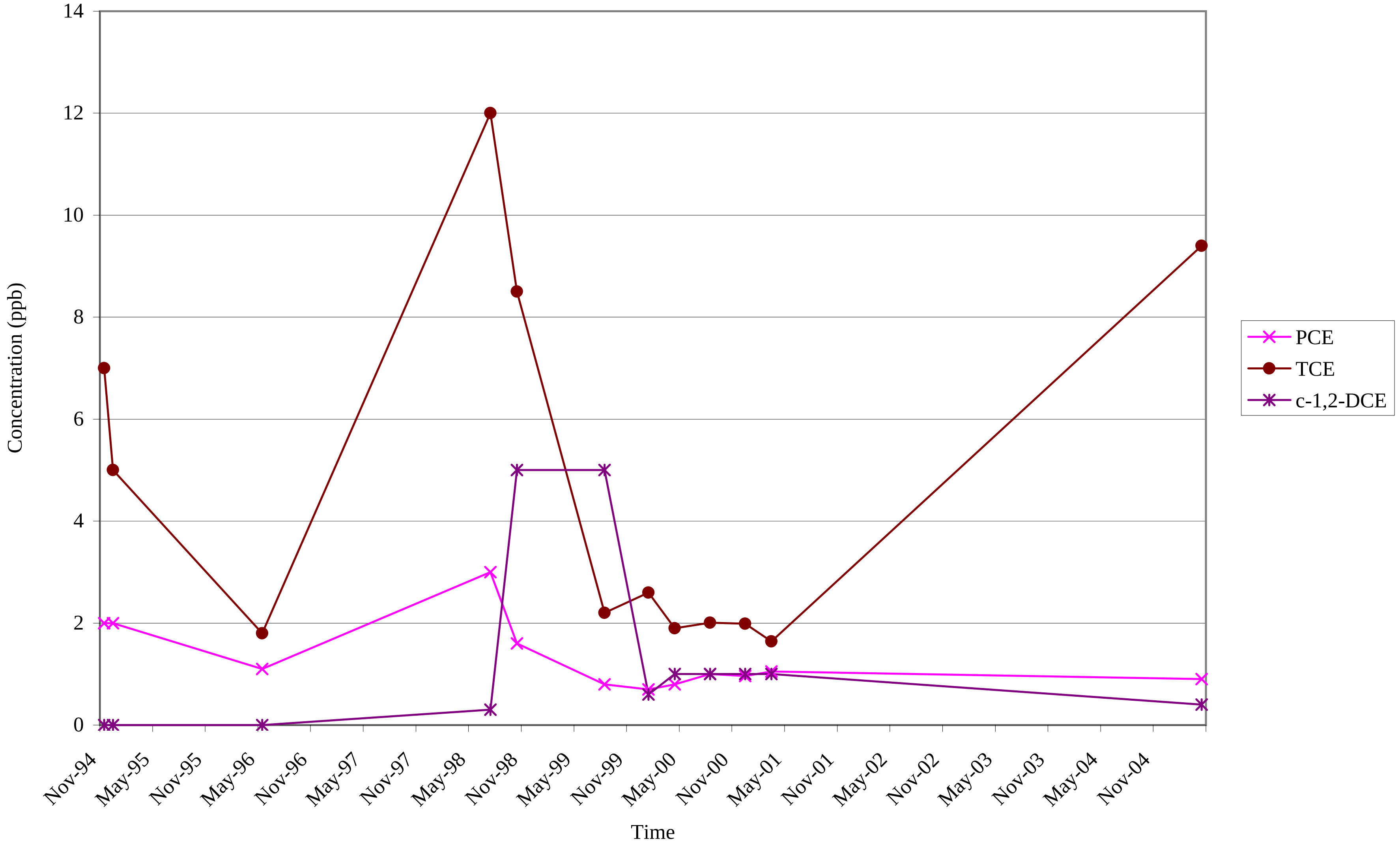
APPENDIX Q
TREND CHART-SELECTED VOCS
DRAFT SUPPLEMENTAL GROUNDWATER DATA REPORT
FORMER RARITAN ARSENAL, EDISON, NEW JERSEY

VOC Trends - AOC 8, MW-8



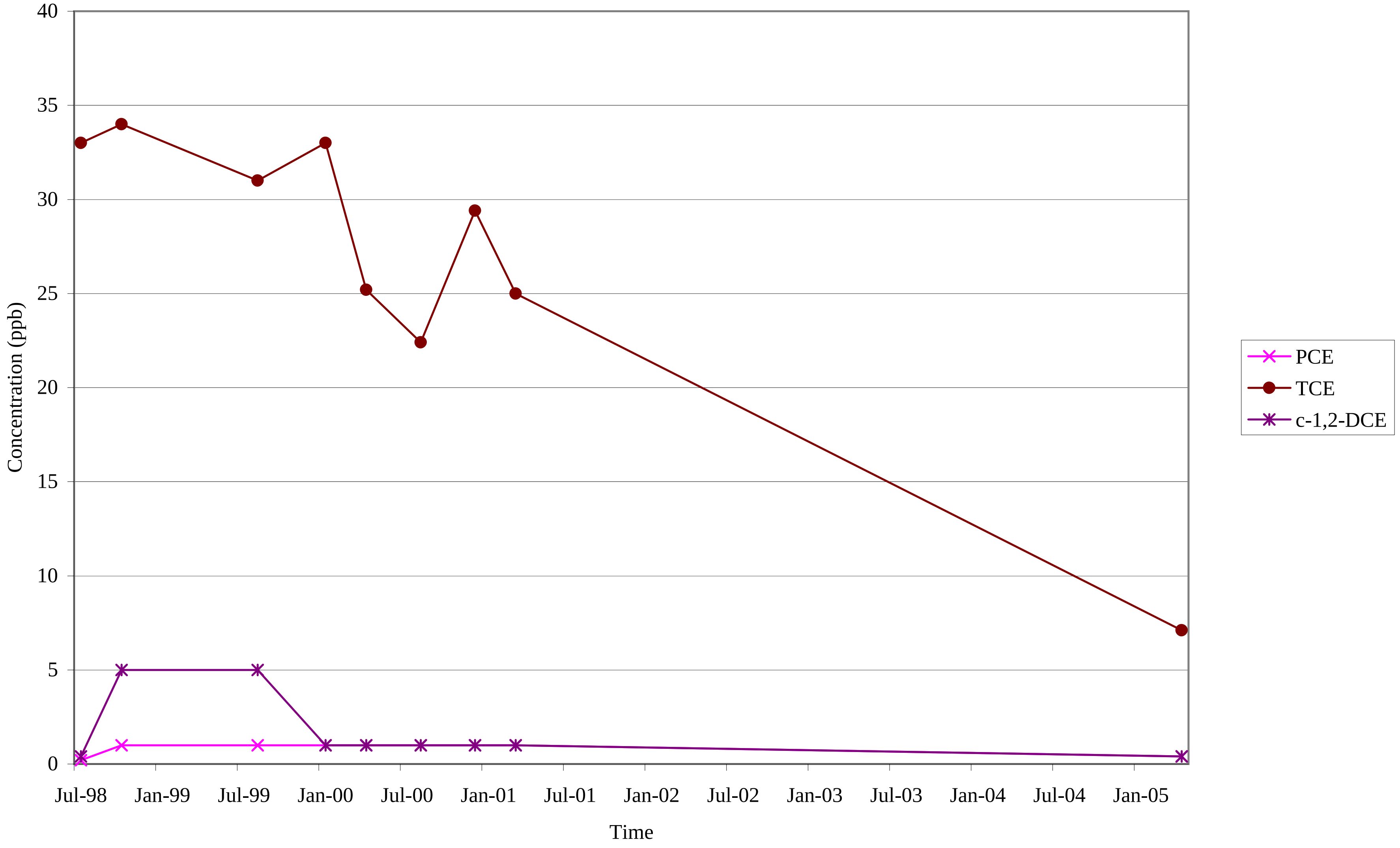
APPENDIX Q
TREND CHART-SELECTED VOCS
DRAFT SUPPLEMENTAL GROUNDWATER DATA REPORT
FORMER RARITAN ARSENAL, EDISON, NEW JERSEY

VOC Trends - AOC 8, MW-87A



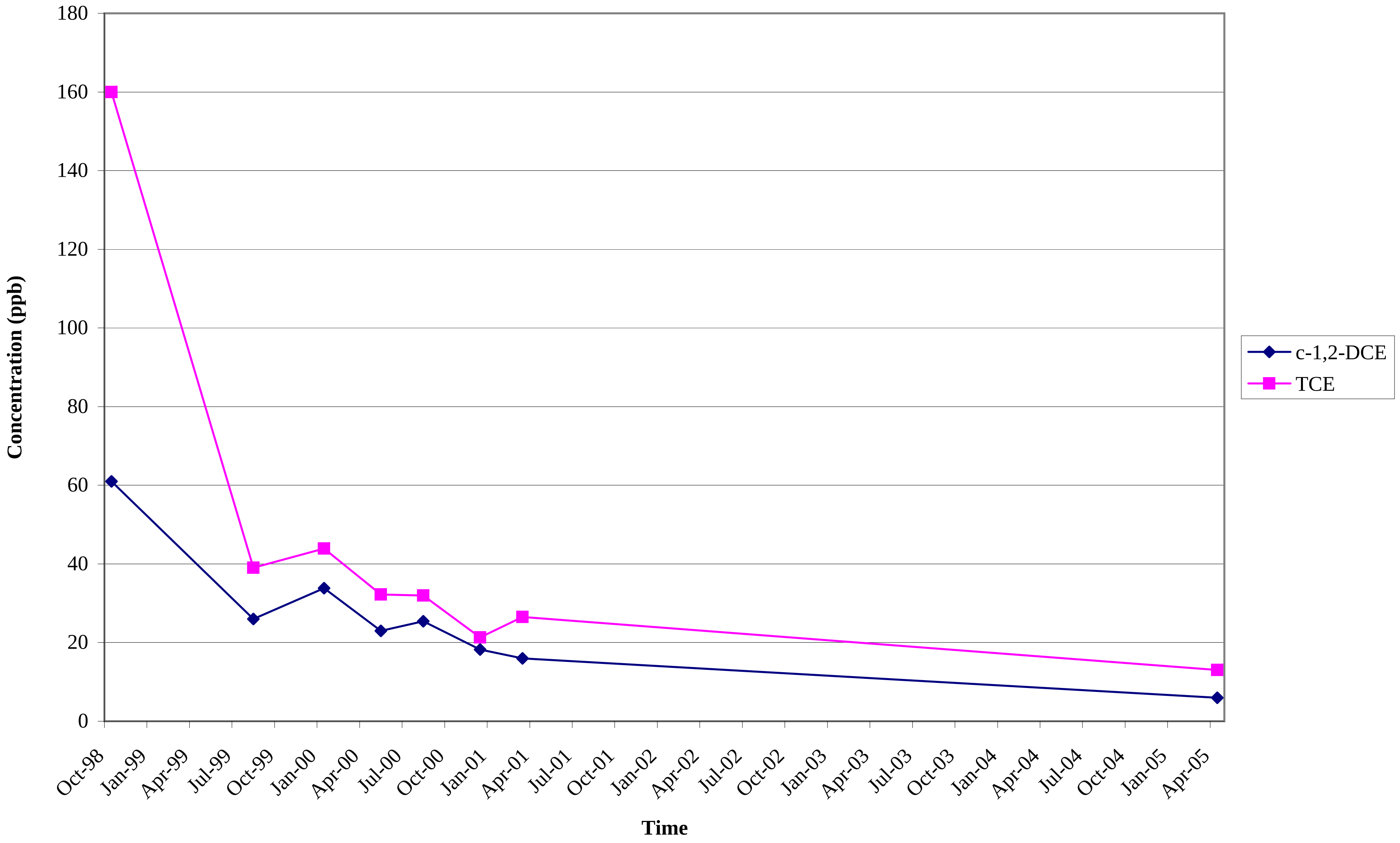
APPENDIX Q
TREND CHART-SELECTED VOCS
DRAFT SUPPLEMENTAL GROUNDWATER DATA REPORT
FORMER RARITAN ARSENAL, EDISON, NEW JERSEY

VOC Trends - AOC 8, MW-125



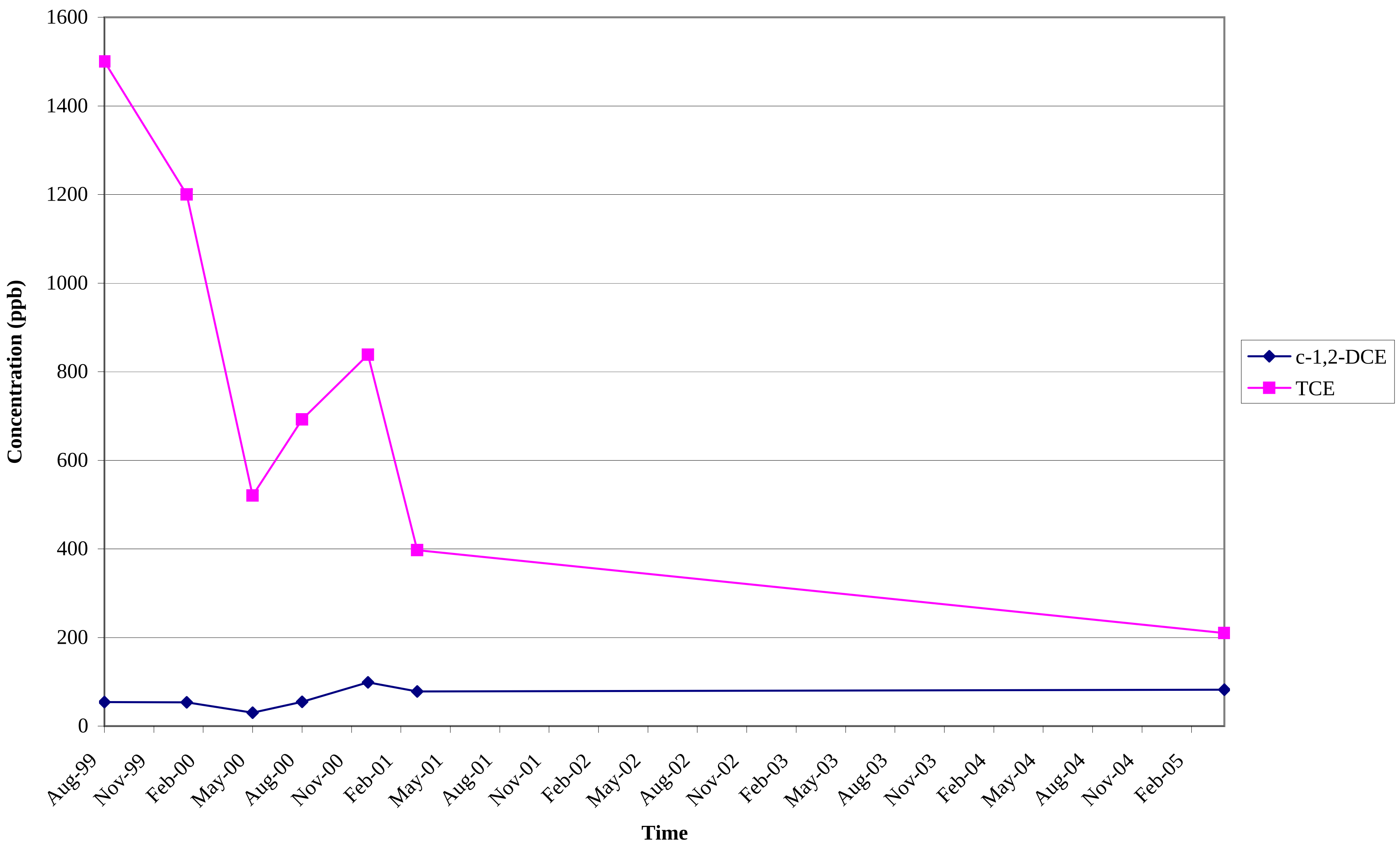
APPENDIX Q
TREND CHART-SELECTED VOCS
DRAFT SUPPLEMENTAL GROUNDWATER DATA REPORT
FORMER RARITAN ARSENAL, EDISON, NEW JERSEY

VOC Trends - AOC 10, MW-129



APPENDIX Q
TREND CHART-SELECTED VOCS
DRAFT SUPPLEMENTAL GROUNDWATER DATA REPORT
FORMER RARITAN ARSENAL, EDISON, NEW JERSEY

VOC Trends - AOC 10, MW-131



APPENDIX C

Table 3-8
Results of the CEA Calculations
Former Raritan Arsenal
Edison, New Jersey

AOC 4

													Duration Estimates of CEA													Distance Estimates of CEA		
COMPOUND	Well ID. #	Cmax (ppb)	Co (ppb)	dt (Days)	t 1/2 Days	High t1/2 (Days)	Low t1/2 (Days)	k (cal) (ft/day)	k (high) (ft/day)	k (low) (ft/day)	Co (ppb)	C (ppb)	w/ calculated t1/2 (yrs)	w/ high t1/2 (yrs)	w/ low t1/2 (yrs)	K (ft/day)	i (ft/ft)	ne *unitless*	Vs (ft/day)	Koc (ml/g)	foc *unitless*	Kd *unitless*	pb (g/ml)	Rd *unitless*	Vpt (ft/day)	w/ calculated t1/2 (feet)	w/ high t1/2 (feet)	w/ low t1/2 (feet)
TCE	MW-46A	18	12.6	569	1105.5	1653	321	0.0006	0.00042	0.0022	12.6	1	11.06	16.54	3.21	25.01	0.0108	0.30	0.900	126	0.005	0.63	1.6	4.36	0.2065	834.69	1248.03	242.36
	MW-122	80	1.44	883	152.32	1653	321	0.0045	0.00042	0.0022	1.44	1	0.22	2.38	0.46	25.01	0.0108	0.30	0.900	126	0.005	0.63	1.6	4.36	0.2065	16.55	179.61	34.88
	MW-120	5.3	3.42	573	906.46	1653	321	0.0008	0.00042	0.0022	3.42	1	4.40	8.03	1.56	25.01	0.0108	0.30	0.900	126	0.005	0.63	1.6	4.36	0.2065	332.14	605.69	117.62
	MW-EPA-2A (1)	16	0.01	979	91.958	1653	321	0.0075	0.00042	0.0022	0.01	1	N/A	N/A	N/A	25.01	0.0108	0.30	0.900	126	0.005	0.63	1.6	4.36	0.2065	N/A	N/A	N/A
cis-1,2-DCE	MW-EPA-2A	160	20.7	979	331.75	2875	56	0.00209	0.00024	0.0124	20.7	10	0.95	8.26	0.16	25.01	0.0108	0.30	0.900	54	0.005	0.27	1.6	2.44	0.3690	128.52	1113.76	21.69
	MW-46A	200	94.8	435	403.8	2875	56	0.00172	0.00024	0.0124	94.8	10	3.59	25.54	0.50	25.01	0.0108	0.30	0.900	54	0.005	0.27	1.6	2.44	0.3690	483.60	3443.15	67.07
	MW-122	210	11.7	883	211.92	2875	56	0.00327	0.00024	0.0124	11.7	10	0.13	1.78	0.03	25.01	0.0108	0.30	0.900	54	0.005	0.27	1.6	2.44	0.3690	17.72	240.35	4.68
	MW-120	41.7	32	435	1138.6	2875	56	0.00061	0.00024	0.0124	32	10	5.23	13.21	0.26	25.01	0.0108	0.30	0.900	54	0.005	0.27	1.6	2.44	0.3690	705.16	1780.60	34.68
Benzene	MW-122	55	19.4	980	651.73	720	10	0.00106	0.00096	0.0693	19.4	1	7.63	8.43	0.12	25.01	0.0108	0.30	0.900	83	0.005	0.415	1.6	3.21	0.2802	781.37	863.23	11.99
	MW-120	4.5	2.95	435	713.89	720	10	0.00097	0.00096	0.0693	2.95	1	3.05	3.08	0.04	25.01	0.0108	0.30	0.900	83	0.005	0.415	1.6	3.21	0.2802	312.25	314.93	4.37
	MW-46A	3	2.08	435	823.1	720	10	0.00084	0.00096	0.0693	2.08	1	2.38	2.08	0.03	25.01	0.0108	0.30	0.900	83	0.005	0.415	1.6	3.21	0.2802	243.73	213.20	2.96
	MW-EPA-2A (1)	1.14	0.01	224	32.776	720	10	0.02114	0.00096	0.0693	0.01	1	N/A	N/A	N/A	25.01	0.0108	0.30	0.900	83	0.005	0.415	1.6	3.21	0.2802	N/A	N/A	N/A
Vinyl Chloride	MW-EPA-2A	63.2	18.8	224	128.03	2875	56	0.00541	0.00024	0.0124	18.8	5	0.67	15.04	0.29	25.01	0.0108	0.30	0.900	57	0.005	0.285	1.6	2.52	0.3573	87.42	1963.11	38.24
	MW-46A	54	31.5	435	559.29	2875	56	0.00124	0.00024	0.0124	31.5	5	4.07	20.90	0.41	25.01	0.0108	0.30	0.900	57	0.005	0.285	1.6	2.52	0.3573	530.72	2728.15	53.14
	MW-122	220	58.5	435	227.58	2875	56	0.00305	0.00024	0.0124	58.5	5	2.21	27.93	0.54	25.01	0.0108	0.30	0.900	57	0.005	0.285	1.6	2.52	0.3573	288.59	3645.72	71.01
	MW-120	50	34	887	1593.9	2875	56	0.00043	0.00024	0.0124	34	5	12.07	21.77	0.42	25.01	0.0108	0.30	0.900	57	0.005	0.285	1.6	2.52	0.3573	1575.20	2841.35	55.34

Notes:

C - the GWQS for contaminant of interest.
Cmax - Maximum concentration measured.
Co - Concentration measured from most recent sampling results.
dt - time (days) between sample results.
foc - Fraction of organic carbon.
High t1/2 - Half-life from reference (P. H. Howard et al.)
i - Hydraulic gradient (Averaged).
k - Decay constant
K - Hydraulic conductivity (Based on WESTON/OBG Data).
Kd - Distribution coefficient.
Koc - Soil sorption coefficient (Compound specific).
Low t1/2 - Half-life from reference (P. H. Howard et al.)
ne - Effective porosity (Estimated).
pb - Bulk density of formation (Estimated as 1.6g/ml).
Rd - Retardation factor.
t1/2 - Half-life value (calculated).
Vpt - Pollutant transport rate.
Vs - Seepage velocity.

(1) The calculations for duration and distance estimates of CEA are not applicable (N/A) because the present C_0 is less than the NJDEP GWQS.

Table 3-8
Results of the CEA Calculations
Former Raritan Arsenal
Edison, New Jersey
(Continued)

AOC 6

													Duration Estimates of CEA													Distance Estimates of CEA		
COMPOUND	Well ID. #	Cmax (ppb)	Co (ppb)	dt (Days)	t 1/2 Days	High t1/2 (Days)	Low t1/2 (Days)	k (cal) (ft/day)	k (high) (ft/day)	k (low) (ft/day)	Co (ppb)	C (ppb)	w/ calculated t1/2 (yrs)	w/ high t1/2 (yrs)	w/ low t1/2 (yrs)	K* (ft/day)	i (ft/ft)	ne *unitless*	Vs (ft/day)	Koc (ml/g)	foc *unitless*	Kd *unitless*	pb (g/ml)	Rd *unitless*	Vpt (ft/day)	w/ calculated t1/2 (feet)	w/ high t1/2 (feet)	w/ low t1/2 (feet)
TCE	MW-47A	99	32.3	578	357.6207	1642.5	325.5	0.0019	0.00042	0.002129	32.3	1	4.91	22.55	4.47	5.67	0.0028	0.30	0.053	126	0.005	0.63	1.6	4.36	0.0121	21.77	99.97	19.81
	MW-48B	37	34.8	110	1243.5456	1642.5	325.5	0.0006	0.00042	0.002129	34.8	1	17.44	23.03	4.56	5.67	0.0028	0.30	0.053	126	0.005	0.63	1.6	4.36	0.0121	77.31	102.11	20.24
PCE	MW-48B	2.7	1.9	578	1139.8873	730	365	0.00061	0.00095	0.0018986	1.9	1	2.89	1.85	0.93	5.67	0.0028	0.30	0.053	364	0.005	1.82	1.6	10.71	0.0049	5.22	3.34	1.67
Benzene	MW-47A	7.3	1.58	230	104.14587	730	10	0.00665	0.00095	0.0693	1.58	1	0.19	1.32	0.02	5.67	0.0028	0.30	0.053	83	0.005	0.415	1.6	3.21	0.0165	1.13	7.94	0.11
cis-1,2-DCE	MW-47A	170	37.2	578	263.61087	2889.5	60.8	0.00263	0.00024	0.011398	37.2	10	1.37	14.99	0.32	5.67	0.0028	0.30	0.053	54	0.005	0.27	1.6	2.44	0.0217	10.84	118.80	2.50
	MW-48B (1)	36.6	36.6	0	0	2889.5	60.8	0	0.00024	0.011398	36.6	10	0.00	14.81	0.31	5.67	0.0028	0.30	0.053	54	0.005	0.27	1.6	2.44	0.0217	0.00	117.33	2.47

Notes:

C - the GWQS for contaminant of interest.
Cmax - Maximum concentration measured.
Co - Concentration measured from most recent sampling results.
dt - time (days) between sample results.
foc - Fraction of organic carbon.
High t1/2 - Half-life from reference (P. H. Howard et al.)

i - Hydraulic gradient (Averaged).
k - Decay constant
K - Hydraulic conductivity (Based on WESTON/OBG Data).
Kd - Distribution coefficient.
Koc - Soil sorption coefficient (Compound specific).
Low t1/2 - Half-life from reference (P. H. Howard et al.)

ne - Effective porosity (Estimated).
pb - Bulk density of formation (Estimated as 1.6g/ml).
Rd - Retardation factor.
t1/2 - Half-life value (calculated).
Vpt - Pollutant transport rate.
Vs - Seepage velocity.

(1) Maximum contaminant concentration (#DIV/0!) and the most recent contaminant concentrations are equal. No attenuation present.

Table 3-8
Results of the CEA Calculations
Former Raritan Arsenal
Edison, New Jersey
(Continued)

AOC 8

													Duration Estimates of CEA													Distance Estimates of CEA		
COMPOUND	Well ID. #	Cmax (ppb)	Co (ppb)	dt (Days)	t 1/2 Days	High t1/2 (Days)	Low t1/2 (Days)	k (cal) (ft/day)	k (high) (ft/day)	k (low) (ft/day)	Co (ppb)	C (ppb)	w/ calculated t1/2 (yrs)	w/ high t1/2 (yrs)	w/ low t1/2 (yrs)	K (ft/day)	I (ft/ft)	ne *unitless*	Vs (ft/day)	Koc (ml/g)	foc *unitless*	Kd *unitless*	pb (g/ml)	Rd *unitless*	Vpt (ft/day)	w/ calculated t1/2 (feet)	w/ high t1/2 (feet)	w/ low t1/2 (feet)
TCE	MW-105A	6.8	4.08	329	446.33	1642.5	325.5	0.0016	0.00042	0.00213	4.08	1	2.48	9.12	1.81	12.97	0.0116	0.30	0.502	126	0.005	0.63	1.6	4.36	0.1150	104.17	383.33	75.97
	MW-121	65.2	60	109	908.83	1642.5	325.5	0.0008	0.00042	0.00213	60	1	14.70	26.56	5.26	12.97	0.0116	0.30	0.502	126	0.005	0.63	1.6	4.36	0.1150	617.62	1116.21	221.20
	MW-125	34	25	890	2005.9	1642.5	325.5	0.0003	0.00042	0.00213	25	1	25.50	20.88	4.14	12.97	0.0116	0.30	0.502	126	0.005	0.63	1.6	4.36	0.1150	1071.67	877.54	173.91
	MW-106A	7.4	2.79	571	405.67	1653	321	0.0017	0.00042	0.00216	2.79	1	1.64	6.70	1.30	12.97	0.0116	0.30	0.502	126	0.005	0.63	1.6	4.36	0.1150	69.09	281.51	54.67
	MW-8	140	103	983	2219.6	1653	321	0.0003	0.00042	0.00216	103	1	40.64	30.26	5.88	12.97	0.0116	0.30	0.502	126	0.005	0.63	1.6	4.36	0.1150	1707.47	1271.61	246.94
	MW-108A (2)	3.1	0.01	329	39.744	1653	321	0.0174	0.00042	0.00216	0.01	1	N/A	N/A	N/A	12.97	0.0116	0.30	0.502	126	0.005	0.63	1.6	4.36	0.1150	N/A	N/A	N/A
	MW-87A (2)	8.5	0.01	890	91.438	1653	321	0.0076	0.00042	0.00216	0.01	1	N/A	N/A	N/A	12.97	0.0116	0.30	0.502	126	0.005	0.63	1.6	4.36	0.1150	N/A	N/A	N/A
PCE	MW-87A	1.6	1.05	890	1464.3	730	365	0.000473	0.00095	0.0019	1.05	1	0.28	0.14	0.07	12.97	0.0116	0.30	0.502	364	0.005	1.82	1.6	10.71	0.0468	4.83	2.41	1.20
	MW-121 (1)	1.66	1.66	0.01	#DIV/0!	730	365	#DIV/0!	0.00095	0.0019	1.66	1	#DIV/0!	1.46	0.73	12.97	0.0116	0.30	0.502	364	0.005	1.82	1.6	10.71	0.0468	#DIV/0!	25.01	12.50

Notes:

C - the GWQS for contaminant of interest.
Cmax - Maximum concentration measured.
Co - Concentration measured from most recent sampling results.
dt - time (days) between sample results.
foc - Fraction of organic carbon.
High t1/2 - Half-life from reference (P. H. Howard et al.)

i - Hydraulic gradient (Averaged).
k - Decay constant
K - Hydraulic conductivity (Based on WESTON/OBG Data).
Kd - Distribution coefficient.
Koc - Soil sorption coefficient (Compound specific).
Low t1/2 - Half-life from reference (P. H. Howard et al.)

ne - Effective porosity (Estimated).
pb - Bulk density of formation (Estimated as 1.6g/ml).
Rd - Retardation factor.
t1/2 - Half-life value (calculated).
Vpt - Pollutant transport rate.
Vs - Seepage velocity.

(1) Maximum contaminant concentration (#DIV/0!) and the most recent contaminant concentrations are equal. No attenuation present.
(2) The calculations for duration and distance estimates of CEA are not applicable (N/A) because the present C_o is less than the NJDEP GWQS.

Table 3-8
Results of the CEA Calculations
Former Raritan Arsenal
Edison, New Jersey
(Continued)

AOC 9

													Duration Estimates of CEA													Distance Estimates of CEA		
COMPOUND	Well ID. #	Cmax (ppb)	Co (ppb)	dt (Days)	t 1/2 Days	High t1/2 (Days)	Low t1/2 (Days)	k (cal) (ft/day)	k (high) (ft/day)	k (low) (ft/day)	Co (ppb)	C (ppb)	w/ calculated t1/2 (yrs)	w/ high t1/2 (yrs)	w/ low t1/2 (yrs)	K (ft/day)	i (ft/ft)	ne *unitless*	Vs (ft/day)	Koc (ml/g)	foc *unitless*	Kd *unitless*	pb (g/ml)	Rd *unitless*	Vpt (ft/day)	w/ calculated t1/2 (feet)	w/ high t1/2 (feet)	w/ low t1/2 (feet)
2,4-2,6-Dinitrotolune	MW-124	67	48.3	993	2102.8	360	2	0.0003	0.00193	0.3465	48.3	10	13.08	2.24	0.01	17	0.0059	0.30	0.334	120	0.005	0.6	1.6	4.2	0.0796	380.39	65.12	0.36
	MW-130	766.5	20.9	566	108.89	360	2	0.0064	0.00193	0.3465	20.9	10	0.32	1.05	0.01	17	0.0059	0.30	0.334	120	0.005	0.6	1.6	4.2	0.0796	9.22	30.48	0.17
2-Amino-4,6-DNT	MW-42A	1.9	0.43	890	415.1	360	2	0.0017	0.00193	0.3465	0.43	0.4	0.12	0.10	0.00	17	0.0059	0.30	0.334	120	0.005	0.6	1.6	4.2	0.0796	3.45	2.99	0.02
	MW-123	133	94.1	224	448.66	360	2	0.0015	0.00193	0.3465	94.1	0.4	9.68	7.77	0.04	17	0.0059	0.30	0.334	120	0.005	0.6	1.6	4.2	0.0796	281.42	225.81	1.25
	MW-124	314	209	566	963.59	360	2	0.0007	0.00193	0.3465	209	0.4	23.82	8.90	0.05	17	0.0059	0.30	0.334	120	0.005	0.6	1.6	4.2	0.0796	692.74	258.81	1.44
	MW-130	413	211	224	231.14	360	2	0.0030	0.00193	0.3465	211	0.4	5.72	8.91	0.05	17	0.0059	0.30	0.334	120	0.005	0.6	1.6	4.2	0.0796	166.42	259.20	1.44
4-Amino-2,6-DNT	MW-123	37.1	22.4	224	307.66	360	2	0.0023	0.00193	0.3465	22.4	0.4	4.89	5.72	0.03	17	0.0059	0.30	0.334	120	0.005	0.6	1.6	4.2	0.0796	142.26	166.46	0.92
	MW-124	87	55.9	111	173.9	360	2	0.0040	0.00193	0.3465	55.9	0.4	3.39	7.02	0.04	17	0.0059	0.30	0.334	120	0.005	0.6	1.6	4.2	0.0796	98.68	204.27	1.13
	MW-130	462.8	253	566	649.5	360	2	0.0011	0.00193	0.3465	253	0.4	16.55	9.17	0.05	17	0.0059	0.30	0.334	120	0.005	0.6	1.6	4.2	0.0796	481.19	266.71	1.48
2,4,6-TNT	MW-124	8.98	4.27	224	208.82	360	28	0.0033	0.00193	0.0248	4.27	0.4	1.95	3.37	0.26	17	0.0059	0.30	0.334	120	0.005	0.6	1.6	4.2	0.0796	56.80	97.92	7.62
	MW-130	772	507	224	369.18	360	28	0.0019	0.00193	0.0248	507	0.4	10.42	10.16	0.79	17	0.0059	0.30	0.334	120	0.005	0.6	1.6	4.2	0.0796	302.99	295.45	22.98

Notes:

C - the GWQS for contaminant of interest.
Cmax - Maximum concentration measured.
Co - Concentration measured from most recent sampling results.
dt - time (days) between sample results.
foc - Fraction of organic carbon.
High t1/2 - Half-life from reference (P. H. Howard et al.)

i - Hydraulic gradient (Averaged).
k - Decay constant
K - Hydraulic conductivity (Based on OBG Data).
Kd - Distribution coefficient.
Koc - Soil sorption coefficient (Compound specific).
Low t1/2 - Half-life from reference (P. H. Howard et al.)

ne - Effective porosity (Estimated).
pb - Bulk density of formation (Estimated as 1.6g/ml).
Rd - Retardation factor.
t1/2 - Half-life value (calculated).
Vpt - Pollutant transport rate.
Vs - Seepage velocity.

(1) Half life information not available for 2-Amino-4,6-Dinitrotoluene and 4-Amino-2,6-Dinitrotoluene, so the half life of 2,4-Dinitrotolune was used.
(2) A GWQS has not been establlished for 2-Amino-4,6-DNT or 4-Amino-2,6-DNT. As draft GWQS for Amino-DNTS is being calculated by NJDEP and may change.

Table 3-8
Results of the CEA Calculations
Former Raritan Arsenal
Edison, New Jersey
(Continued)

AOC 10

													Duration Estimates of CEA													Distance Estimates of CEA		
	Well	Cmax	Co	dt	t 1/2	High t1/2	Low t1/2	k (cal)	k (high)	k (low)	Co	C	w/ calculated t1/2	w/ high t1/2	w/ low t1/2	K	i	ne	Vs	Koc	foc	Kd	pb	Rd	Vpt	w/ calculated t1/2	w/ high t1/2	w/ low t1/2
COMPOUND	ID. #	(ppb)	(ppb)	(Days)	Days	(Days)	(Days)	(ft/day)	(ft/day)	(ft/day)	(ppb)	(ppb)	(yrs)	(yrs)	(yrs)	(ft/day)	(ft/ft)	*unitless*	(ft/day)	(ml/g)	*unitless*	*unitless*	(g/ml)	*unitless*	(ft/day)	(feet)	(feet)	(feet)
TCE	MW-129	170	26.5	888	331.09	1653	321	0.0021	0.00042	0.0022	26.5	1	4.29	21.40	4.16	95.67	0.0085	0.30	2.711	126	0.005	0.63	1.6	4.36	0.6217	973.41	4859.84	943.74
	MW-131	1500	397	570	297.16	1653	321	0.0023	0.00042	0.0022	397	1	7.02	39.07	7.59	95.67	0.0085	0.30	2.711	126	0.005	0.63	1.6	4.36	0.6217	1595.26	8873.88	1723.24
cis-1,2-DCE	MW-129	68	15.8	888	421.64	2875	56	0.00164	0.00024	0.0124	15.8	10	0.76	5.19	0.10	95.67	0.0085	0.30	2.711	54	0.005	0.27	1.6	2.44	1.1109	309.18	2108.18	41.06
	MW-131	98.8	78.2	108	320.08	2875	56	0.00217	0.00024	0.0124	78.2	10	2.60	23.36	0.45	95.67	0.0085	0.30	2.711	54	0.005	0.27	1.6	2.44	1.1109	1055.31	9478.86	184.63

Notes:
C - the GWQS for contaminant of interest.
Cmax - Maximum concentration measured.
Co - Concentration measured from most recent sampling results.
dt - time (days) between sample results.
foc - Fraction of organic carbon.
High t1/2 - Half-life from reference (P. H. Howard et al.)
i - Hydraulic gradient (Averaged).
k - Decay constant
K - Hydraulic conductivity (Based on WESTON/OBG Data).
Kd - Distribution coefficient.
Koc - Soil sorption coefficient (Compound specific).
Low t1/2 - Half-life from reference (P. H. Howard et al.)
ne - Effective porosity (Estimated).
pb - Bulk density of formation (Estimated as 1.6g/ml).
Rd - Retardation factor.
t1/2 - Half-life value (calculated).
Vpt - Pollutant transport rate.
Vs - Seepage velocity.

APPENDIX D

Legend

- Proposed Classification Exception Area Boundary
- ● Proposed Long-Term Compliance Monitoring Well (Existing)
- ● Proposed Long-Term Compliance Monitoring Well (Proposed New Well)
- ● Monitoring Well Location
- ● Proposed Surface Water Location Sampled During Quarterly Program
- ● Shallow Groundwater Screening Location(3)
- ★ CEA Point of Compliance
- ☐ Groundwater AOC Boundary (as of 2005)
- 🟥 DOD Source Removal Area
- ☐ Former Groundwater AOC Boundary (as of 2001)
- ☐ Potential Source Area
- ☐ Soil Investigation Area Boundary
- Wetlands
- 🟧 Class IIIB Aquifer
- Surface Water
- 426 Building Number
- Area4 Soil Investigation Area
- AOC3 Former Groundwater AOC (as of 2001)
- AOC3 Groundwater AOC (as of 2005)

Notes

1. Monitoring well MW-153 is an EPA well that was adopted as part of the USACE 2004-2005 Site-Wide Groundwater Investigation.
2. Monitoring wells MW-133 through MW-137 were installed in 2004 as part of the 18E Supplemental Investigation.
3. Shallow groundwater screening locations completed in 2004-2005 as part of the 18E Investigation and Groundwater AOC 8-EPA Building Investigation are not depicted on this figure.

AOC - Area of Concern
DOD - Department of Defense
EPA - Environmental Protection Agency
USACE - United States Army Corps of Engineers

450 0 450 900
Graphic Scale In Feet

WESTON SOLUTIONS

Weston Solutions, Inc.
205 Campus Drive Edison, New Jersey 08837-3939
TEL: (732) 417-5800 Fax: (732) 417-5801
http://www.westonsolutions.com

PROJECT MANAGER:	PAUL BOVITZ
CHECKED BY:	RALPH COSTA
DRAWN/MODIFIED BY:	STEVE POULTNEY
DATE CREATED:	7-31-07
REPORT DATE:	FEBRUARY 2008
DRAWING PATH:	05455_Sitemap.mxd K:\Raritan01\RaritanGIS\Mxd\0108_RAWP\
REVISION No.	0
WORK ORDER No.	03886.110.027.0005
REPORT NAME:	DRAFT - GROUNDWATER REMEDIAL ACTION WORK PLAN FEBRUARY 2008
CLIENT NAME:	UNITED STATES ARMY CORPS OF ENGINEERS
PROJECT NAME:	FORMER RARTIAN ARSENAL
DRAWING TITLE:	PROPOSED SITE-WIDE CLASSIFICATION EXCEPTION AREA BOUNDARY AND LONG-TERM COMPLIANCE POINTS
DATE:	2-1-08
SCALE:	*see scale bar
FIGURE:	3-1

APPENDIX E

B. PROPOSED CLASSIFICATION EXCEPTION AREA INFORMATION

1. Narrative description of proposed classification exception area:

The proposed site-wide Classification Exception Area (CEA) includes a portion of the 3,200 acre former Raritan Arsenal which lies in Edison Township, Middlesex County, New Jersey. The former Arsenal site bordered by the Raritan River on the south, Woodbridge Avenue on the north and northwest, Mill Road and the Industrial Land Reclamation (ILR) on the southwest, and vacant and industrial properties on the east. The proposed site-wide CEA includes all individual Groundwater Areas of Concern (AOCs) 2, 3, 4, 6, 7, 8, 9, and 10 at the former Arsenal. The area of the site-wide has been redeveloped into the Raritan Center Industrial Park owned by Federal Business Centers (FBC) and Summit Associates, Inc. (SAI); and is currently zoned for industrial use.

The proposed CEA is proposed for trichloroethylene exceedances of NJDEP Class-IIA Ground Water Quality Standards (GWQS) within the Farrington Sand member of the New Jersey Coastal Plain's Middle Patomic-Rartan-Magothy (PRM) Aquifer. The Farrington Sand member (referred to as the "Lower Sand" at the former Arsenal site) is generally 10 to 30 feet thick; and underlain by the Raritan fire Clay and/or Mesozoic bedrock.

The proposed expiration date for the site-wide CEA is March 15, 2041.

2. Location of proposed classification exception area (duplicate if the site is located in more than one municipality):

a. Name of the municipality in which the site is located: Edison Township

b. Block and Lots: See table provided as ***Exhibit D*** (attached)____

c. Year of tax map: 2006/2007

3. Affected aquifer(s):

Aquifer Name	Vertical Depth	Ground Water Classification
Middle PRM	Down to top of Raritan Fire Clay and/or Mesozoic bedrock (est. up to 80 feet below ground surface)	Class II-A

Ground Water Classification Exception Area Fact Sheet

A. SITE INFORMATION

1. Program's Site Identification Number: --
2. Program Interest Number (Preferred ID): 006021
3. Program Interest Name: Former Raritan Arsenal / USEPA Edison Facility
4. Street address: 2890 Woodbridge Avenue
5. City: Edison Township
6. County: Middlesex
7. Block and Lots of the site (duplicate if the site is located in more than one municipality):
   a. Name of the municipality in which the site is located: Edison Township
   b. Block and Lots: See table provided as ***Exhibit C*** (attached)
   c. Year of tax map: 2006/2007
8. United States Geological Survey Quadrangle map, indicating the location of the site, presented as ***Exhibit A***.

9. Site Contact:

   a. Name of contact person: Mr. James T. Moore
   b. Company name: USACE New York District
   c. Mailing address: 190 Route 18, Suite 202, East Brunswick, NJ 08816
   d. Phone number: (732) 435 - 0079

4. Contaminant concentrations:

Contaminant	Concentration[1]	GWQS[2]	SWQS[3]
Trichloroethylene (TCE)	46,000 ug/L	1 ug/L	1 ug/L
Tetrachloroethene (PCE)	180 ug/L	1 ug/L	0.34 ug/L
cis-1,2-Dichloroethylene	830 ug/L	70 ug/L	0.34 ug/L
Vinyl Chloride	35 ug/L	1 ug/L	0.082 ug/L
Benzene	1.6 ug/L	1 ug/L	0.15 ug/L
2,4-Dinitrotoluene/2,6-Dinitrotoluene mix	53 ug/L	10 ug/L	0.11 ug/L

5. Proposed classification exception area boundaries:

Horizontal: Scaled map indicating projected areal extent of proposed classification exception area, as well as location of site, presented as ***Exhibit B***.

Vertical: As stated in B.3., above.

Locational coordinates of boundary of proposed classification exception area as New Jersey State Plane Coordinates. A minimum of four coordinates shall be submitted, in a format compatible with Department's geographic information system:

New Jersey State Plane Coordinates

Northing	Easting
612436.079552	530594.138281
612972.006140	531346.589776
612095.075400	532293.213199
612804.654956	533065.383289
611215.790694	536869.881477
611421.695108	537500.825305
610005.091399	537979.044822
608867.973655	539419.092691
606110.134546	534925.545367
606512.864263	532092.273723
607740.924526	528911.860610
608061.088961	529453.071007
605915.627276	530709.351393
605609.421308	530153.010258

6. Estimated size of the proposed ground water classification exception area:

_Total area is approximately 38, 500,000 square feet (884 acres)

7. Projected duration and expiration date of the proposed classification exception area:

a. Duration (in years and or days): 40 years beginning in 2001.________

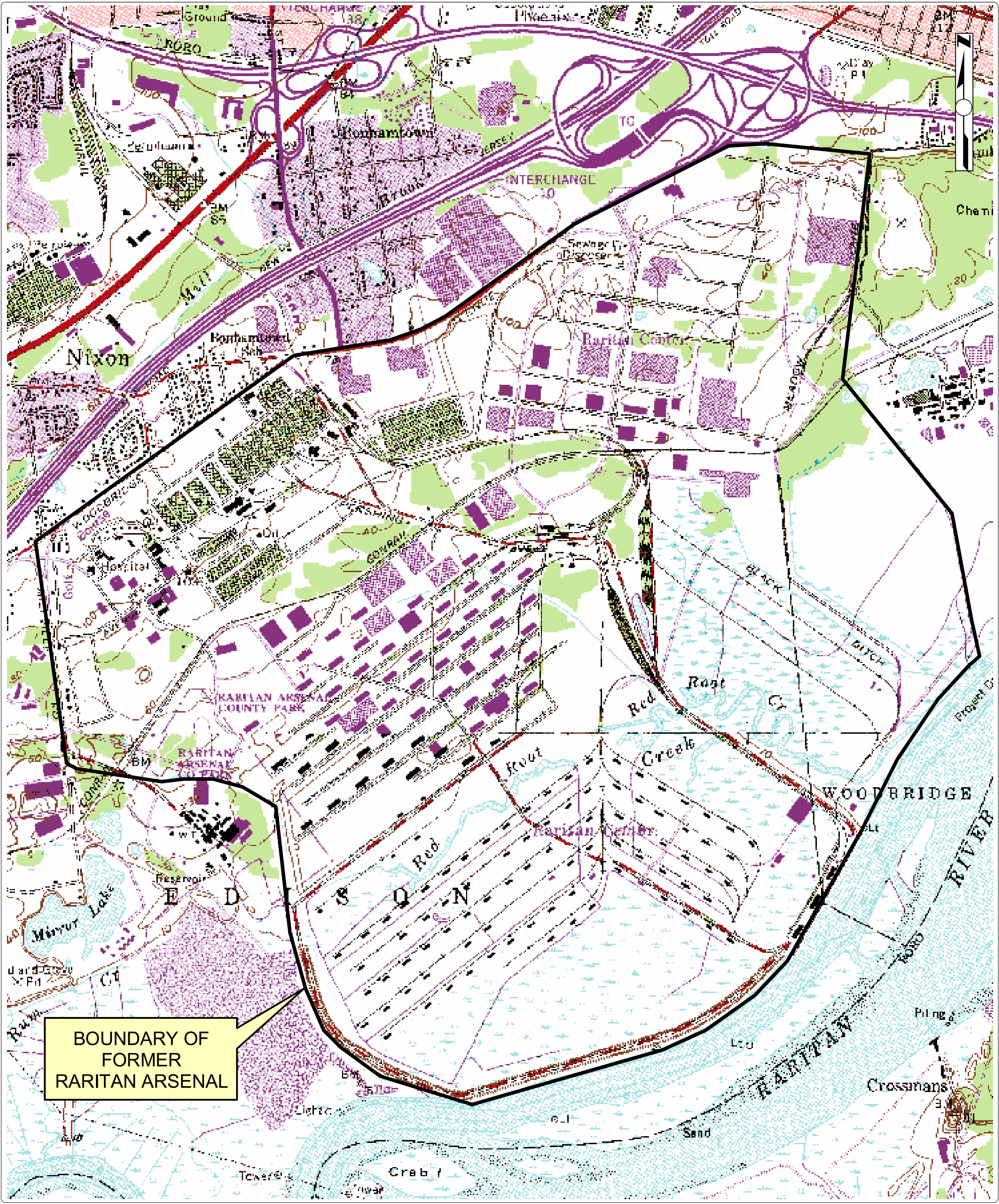
b. Expiration date (as calendar date): March 15, 2041_______________________

Footnotes

1 Maximum concentration detected at the time Classification Exception Area information submitted to the Department.

2 New Jersey Ground Water Quality Standards, N.J.A.C. 7:9-6.

3 New Jersey Surface Water Quality Standards, N.J.A.C. 7:9B.



LEGEND:

1,000 0 1,000 2,000

1 Inch = 2000 Ft.

SOURCE: U.S.G.S. TOPO QUAD - PERTH AMBOY/SOUTH AMBOY NJ

PROJECT:
DRAFT GROUNDWATER REMEDIAL
ACTION WORK PLAN - AUGUST 2007

TITLE:

FORMER RARITAN ARSENAL
SITE LOCATION MAP
EDISON, NEW JERSEY

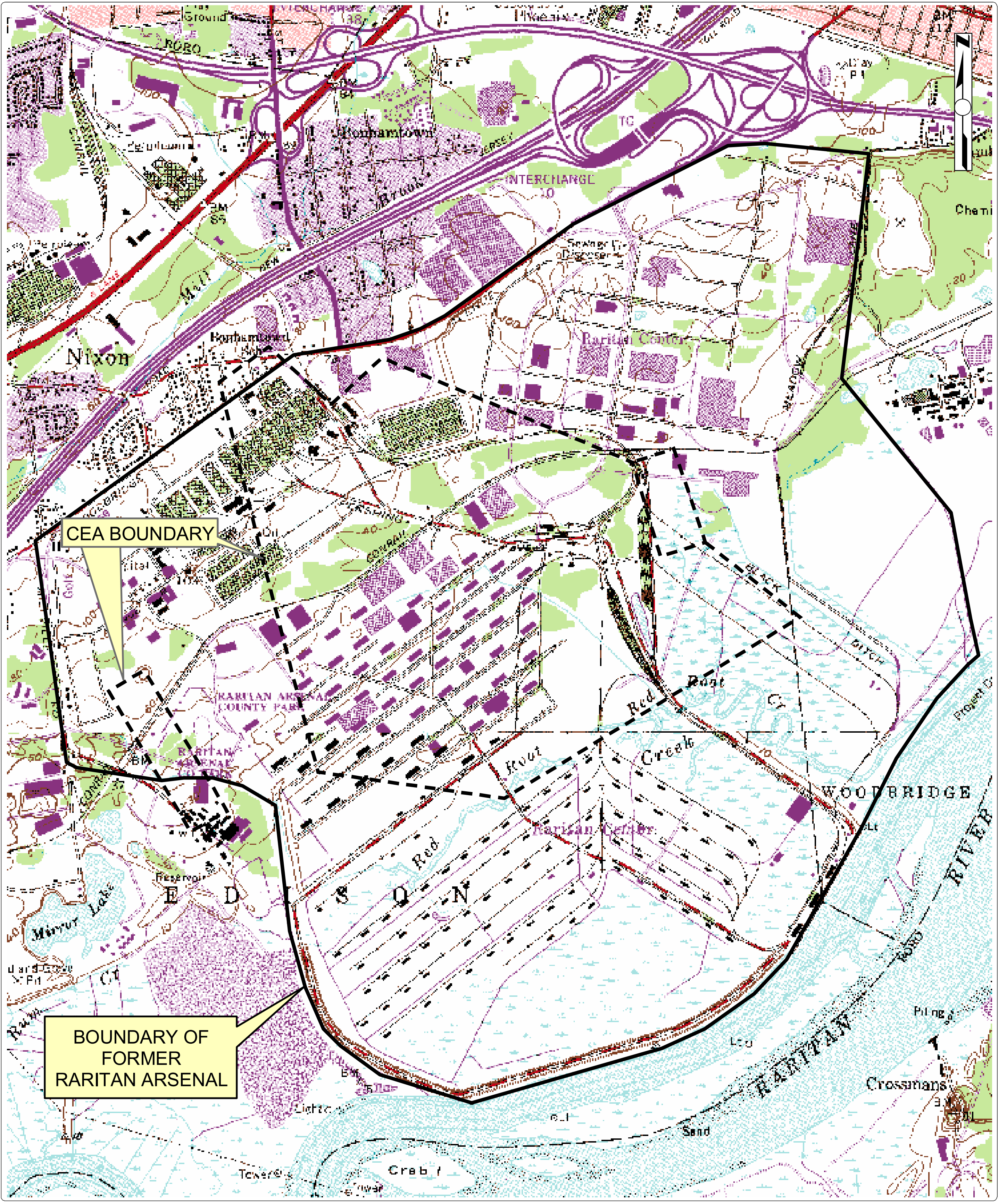
CLIENT NAME:
U.S. ARMY CORPS OF ENGINEERS

WESTON SOLUTIONS

DATE:
8-27-07

FIGURE #:
EXHIBIT A

K:\Raritan01\RaritanGIS\Mxd\0807_GWRAWP\04920_SiteLoc.mxd



LEGEND:

1,000 0 1,000 2,000

1 Inch = 2000 Ft.

SOURCE: U.S.G.S. TOPO QUAD - PERTH AMBOY/SOUTH AMBOY NJ

TITLE:

FORMER RARITAN ARSENAL
SITE LOCATION MAP
WITH CEA BOUNDARY
EDISON, NEW JERSEY

PROJECT: DRAFT GROUNDWATER REMEDIAL ACTION WORK PLAN - AUGUST 2007

CLIENT NAME: U.S. ARMY CORPS OF ENGINEERS

WESTON SOLUTIONS

DATE: 8-27-07

FIGURE #: EXHIBIT B

K:\Raritan01\RaritanGIS\Mxd\0807_GWRAWP\04921_SiteCEA.mxd

Exhibit C
Current Property Owners
as of August 23, 2007
Former Raritan Arsenal
Edison, New Jersey

Tax Sheet	Date Modified	Block	Lot	Address	Owner	Street Address	City, State, Zip
200	1-Jan-06	390.CC	1	PARKWAY PL	F&V VISCEGLIA	300 RARITAN CENTER PKWY	EDISON, NJ 08837
200	1-Jan-06	390.CC	2	CLOVER PL	CENTER REALTY	300 RARITAN CENTER PKWY	EDISON, NJ 08837
200	1-Jan-06	390.R	9	50-60 PARKWAY PL	A PANZA & SONS, LTD	50-60 PARKWAY PL	EDISON, NJ 08837
200	1-Jan-06	390.R	10.A	1 CLOVER PL	BT NEW YORK C/O PROPERTY TAX DEP'T	PO BOX 28606	ATLANTA, GA 30358
200	1-Jan-06	390.P	6.A1	220 RARITAN CENTER PKWY	PAPER MILL PLAYHOUSE	220 RARITAN CENTER PKWY	EDISON, NJ 08837
200	1-Jan-06	390.P	6.A2	12 PARKWAY PLACE	FEDERAL BUSINESS CENTERS, INC	300 RARITAN CENTER PKWY	EDISON, NJ 08837
200	1-Jan-06	390.C	5	200 RARITAN CENTER PKWY	DAVANNE REALTY/VAN NESS DEVRIES TRADING	200 RARITAN CENTER PKWY	EDISON, NJ 08837
200	1-Jan-06	390.C	7	PARKWAY PL	ASHCO REALTY C/O ALMAR SALES CO	31 W 34TH ST 8TH FLOOR	NEW YORK, NY 10001
200	1-Jan-06	390.C	22	17 PARKWAY PLACE	RILEY FAMILY LTD PARTNERSHIP	23 WADE DRIVE	SUMMIT, NJ 07026
200	1-Jan-06	390.C	21	30 PARKWAY PLACE	RONALD A. CASALETTO	1536 LAGUNA DR	POINT PLEASANT, NJ 07842
200	1-Jan-06	390.C	4	180 RARITAN CENTER PKWY	180 RARITAN CENTER, LLC	1201 CORBIN ST	ELIZABETH, NJ 07201
200	1-Jan-06	390.C	16	160 RARITAN CENTER PKWY	160 RARITAN CENTER PKWY, LLC C/O ADLER DEV.	PO BOX 7808	EDISON, NJ 08837
200	1-Jan-06	390.C	15	150 RARITAN CENTER PKWY	EXPEDITORS INT'L OF WASHINGTON, INC	1015 THIRD AVE 12TH FLOOR	SEATTLE, WA 98104
200	1-Jan-06	390.C	2.B	120 RARITAN CENTER PKWY	ALLEGIANCE HEATHCARE CORP	1430 WAUKEGAN RD	MC GAW PARK, IL 60085
200	1-Jan-06	390.C	2.D1	20 MCGAW DR	D&M MAGGS C/O D QUINN	1580 COMUMBIA TPK	CASTLETON, NY 12033
200	1-Jan-06	390.C	2.C	200-220 MCGAW DR	FEDERAL STORAGE WAREHOUSES, INC	300 RARITAN CENTER PKWY	EDISON, NJ 08837
200	1-Jan-06	390.C	2.D2	300 MCGAW DR	ICE, INC C/O SADDLEBACK REALTY	87 WEST PASSAIC ST	ROCHELLE PARK, NJ 07662
200	1-Jan-06	390.C	2.E	100 MCGAW DR	FEDERAL STORAGE WAREHOUSES, INC	300 RARITAN CENTER PKWY	EDISON, NJ 08837
200	1-Jan-06	390.C	20	401 CLEARVIEW RD	FEDERATED CORPORATE SERVICES II INC	7 WEST 7TH STREET	CINCINNATI, OH 45202
200	1-Jan-06	390.C	23	1150 KING GEORGES POST RD	FEDERAL STORAGE WAREHOUSES, INC	300 RARITAN CENTER PKWY	EDISON, NJ 08837
200	1-Jan-06	390.C	24	1100 KING GEORGES POST RD	FEDERAL STORAGE WAREHOUSES, INC	300 RARITAN CENTER PKWY	EDISON, NJ 08837
200	1-Jan-06	390.C	25	85 CLEARVIEW RD	FEDERAL STORAGE WAREHOUSES, INC	300 RARITAN CENTER PKWY	EDISON, NJ 08837
200	1-Jan-06	390.C	13.B3	125 CLEARVIEW RD	SAMUEL FROMKIN	125 CLEARVIEW RD BOX 6678	EDISON, NJ 08837
200	1-Jan-06	390.C	13.B4	205 CLEARVIEW RD	305 CLEARVIEW LTD C/O SUMMIT ASSOC	RARITAN CENTER-CN 7807	EDISON, NJ 08837
200	1-Jan-06	390.B	2.B2	110 CLEARVIEW RD	FEDERAL STORAGE WAREHOUSES, INC	300 RARITAN CENTER PKWY	EDISON, NJ 08837
200	1-Jan-06	390.B	2.B3	80 CLEARVIEW RD	FEDERAL STORAGE WAREHOUSES, INC	300 RARITAN CENTER PKWY	EDISON, NJ 08837
200	1-Jan-06	390.B	2.A1	50 CLEARVIEW RD	FEDERAL BUSINESS CENTERS, INC	300 RARITAN CENTER PKWY	EDISON, NJ 08837
200	1-Jan-06	390.B	3	30 CLEARVIEW RD	SECURITY CAP IND TRST C/O DELOITTE	2 WORLD FINANCIAL CENTER	NEW YORK, NY 10281
200	1-Jan-06	390.B	I.E	KING GEORGES POST RD	BCE ASSOC, LP C/O DENHOLTZ-EPROP TAX	DEPT 116 - PO BOX 4900	SCOTTSDALE, AZ 85261

Exhibit C
Current Property Owners
as of August 23, 2007
Former Raritan Arsenal
Edison, New Jersey

Tax Sheet	Date Modified	Block	Lot	Address	Owner	Street Address	City, State, Zip
200	1-Jan-06	390.B	1.F	10 CLEARVIEW RD	BCE ASSOC, LP C/O DENHOLTZ-EPROP TAX	DEPT 116 - PO BOX 4900	SCOTTSDALE, AZ 85261
200	1-Jan-06	390.B	1.D	1090 KING GEORGES POST RD	BCE ASSOC, LP C/O DENHOLTZ-EPROP TAX	DEPT 116 - PO BOX 4900	SCOTTSDALE, AZ 85261
200	1-Jan-06	390.A	1.A4	844 KING GEORGES POST RD	FEDERAL STORAGE WAREHOUSES, INC	300 RARITAN CENTER PKWY	EDISON, NJ 08837
200	1-Jan-06	390.A	2	3050 WOODBRIDGE AVE	LIFCO HOTELS, LLC C/O B'WAY MGMT	1 UNIVERSITY PLAZA # 206	HACKENSACK, NJ 07601
200	1-Jan-06	390.A	3	855 KING GEORGES POST RD	FEDERAL STORAGE WAREHOUSES, INC C/O HERSHA HOSPITALITY	50 RARITAN CENTER PKWY	EDISON, NJ 08837
201	1-Jan-06	390.D	17	215 RARITAN CENTER PKWY	TOWNSHIP OF EDISON	100 MUNICIPAL BLVD	EDISON, NJ 08817
201	1-Jan-06	390.D	7.A	195-199 RARITAN CENTER PKWY	BFG REALTY, LLC C/O JOEL BOTWICK	195 RARITAN CENTER PKWY	EDISON, NJ 08837
201	1-Jan-06	390.D	5.A	**			
201	1-Jan-06	390.D	4.A	115 RARITAN CENTER PKWY	FEDERAL BUSINESS CENTERS, INC	300 RARITAN CENTER PKWY	EDISON, NJ 08837
201	1-Jan-06	390.D	3.C	135 RARITAN CENTER PKWY	135 RCP ASSOC, LP C/O SUMMIT ASSOC	RARITAN PLAZA 1	EDISON, NJ 08837
201	1-Jan-06	390.D	15	110 FIELDCREST AVE	RARITAN PLAZA 1 ASSOC C/O SUMMIT ASSOC	RARITAN PLAZA 1	EDISON, NJ 08837
201	1-Jan-06	390.D	14	FIELDCREST AVE	EDISON HOTEL ASSOC C/O PROPERTY TAX	PO BOX 4900 DEPT 206	SCOTTSDALE, AZ 85261
201	1-Jan-06	390.D	8.B	150 FIELDCREST AVE	NIN VIN LTD C/O SUMMIT ASSOC	RARITAN PLAZA 1	EDISON, NJ 08837
201	1-Jan-06	390.D	8.C	160 FIELDCREST AVE	FIELDCREST JH ASSOC C/O SUMMIT ASSOC	RARITAN PLAZA 1	EDISON, NJ 08837
201	1-Jan-06	390.D	9.A	140 FIELDCREST AVE	FEDERAL BUSINESS CENTERS, INC	300 RARITAN CENTER PKWY	EDISON, NJ 08837
201	1-Jan-06	390.D	10.A	130 FIELDCREST AVE	WILLIAM GRANT & SONS, INC	130 FIELDCREST AVE	EDISON, NJ 08837
201	1-Jan-06	390.D	16	120 FIELDCREST AVE	120 FC ASSOC, LP C/O SUMMIT ASSOC	RARITAN PLAZA 1	EDISON, NJ 08837
201	1-Jan-06	390.DD	8.B	225 RARITAN CENTER PKWY	FEDERAL STORAGE WAREHOUSES, INC	300 RARITAN CENTER PKWY	EDISON, NJ 08837
201	1-Jan-06	390.N	2	1 FIELDCREST AVE	BRE/ESA P PORTFOLIO, LLC C/O PROP TX	100 DUNBAR ST	SPARTANBURG, SC 29306
201	1-Jan-06	390	47.B	2890 WOODBRIDGE AVE	ISAAC HELLER	205 MILL ROAD	EDISON, NJ 08837
201	1-Jan-06	390	48.B	2960 WOODBRIDGE AVE	STEEL FAB REALTY, LLC	8-01 26TH AVE	ASTORIA, NY 11102
201	1-Jan-06	390	48.A	2956 WOODBRIDGE AVE	STEEL FAB REALTY, LLC	8-01 26TH AVE	ASTORIA, NY 11102
201	1-Jan-06	390	49.A	2900 WOODBRIDGE AVE	OWENS-ILLINOIS C/O GRAHAM PACKING	2401 PLEASANT VALLEY RD	YORK, PA 17402
201	1-Jan-06	390	51	2850 WOODBRIDGE AVE	ABRAMS&ZIMMERMAN&BUSSEL C/O BUSINESS REALTY MGMT	2 ETHEL RD STE 202A	EDISON, NJ 08817
201	1-Jan-06	390	54	WOODBRIDGE AVE	US GOV'T EPA REGION II	WOODBRIDGE AVE BLDG 209	EDISON, NJ 08837
201	1-Jan-06	390.F	4	75 FIELDCREST AVE	SIMPSON & LAUFENBERG	RARITAN CENTER-CN 7807	EDISON, NJ 08837
201	1-Jan-06	390.F	3	105 FIELDCREST AVE	GRE IVY RARITAN PLAZA C/O IVY REALTY	1 PARAGON DRIVE STE 125	MONTVALE, NJ 07645
201	1-Jan-06	390.F	2	111 FIELDCREST AVE	111 FIELDCREST ASSOC LP C/O SUMMIT	RARITAN PLAZA 1	EDISON, NJ 08837
201	1-Jan-06	390.E	8	121 FIELDCREST AVE	BYEMOOR DEV, LLC C/O FEDERAL BUSINESS CENTERS	300 RARITAN CENTER PKWY	EDISON, NJ 08837

Exhibit C
Current Property Owners
as of August 23, 2007
Former Raritan Arsenal
Edison, New Jersey

Tax Sheet	Date Modified	Block	Lot	Address	Owner	Street Address	City, State, Zip
201	1-Jan-06	390.E	7.01	135 FIELDCREST AVE	FEDERAL BUSINESS CENTERS, INC	300 RARITAN CENTER PKWY	EDISON, NJ 08837
201	1-Jan-06	390.E	6.01	141 FIELDCREST AVE	EMBA REALTY CORP	141 FIELDCREST AVE	EDISON, NJ 08837
201	1-Jan-06	390.E	5	151 FIELDCREST AVE	151 FIELDCREST, LLC C/O ADLER DEVEL	PO BOX 7808	EDISON, NJ 08837
201	1-Jan-06	390.E	4	165 FIELDCREST AVE	FEDERAL BUSINESS CENTERS, INC	300 RARITAN CENTER PKWY	EDISON, NJ 08837
202	5-Jul-07	390	50.A	2880 WOODBRIDGE AVE	ANTON NADER	8 WINCHESTER DRIVE	SCOTCH PLAINS, NJ 07076
202	5-Jul-07	394	2	MEADOW RD	US GOV'T EPA REGION II	WOODBRIDGE AVE BLDG 209	EDISON, NJ 08837
202	5-Jul-07	396	6	WOODBRIDGE AVE	US GOV'T EPA REGION II	WOODBRIDGE AVE BLDG 209	EDISON, NJ 08837
202	5-Jul-07	396	10	2800 WOODBRIDGE AVE	MIDDLESEX INTERFAITH PARTNERS	2800 WOODBRIDGE AVE	EDISON, NJ 08837
202	5-Jul-07	396	5.01	2650 WOODBRIDGE AVE	BEECHWOOD AT EDISON, LLC	69 CENTURY DRIVE	CLIFTON, NJ 07014
202	5-Jul-07	396	7.01	WOODBRIDGE AVE	US HOME CORPORATION	800 WEST MAIN STREET	FREEHOLD, NJ 07728
202	5-Jul-07	396	9	WOODBRIDGE AVE	MIDDLESEX COUNTY COLLEGE	PO BOX 3050-ACCTS PAYABLE	EDISON, NJ 08837
202	5-Jul-07	396	4.D	WOODBRIDGE AVE	MIDDLESEX COUNTY COLLEGE	PO BOX 3050-ACCTS PAYABLE	EDISON, NJ 08837
202	5-Jul-07	396	2	WOODBRIDGE AVE	MIDDLESEX COUNTY COLLEGE	PO BOX 3050-ACCTS PAYABLE	EDISON, NJ 08837
202	5-Jul-07	396	4.F	WOODBRIDGE AVE	MIDDLESEX COUNTY COLLEGE	PO BOX 3050-ACCTS PAYABLE	EDISON, NJ 08837
202	5-Jul-07	396	8	**			
202	5-Jul-07	396	3.B	2600 WOODBRIDGE AVE	MIDDLESEX COUNTY COLLEGE	PO BOX 661 (PARKS DEPT)	NEW BRUNSWICK, NJ 08903
202	5-Jul-07	395	1.B1	WOODBRIDGE AVE	COUNTY OF MIDDLESEX	PO BOX 661 (PARKS DEPT)	NEW BRUNSWICK, NJ 08903
202	5-Jul-07	395	1.B2	WOODBRIDGE AVE	COUNTY OF MIDDLESEX	PO BOX 661 (PARKS DEPT)	NEW BRUNSWICK, NJ 08903
202	5-Jul-07	395	32	110 NEWFIELD AVE	110 NEWFIELD ASSOC C/O SUMMIT	RARITAN PLAZA 1	EDISON, NJ 08837
202	5-Jul-07	395	36	45 FERNWOOD AVE	NORTHFIELD NEM ASSOC C/O SUMMIT	RARITAN PLAZA 1	EDISON, NJ 08837
202	5-Jul-07	395	35	FERNWOOD AVE BLDG 503	NEW CARSUN HILLS LP C/O SUMMIT ASSOC	RARITAN PLAZA 1	EDISON, NJ 08837
202	5-Jul-07	395	24	100 NEWFIELD AVE	305 CLEARVIEW LTD C/O SUMMIT ASSOC	RARITAN PLAZA 1	EDISON, NJ 08837
202	5-Jul-07	395.A	21	115 NEWFIELD AVE	NORTHFIELD NEM ASSOC C/O SUMMIT	RARITAN PLAZA 1	EDISON, NJ 08837
202	5-Jul-07	395.A	22	104 SUNFIELD AVE	305 CLEARVIEW LTD C/O SUMMIT ASSOC	RARITAN PLAZA 1	EDISON, NJ 08837
202	5-Jul-07	395	20	90 NEWFIELD AVE	305 CLEARVIEW LTD C/O SUMMIT ASSOC	RARITAN PLAZA 1	EDISON, NJ 08837
202	5-Jul-07	395	19	80 NEWFIELD AVE	305 CLEARVIEW LTD C/O SUMMIT ASSOC	RARITAN PLAZA 1	EDISON, NJ 08837
202	5-Jul-07	395	7	70 NEWFIELD AVE	NEWFIELD NEM ASSOC	RARITAN PLAZA 1	EDISON, NJ 08837
202	5-Jul-07	395	6	375 RARITAN CENTER PKWY	375/425 RCP ASSOC, LP C/O SUMMIT	RARITAN PLAZA 1	EDISON, NJ 08837
202	5-Jul-07	395.A	20	105 NEWFIELD AVE	305 CLEARVIEW LTD C/O SUMMIT ASSOC	RARITAN PLAZA 1	EDISON, NJ 08837

Exhibit C
Current Property Owners
as of August 23, 2007
Former Raritan Arsenal
Edison, New Jersey

Tax Sheet	Date Modified	Block	Lot	Address	Owner	Street Address	City, State, Zip
202	5-Jul-07	395.A	19	95 NEWFIELD AVE	305 CLEARVIEW LTD C/O SUMMIT ASSOC	RARITAN PLAZA 1	EDISON, NJ 08837
202	5-Jul-07	395.A	18	NEWFIELD AVE BLDG 505	305 CLEARVIEW LTD C/O SUMMIT ASSOC	RARITAN PLAZA 1	EDISON, NJ 08837
202	5-Jul-07	395.A	27	SUNFIELD AVE	GARDEN STATE BUILDINGS	RARITAN PLAZA 1	EDISON, NJ 08837
202	5-Jul-07	395.A	17	75 NEWFIELD AVE	305 CLEARVIEW LTD C/O SUMMIT ASSOC	RARITAN PLAZA 1	EDISON, NJ 08837
202	5-Jul-07	395.A	24	425 RARITAN CENTER PKWY	375/425 RCP ASSOC, LP C/O SUMMIT	RARITAN PLAZA 1	EDISON, NJ 08837
202	5-Jul-07	395.A	26	475 RARITAN CENTER PKWY	GARDEN STATE BUILDINGS	RARITAN PLAZA 1	EDISON, NJ 08837
202	5-Jul-07	395	4.B	304 RARITAN CENTER PKWY	FEDERAL BUSINESS CENTERS, INC	300 RARITAN CENTER PKWY	EDISON, NJ 08837
202	5-Jul-07	395	4.C4	RARITAN CENTER PKWY	CENTER REALTY	300 RARITAN CENTER PKWY	EDISON, NJ 08837
202	5-Jul-07	395	4.C5	10&30 NORTHFIELD AVE	FEDERAL STORAGE WAREHOUSES	300 RARITAN CENTER PKWY	EDISON, NJ 08837
202	5-Jul-07	395	4.C8	350 RARITAN CENTER PKWY	350 RCP ASSOC C/O SUMMIT ASSOC	RARITAN PLAZA 1	EDISON, NJ 08837
202	5-Jul-07	395	22	RARITAN CENTER PKWY	CENTER REALTY	300 RARITAN CENTER PKWY	EDISON, NJ 08837
202	5-Jul-07	396	4.F	WOODBRIDGE AVE	MIDDLESEX COUNTY COLLEGE	PO BOX 3050-ACCTS PAYABLE	EDISON, NJ 08837
203	5-Jul-07	395	23.01	100 CLOVER PL	CENTER REALTY	300 RARITAN CENTER PKWY	EDISON, NJ 08837
203	5-Jul-07	395	23.02	100 CLOVER PL	CENTER REALTY	300 RARITAN CENTER PKWY	EDISON, NJ 08837
203	5-Jul-07	395	37	RARITAN RIVER	GARDEN STATE BUILDINGS	RARITAN PLAZA 1	EDISON, NJ 08837
203	5-Jul-07	395	31.03	SUNFIELD AVE	NEW CARSUN HILLS LP C/O SUMMIT ASSOC	RARITAN PLAZA 1	EDISON, NJ 08837
203	5-Jul-07	395	31.04	87 SUNFIELD AVE	GARDEN STATE BUILDINGS	RARITAN PLAZA 1	EDISON, NJ 08837
203	5-Jul-07	395	30	5 SUNFIELD AVE	523 RCP ASSOC	RARITAN PLAZA 1	EDISON, NJ 08837
203	5-Jul-07	395	5	551 RARITAN CENTER PKWY	S/K CENTER PARKWAY ASSOCIATES	981 ROUTE 22 PO BOX 6872	BRIDGEWATER, NJ 08807
203	5-Jul-07	395	29	COLUMBUS CIRCLE	GARDEN STATE BUILDINGS	RARITAN PLAZA 1	EDISON, NJ 08837
203	5-Jul-07	395	28	450 RARITAN CENTER PKWY	NORTHFIELD NEM ASSOC C/O SUMMIT	RARITAN PLAZA 1	EDISON, NJ 08837
203	5-Jul-07	395	4.C20	400 RARITAN CENTER PKWY	FIRST INDUSTRIAL, LP	43 RT 46 EAST BOX 600	PINE BROOK, NJ 07058
203	5-Jul-07	395	4.C21	300 COLUMBUS CIRCLE	FIRST INDUSTRIAL, LP	43 RT 46 EAST BOX 600	PINE BROOK, NJ 07058
203	5-Jul-07	395	21	CLOVER PL	CENTER REALTY	300 RARITAN CENTER PKWY	EDISON, NJ 08837
203	5-Jul-07	395	3.B	RARITAN CENTER PKWY	FEDERAL TRANSPORTATION CO	300 RARITAN CENTER PKWY	EDISON, NJ 08837
203	5-Jul-07	390.L	12	RARITAN CENTER PKWY	OWLHEAD HRBR DEV C/O FEDERAL BUSINESS CENTERS	300 RARITAN CENTER PKWY	EDISON, NJ 08837

**Edison Township tax maps indicate these lot numbers exist; however, the Tax Assessor's office has no record of them.

Exhibit D

Current Property Owners
as of August 23, 2007
Within the CEA of The Former Raritan Arsenal
Edison, New Jersey

Tax Sheet	Date Modified	Block	Lot	Address	Owner	Street Address	City, State, Zip
200	1-Jan-06	390.CC	2	CLOVER PL	CENTER REALTY	300 RARITAN CENTER PKWY	EDISON, NJ 08837
200	1-Jan-06	390.R	9	50-60 PARKWAY PL	A PANZA & SONS, LTD	50-60 PARKWAY PL	EDISON, NJ 08837
200	1-Jan-06	390.R	10.A	1 CLOVER PL	BT NEW YORK C/O PROPERTY TAX DEP'T	PO BOX 28606	ATLANTA, GA 30358
201	1-Jan-06	390.D	17	215 RARITAN CENTER PKWY	TOWNSHIP OF EDISON	100 MUNICIPAL BLVD	EDISON, NJ 08817
201	1-Jan-06	390.D	8.B	150 FIELDCREST AVE	NIN VIN LTD C/O SUMMIT ASSOC	RARITAN PLAZA 1	EDISON, NJ 08837
201	1-Jan-06	390.D	8.C	160 FIELDCREST AVE	FIELDCREST JH ASSOC C/O SUMMIT ASSOC	RARITAN PLAZA 1	EDISON, NJ 08837
201	1-Jan-06	390.DD	8.B	225 RARITAN CENTER PKWY	FEDERAL STORAGE WAREHOUSES, INC	300 RARITAN CENTER PKWY	EDISON, NJ 08837
201	1-Jan-06	390	47.B	2890 WOODBRIDGE AVE	ISAAC HELLER	205 MILL ROAD	EDISON, NJ 08837
201	1-Jan-06	390	48.B	2960 WOODBRIDGE AVE	STEEL FAB REALTY, LLC	8-01 26TH AVE	ASTORIA, NY 11102
201	1-Jan-06	390	48.A	2956 WOODBRIDGE AVE	STEEL FAB REALTY, LLC	8-01 26TH AVE	ASTORIA, NY 11102
201	1-Jan-06	390	49.A	2900 WOODBRIDGE AVE	OWENS-ILLINOIS C/O GRAHAM PACKING	2401 PLEASANT VALLEY RD	YORK, PA 17402
201	1-Jan-06	390	51	2850 WOODBRIDGE AVE	ABRAMS&ZIMMERMAN&BUSSEL C/O BUSINESS REALTY MGMT	2 ETHEL RD STE 202A	EDISON, NJ 08817
201	1-Jan-06	390	54	WOODBRIDGE AVE	US GOV'T EPA REGION II	WOODBRIDGE AVE BLDG 209	EDISON, NJ 08837
201	1-Jan-06	390.E	5	151 FIELDCREST AVE	151 FIELDCREST, LLC C/O ADLER DEVEL	PO BOX 7808	EDISON, NJ 08837
201	1-Jan-06	390.E	4	165 FIELDCREST AVE	FEDERAL BUSINESS CENTERS, INC	300 RARITAN CENTER PKWY	EDISON, NJ 08837
202	5-Jul-07	394	2	MEADOW RD	US GOV'T EPA REGION II	WOODBRIDGE AVE BLDG 209	EDISON, NJ 08837
202	5-Jul-07	396	6	WOODBRIDGE AVE	US GOV'T EPA REGION II	WOODBRIDGE AVE BLDG 209	EDISON, NJ 08837
202	5-Jul-07	396	10	2800 WOODBRIDGE AVE	MIDDLESEX INTERFAITH PARTNERS	2800 WOODBRIDGE AVE	EDISON, NJ 08837
202	5-Jul-07	396	7.01	WOODBRIDGE AVE	US HOME CORPORATION	800 WEST MAIN STREET	FREEHOLD, NJ 07728
202	5-Jul-07	395	1.B2	WOODBRIDGE AVE	COUNTY OF MIDDLESEX	PO BOX 661 (PARKS DEPT)	NEW BRUNSWICK, NJ 08903
202	5-Jul-07	395	32	110 NEWFIELD AVE	110 NEWFIELD ASSOC C/O SUMMIT	RARITAN PLAZA 1	EDISON, NJ 08837
202	5-Jul-07	395	36	45 FERNWOOD AVE	NORTHFIELD NEM ASSOC C/O SUMMIT	RARITAN PLAZA 1	EDISON, NJ 08837
202	5-Jul-07	395	35	FERNWOOD AVE BLDG 503	NEW CARSUN HILLS LP C/O SUMMIT ASSOC	RARITAN PLAZA 1	EDISON, NJ 08837
202	5-Jul-07	395	24	100 NEWFIELD AVE	305 CLEARVIEW LTD C/O SUMMIT ASSOC	RARITAN PLAZA 1	EDISON, NJ 08837
202	5-Jul-07	395.A	21	115 NEWFIELD AVE	NORTHFIELD NEM ASSOC C/O SUMMIT	RARITAN PLAZA 1	EDISON, NJ 08837
202	5-Jul-07	395.A	22	104 SUNFIELD AVE	305 CLEARVIEW LTD C/O SUMMIT ASSOC	RARITAN PLAZA 1	EDISON, NJ 08837
202	5-Jul-07	395	20	90 NEWFIELD AVE	305 CLEARVIEW LTD C/O SUMMIT ASSOC	RARITAN PLAZA 1	EDISON, NJ 08837
202	5-Jul-07	395	19	80 NEWFIELD AVE	305 CLEARVIEW LTD C/O SUMMIT ASSOC	RARITAN PLAZA 1	EDISON, NJ 08837
202	5-Jul-07	395	7	70 NEWFIELD AVE	NEWFIELD NEM ASSOC	RARITAN PLAZA 1	EDISON, NJ 08837

Exhibit D
Current Property Owners
as of August 23, 2007
Within the CEA of The Former Raritan Arsenal
Edison, New Jersey

Tax Sheet	Date Modified	Block	Lot	Address	Owner	Street Address	City, State, Zip
202	5-Jul-07	395	6	375 RARITAN CENTER PKWY	375/425 RCP ASSOC, LP C/O SUMMIT	RARITAN PLAZA 1	EDISON, NJ 08837
202	5-Jul-07	395.A	20	105 NEWFIELD AVE	305 CLEARVIEW LTD C/O SUMMIT ASSOC	RARITAN PLAZA 1	EDISON, NJ 08837
202	5-Jul-07	395.A	19	95 NEWFIELD AVE	305 CLEARVIEW LTD C/O SUMMIT ASSOC	RARITAN PLAZA 1	EDISON, NJ 08837
202	5-Jul-07	395.A	18	NEWFIELD AVE BLDG 505	305 CLEARVIEW LTD C/O SUMMIT ASSOC	RARITAN PLAZA 1	EDISON, NJ 08837
202	5-Jul-07	395.A	27	SUNFIELD AVE	GARDEN STATE BUILDINGS	RARITAN PLAZA 1	EDISON, NJ 08837
202	5-Jul-07	395.A	17	75 NEWFIELD AVE	305 CLEARVIEW LTD C/O SUMMIT ASSOC	RARITAN PLAZA 1	EDISON, NJ 08837
202	5-Jul-07	395.A	24	425 RARITAN CENTER PKWY	375/425 RCP ASSOC, LP C/O SUMMIT	RARITAN PLAZA 1	EDISON, NJ 08837
202	5-Jul-07	395.A	26	475 RARITAN CENTER PKWY	GARDEN STATE BUILDINGS	RARITAN PLAZA 1	EDISON, NJ 08837
202	5-Jul-07	395	4.B	304 RARITAN CENTER PKWY	FEDERAL BUSINESS CENTERS, INC	300 RARITAN CENTER PKWY	EDISON, NJ 08837
202	5-Jul-07	395	4.C4	RARITAN CENTER PKWY	CENTER REALTY	300 RARITAN CENTER PKWY	EDISON, NJ 08837
202	5-Jul-07	395	4.C5	10&30 NORTHFIELD AVE	FEDERAL STORAGE WAREHOUSES	300 RARITAN CENTER PKWY	EDISON, NJ 08837
202	5-Jul-07	395	4.C8	350 RARITAN CENTER PKWY	350 RCP ASSOC C/O SUMMIT ASSOC	RARITAN PLAZA 1	EDISON, NJ 08837
202	5-Jul-07	395	22	RARITAN CENTER PKWY	CENTER REALTY	300 RARITAN CENTER PKWY	EDISON, NJ 08837
203	5-Jul-07	395	23.01	100 CLOVER PL	CENTER REALTY	300 RARITAN CENTER PKWY	EDISON, NJ 08837
203	5-Jul-07	395	23.02	100 CLOVER PL	CENTER REALTY	300 RARITAN CENTER PKWY	EDISON, NJ 08837
203	5-Jul-07	395	37	RARITAN RIVER	GARDEN STATE BUILDINGS	RARITAN PLAZA 1	EDISON, NJ 08837
203	5-Jul-07	395	31.03	SUNFIELD AVE	NEW CARSUN HILLS LP C/O SUMMIT ASSOC	RARITAN PLAZA 1	EDISON, NJ 08837
203	5-Jul-07	395	31.04	87 SUNFIELD AVE	GARDEN STATE BUILDINGS	RARITAN PLAZA 1	EDISON, NJ 08837
203	5-Jul-07	395	30	5 SUNFIELD AVE	523 RCP ASSOC	RARITAN PLAZA 1	EDISON, NJ 08837
203	5-Jul-07	395	5	551 RARITAN CENTER PKWY	S/K CENTER PARKWAY ASSOCIATES	981 ROUTE 22 PO BOX 6872	BRIDGEWATER, NJ 08807
203	5-Jul-07	395	29	COLUMBUS CIRCLE	GARDEN STATE BUILDINGS	RARITAN PLAZA 1	EDISON, NJ 08837
203	5-Jul-07	395	28	450 RARITAN CENTER PKWY	NORTHFIELD NEM ASSOC C/O SUMMIT	RARITAN PLAZA 1	EDISON, NJ 08837
203	5-Jul-07	395	4.C20	400 RARITAN CENTER PKWY	FIRST INDUSTRIAL, LP	43 RT 46 EAST BOX 600	PINE BROOK, NJ 07058
203	5-Jul-07	395	4.C21	300 COLUMBUS CIRCLE	FIRST INDUSTRIAL, LP	43 RT 46 EAST BOX 600	PINE BROOK, NJ 07058
203	5-Jul-07	395	21	CLOVER PL	CENTER REALTY	300 RARITAN CENTER PKWY	EDISON, NJ 08837

APPENDIX F

Mr. Dennis Pipala
Edison Planning Board
100 Municipal Boulevard
Edison, NJ 08817

Mr. John Grunn
Edison Health Department
100 Municipal Boulevard
Edison, NJ 08817

Mr. David Papi
Department of Public Health
Middlesex County Administration
Building
5th Floor
John F Kennedy Square
New Brunswick, NJ 08901

Ms. Reina Murphy
Municipal Clerk
100 Municipal Boulevard
Edison, NJ 08817

Ms. Elaine M. Flynn
County Clerk
Middlesex County Administration
Building
75 Bayard Street
PO Box 1110
New Brunswick, NJ 08901

Ms. Christine Fontecchio
New Jersey Department of Health
3635 Quakerbridge Road
Trenton, NJ 08625

Mr. George M. Ververides
Middlesex County Planning Department
40 Livingston Avenue
New Brunswick, NJ 08901

New Jersey Bureau of Safe Drinking
Water
401 East State Street
Box 426
Trenton, NJ 08625

Ms. Diane Zalaskus
New Jersey Bureau of Water Allocation
401 East State Street
Box 426
Trenton, NJ 08625

Exhibit D

Current Property Owners
as of August 23, 2007
Within the CEA of The Former Raritan Arsenal
Edison, New Jersey

Owner	Street Address	City, State, Zip
110 NEWFIELD ASSOC C/O SUMMIT	RARITAN PLAZA 1	EDISON, NJ 08837
151 FIELDCREST, LLC C/O ADLER DEVEL	PO BOX 7808	EDISON, NJ 08837
305 CLEARVIEW LTD C/O SUMMIT ASSOC	RARITAN PLAZA 1	EDISON, NJ 08837
350 RCP ASSOC C/O SUMMIT ASSOC	RARITAN PLAZA 1	EDISON, NJ 08837
375/425 RCP ASSOC, LP C/O SUMMIT	RARITAN PLAZA 1	EDISON, NJ 08837
523 RCP ASSOC	RARITAN PLAZA 1	EDISON, NJ 08837
A PANZA & SONS, LTD	50-60 PARKWAY PL	EDISON, NJ 08837
ABRAMS&ZIMMERMAN&BUSSEL C/O BUSINESS REALTY MGMT	2 ETHEL RD STE 202A	EDISON, NJ 08817
BT NEW YORK C/O PROPERTY TAX DEP'T	PO BOX 28606	ATLANTA, GA 30358
CENTER REALTY	300 RARITAN CENTER PKWY	EDISON, NJ 08837
COUNTY OF MIDDLESEX	PO BOX 661 (PARKS DEPT)	NEW BRUNSWICK, NJ 08903
FEDERAL BUSINESS CENTERS, INC	300 RARITAN CENTER PKWY	EDISON, NJ 08837
FEDERAL STORAGE WAREHOUSES	300 RARITAN CENTER PKWY	EDISON, NJ 08837
FIELDCREST JH ASSOC C/O SUMMIT ASSOC	RARITAN PLAZA 1	EDISON, NJ 08837
FIRST INDUSTRIAL, LP	43 RT 46 EAST BOX 600	PINE BROOK, NJ 07058
GARDEN STATE BUILDINGS	RARITAN PLAZA 1	EDISON, NJ 08837
ISAAC HELLER	205 MILL ROAD	EDISON, NJ 08837
MIDDLESEX INTERFAITH PARTNERS	2800 WOODBRIDGE AVE	EDISON, NJ 08837
NEW CARSUN HILLS LP C/O SUMMIT ASSOC	RARITAN PLAZA 1	EDISON, NJ 08837
NEWFIELD NEM ASSOC	RARITAN PLAZA 1	EDISON, NJ 08837
NIN VIN LTD C/O SUMMIT ASSOC	RARITAN PLAZA 1	EDISON, NJ 08837
NORTHFIELD NEM ASSOC C/O SUMMIT	RARITAN PLAZA 1	EDISON, NJ 08837
OWENS-ILLINOIS C/O GRAHAM PACKING	2401 PLEASANT VALLEY RD	YORK, PA 17402
S/K CENTER PARKWAY ASSOCIATES	981 ROUTE 22 PO BOX 6872	BRIDGEWATER, NJ 08807
STEEL FAB REALTY, LLC	8-01 26TH AVE	ASTORIA, NY 11102
TOWNSHIP OF EDISON	100 MUNICIPAL BLVD	EDISON, NJ 08817
US GOV'T EPA REGION II	WOODBRIDGE AVE BLDG 209	EDISON, NJ 08837
US HOME CORPORATION	800 WEST MAIN STREET	FREEHOLD, NJ 07728

February 11, 2008

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

Mr. Dennis Pipala
Edison Planning Board
100 Municipal Boulevard
Edison, NJ 08817

Subject: **CLASSIFICATION EXCEPTION AREA**
FORMER RARITAN ARSENAL, EDISON, NEW JERSEY

In accordance with the New Jersey Requirements for Site Remediation (N.J.A.C. 7:26E) a Classification Exception Area (CEA) is established in order to provide notice that the constituent standards for a given aquifer classification are not or will not be met in a localized area due to natural water quality or anthropogenic influences, and that designated aquifer uses are suspended in the affected area for the term of the CEA.

This letter serves to notify you that a CEA is being proposed for the area of the Former Raritan Arsenal. A map of the area is attached.

The point of contact for all questions concerning the delineation of the CEA is:

Mr. Jim Kelly
US ARMY Corps of Engineers
New England District
696 Virginia Road
Concord, MA 01742-2751

Regards,

WESTON SOLUTIONS, INC.

Paul Bovitz

Paul Bovitz, CPWS
Principle Project Manager

February 11, 2008

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

Mr. John Grunn
Edison Health Department
100 Municipal Boulevard
Edison, NJ 08817

Subject: **CLASSIFICATION EXCEPTION AREA**
FORMER RARITAN ARSENAL, EDISON, NEW JERSEY

In accordance with the New Jersey Requirements for Site Remediation (N.J.A.C. 7:26E) a Classification Exception Area (CEA) is established in order to provide notice that the constituent standards for a given aquifer classification are not or will not be met in a localized area due to natural water quality or anthropogenic influences, and that designated aquifer uses are suspended in the affected area for the term of the CEA.

This letter serves to notify you that a CEA is being proposed for the area of the Former Raritan Arsenal. A map of the area is attached.

The point of contact for all questions concerning the delineation of the CEA is:

Mr. Jim Kelly
US ARMY Corps of Engineers
New England District
696 Virginia Road
Concord, MA 01742-2751

Regards,

WESTON SOLUTIONS, INC.

Paul Bovitz

Paul Bovitz, CPWS
Principle Project Manager

February 11, 2008

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

Mr. David Papi
Department of Public Health
Middlesex County Administration Building
5th Floor, John F Kennedy Square
New Brunswick, NJ 08901

Subject: CLASSIFICATION EXCEPTION AREA
FORMER RARITAN ARSENAL, EDISON, NEW JERSEY

In accordance with the New Jersey Requirements for Site Remediation (N.J.A.C. 7:26E) a Classification Exception Area (CEA) is established in order to provide notice that the constituent standards for a given aquifer classification are not or will not be met in a localized area due to natural water quality or anthropogenic influences, and that designated aquifer uses are suspended in the affected area for the term of the CEA.

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Mr. Jim Kelly
US ARMY Corps of Engineers
New England District
696 Virginia Road
Concord, MA 01742-2751

Regards,

WESTON SOLUTIONS, INC.

Paul J Bovitz

Paul Bovitz, CPWS
Principle Project Manager

February 11, 2008

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

Ms. Reina Murphy
Municipal Clerk
100 Municipal Boulevard
Edison, NJ 08817

Subject: **CLASSIFICATION EXCEPTION AREA**
FORMER RARITAN ARSENAL, EDISON, NEW JERSEY

In accordance with the New Jersey Requirements for Site Remediation (N.J.A.C. 7:26E) a Classification Exception Area (CEA) is established in order to provide notice that the constituent standards for a given aquifer classification are not or will not be met in a localized area due to natural water quality or anthropogenic influences, and that designated aquifer uses are suspended in the affected area for the term of the CEA.

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Mr. Jim Kelly
US ARMY Corps of Engineers
New England District
696 Virginia Road
Concord, MA 01742-2751

Regards,

WESTON SOLUTIONS, INC.

Paul Bovitz, CPWS
Principle Project Manager

February 11, 2008

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

Ms. Elaine M. Flynn
County Clerk
Middlesex County Administration Building
75 Bayard Street, PO Box 1110
New Brunswick, NJ 08901

Subject: **CLASSIFICATION EXCEPTION AREA**
FORMER RARITAN ARSENAL, EDISON, NEW JERSEY

In accordance with the New Jersey Requirements for Site Remediation (N.J.A.C. 7:26E) a Classification Exception Area (CEA) is established in order to provide notice that the constituent standards for a given aquifer classification are not or will not be met in a localized area due to natural water quality or anthropogenic influences, and that designated aquifer uses are suspended in the affected area for the term of the CEA.

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Mr. Jim Kelly
US ARMY Corps of Engineers
New England District
696 Virginia Road
Concord, MA 01742-2751

Regards,

WESTON SOLUTIONS, INC.

Paul J Bovitz

Paul Bovitz, CPWS
Principle Project Manager

February 11, 2008

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

Ms. Christine Fontecchio
New Jersey Department of Health
3635 Quakerbridge Road
Trenton, NJ 08625

Subject: CLASSIFICATION EXCEPTION AREA
FORMER RARITAN ARSENAL, EDISON, NEW JERSEY

In accordance with the New Jersey Requirements for Site Remediation (N.J.A.C. 7:26E) a Classification Exception Area (CEA) is established in order to provide notice that the constituent standards for a given aquifer classification are not or will not be met in a localized area due to natural water quality or anthropogenic influences, and that designated aquifer uses are suspended in the affected area for the term of the CEA.

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Mr. Jim Kelly
US ARMY Corps of Engineers
New England District
696 Virginia Road
Concord, MA 01742-2751

Regards,

WESTON SOLUTIONS, INC.

Paul Bovitz, CPWS
Principle Project Manager

February 11, 2008

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

Mr. George M. Ververides
Middlesex County Planning Department
40 Livingston Avenue
New Brunswick, NJ 08901

Subject: **CLASSIFICATION EXCEPTION AREA**
FORMER RARITAN ARSENAL, EDISON, NEW JERSEY

In accordance with the New Jersey Requirements for Site Remediation (N.J.A.C. 7:26E) a Classification Exception Area (CEA) is established in order to provide notice that the constituent standards for a given aquifer classification are not or will not be met in a localized area due to natural water quality or anthropogenic influences, and that designated aquifer uses are suspended in the affected area for the term of the CEA.

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Mr. Jim Kelly
US ARMY Corps of Engineers
New England District
696 Virginia Road
Concord, MA 01742-2751

Regards,

WESTON SOLUTIONS, INC.

Paul Bovitz, CPWS
Principle Project Manager

February 11, 2008

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

New Jersey Bureau of Safe Drinking Water
401 East State Street
Box 426
Trenton, NJ 08625

Subject: **CLASSIFICATION EXCEPTION AREA**
FORMER RARITAN ARSENAL, EDISON, NEW JERSEY

In accordance with the New Jersey Requirements for Site Remediation (N.J.A.C. 7:26E) a Classification Exception Area (CEA) is established in order to provide notice that the constituent standards for a given aquifer classification are not or will not be met in a localized area due to natural water quality or anthropogenic influences, and that designated aquifer uses are suspended in the affected area for the term of the CEA.

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Mr. Jim Kelly
US ARMY Corps of Engineers
New England District
696 Virginia Road
Concord, MA 01742-2751

Regards,

WESTON SOLUTIONS, INC.

Paul J Bovitz

Paul Bovitz, CPWS
Principle Project Manager

February 11, 2008

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

Ms. Diane Zalaskus
New Jersey Bureau of Water Allocation
401 East State Street
Box 426
Trenton, NJ 08625

Subject: **CLASSIFICATION EXCEPTION AREA**
FORMER RARITAN ARSENAL, EDISON, NEW JERSEY

In accordance with the New Jersey Requirements for Site Remediation (N.J.A.C. 7:26E) a Classification Exception Area (CEA) is established in order to provide notice that the constituent standards for a given aquifer classification are not or will not be met in a localized area due to natural water quality or anthropogenic influences, and that designated aquifer uses are suspended in the affected area for the term of the CEA.

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The point of contact for all questions concerning the delineation of the CEA is:

Mr. Jim Kelly
US ARMY Corps of Engineers
New England District
696 Virginia Road
Concord, MA 01742-2751

Regards,

WESTON SOLUTIONS, INC.

Paul J Bovitz

Paul Bovitz, CPWS
Principle Project Manager

February 11, 2008

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

CENTER REALTY
300 RARITAN CENTER PKWY
EDISON, NJ 08837

Subject: **CLASSIFICATION EXCEPTION AREA**
FORMER RARITAN ARSENAL, EDISON, NEW JERSEY
BLOCK 390.CC, LOT 2; CLOVER PL
BLOCK 395, LOT 21; CLOVER PL
BLOCK 395, LOT 4.C4; RARITAN CENTER PKWY
BLOCK 395, LOT 22; RARITAN CENTER PKWY
BLOCK 395, LOT 23.01; 100 CLOVER PL
BLOCK 395, LOT 23.02; 100 CLOVER PL

Dear Madam or Sir:

In accordance with the New Jersey Requirements for Site Remediation (N.J.A.C. 7:26E) a Classification Exception Area (CEA) is established in order to provide notice that the constituent standards for a given aquifer classification are not or will not be met in a localized area due to natural water quality or anthropogenic influences, and that designated aquifer uses are suspended in the affected area for the term of the CEA.

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Mr. Jim Kelly
US ARMY Corps of Engineers
New England District
696 Virginia Road
Concord, MA 01742-2751

Regards,

WESTON SOLUTIONS, INC.

Paul Bovitz, CPWS
Principle Project Manager

February 11, 2008

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

A PANZA & SONS, LTD
50-60 PARKWAY PL
EDISON, NJ 08837

Subject: **CLASSIFICATION EXCEPTION AREA**
FORMER RARITAN ARSENAL, EDISON, NEW JERSEY
BLOCK 390.R, LOT 9; 50-60 PARKWAY PL

Dear Madam or Sir:

In accordance with the New Jersey Requirements for Site Remediation (N.J.A.C. 7:26E) a Classification Exception Area (CEA) is established in order to provide notice that the constituent standards for a given aquifer classification are not or will not be met in a localized area due to natural water quality or anthropogenic influences, and that designated aquifer uses are suspended in the affected area for the term of the CEA.

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Mr. Jim Kelly
US ARMY Corps of Engineers
New England District
696 Virginia Road
Concord, MA 01742-2751

Regards,

WESTON SOLUTIONS, INC.

Paul J Bovitz

Paul Bovitz, CPWS
Principle Project Manager

February 11, 2008

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

BT NEW YORK C/O PROPERTY TAX DEP'T
PO BOX 28606
ATLANTA, GA 30358

Subject: **CLASSIFICATION EXCEPTION AREA**
FORMER RARITAN ARSENAL, EDISON, NEW JERSEY
BLOCK 390.R, LOT 10.A; 1 CLOVER PL

Dear Madam or Sir:

In accordance with the New Jersey Requirements for Site Remediation (N.J.A.C. 7:26E) a Classification Exception Area (CEA) is established in order to provide notice that the constituent standards for a given aquifer classification are not or will not be met in a localized area due to natural water quality or anthropogenic influences, and that designated aquifer uses are suspended in the affected area for the term of the CEA.

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Mr. Jim Kelly
US ARMY Corps of Engineers
New England District
696 Virginia Road
Concord, MA 01742-2751

Regards,

WESTON SOLUTIONS, INC.

Paul Bovitz, CPWS
Principle Project Manager

February 11, 2008

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

TOWNSHIP OF EDISON
100 MUNICIPAL BLVD
EDISON, NJ 08817

Subject: **CLASSIFICATION EXCEPTION AREA**
FORMER RARITAN ARSENAL, EDISON, NEW JERSEY
BLOCK 390.D, LOT 17; 215 RARITAN CENTER PKWY

Dear Madam or Sir:

In accordance with the New Jersey Requirements for Site Remediation (N.J.A.C. 7:26E) a Classification Exception Area (CEA) is established in order to provide notice that the constituent standards for a given aquifer classification are not or will not be met in a localized area due to natural water quality or anthropogenic influences, and that designated aquifer uses are suspended in the affected area for the term of the CEA.

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Mr. Jim Kelly
US ARMY Corps of Engineers
New England District
696 Virginia Road
Concord, MA 01742-2751

Regards,

WESTON SOLUTIONS, INC.

Paul Bovitz, CPWS
Principle Project Manager

February 11, 2008

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

NIN VIN LTD C/O SUMMIT ASSOC
RARITAN PLAZA 1
EDISON, NJ 08837

Subject: **CLASSIFICATION EXCEPTION AREA**
FORMER RARITAN ARSENAL, EDISON, NEW JERSEY
BLOCK 390.D, LOT 8.B; 150 FIELDCREST AVE

Dear Madam or Sir:

In accordance with the New Jersey Requirements for Site Remediation (N.J.A.C. 7:26E) a Classification Exception Area (CEA) is established in order to provide notice that the constituent standards for a given aquifer classification are not or will not be met in a localized area due to natural water quality or anthropogenic influences, and that designated aquifer uses are suspended in the affected area for the term of the CEA.

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Mr. Jim Kelly
US ARMY Corps of Engineers
New England District
696 Virginia Road
Concord, MA 01742-2751

Regards,

WESTON SOLUTIONS, INC.

Paul Bovitz, CPWS
Principle Project Manager

February 11, 2008

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

FIELDCREST JH ASSOC C/O SUMMIT ASSOC
RARITAN PLAZA 1
EDISON, NJ 08837

Subject: **CLASSIFICATION EXCEPTION AREA**
FORMER RARITAN ARSENAL, EDISON, NEW JERSEY
BLOCK 390.D, LOT 8.C; 160 FIELDCREST AVE

Dear Madam or Sir:

In accordance with the New Jersey Requirements for Site Remediation (N.J.A.C. 7:26E) a Classification Exception Area (CEA) is established in order to provide notice that the constituent standards for a given aquifer classification are not or will not be met in a localized area due to natural water quality or anthropogenic influences, and that designated aquifer uses are suspended in the affected area for the term of the CEA.

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Mr. Jim Kelly
US ARMY Corps of Engineers
New England District
696 Virginia Road
Concord, MA 01742-2751

Regards,

WESTON SOLUTIONS, INC.

Paul Bovitz, CPWS
Principle Project Manager

February 11, 2008

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

FEDERAL STORAGE WAREHOUSES, INC
300 RARITAN CENTER PKWY
EDISON, NJ 08837

Subject: **CLASSIFICATION EXCEPTION AREA**
FORMER RARITAN ARSENAL, EDISON, NEW JERSEY
BLOCK 390.DD, LOT 8.B; 225 RARITAN CENTER PKWY
BLOCK 395, LOT 4.C5; 10&30 NORTHFIELD AVE

Dear Madam or Sir:

In accordance with the New Jersey Requirements for Site Remediation (N.J.A.C. 7:26E) a Classification Exception Area (CEA) is established in order to provide notice that the constituent standards for a given aquifer classification are not or will not be met in a localized area due to natural water quality or anthropogenic influences, and that designated aquifer uses are suspended in the affected area for the term of the CEA.

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US ARMY Corps of Engineers
New England District
696 Virginia Road
Concord, MA 01742-2751

Regards,

WESTON SOLUTIONS, INC.

Paul Bovitz, CPWS
Principle Project Manager

February 11, 2008

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

ISAAC HELLER
205 MILL ROAD
EDISON, NJ 08837

Subject: CLASSIFICATION EXCEPTION AREA
FORMER RARITAN ARSENAL, EDISON, NEW JERSEY
BLOCK 390, LOT 47.B; 2890 WOODBRIDGE AVE

Dear Madam or Sir:

In accordance with the New Jersey Requirements for Site Remediation (N.J.A.C. 7:26E) a Classification Exception Area (CEA) is established in order to provide notice that the constituent standards for a given aquifer classification are not or will not be met in a localized area due to natural water quality or anthropogenic influences, and that designated aquifer uses are suspended in the affected area for the term of the CEA.

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US ARMY Corps of Engineers
New England District
696 Virginia Road
Concord, MA 01742-2751

Regards,

WESTON SOLUTIONS, INC.

Paul Bovitz, CPWS
Principle Project Manager

February 11, 2008

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

STEEL FAB REALTY, LLC
8-01 26TH AVE
ASTORIA, NY 11102

Subject: **CLASSIFICATION EXCEPTION AREA**
FORMER RARITAN ARSENAL, EDISON, NEW JERSEY
BLOCK 390, LOT 48.B; 2960 WOODBRIDGE AVE
BLOCK 390, LOT 48.A; 2956 WOODBRIDGE AVE

Dear Madam or Sir:

In accordance with the New Jersey Requirements for Site Remediation (N.J.A.C. 7:26E) a Classification Exception Area (CEA) is established in order to provide notice that the constituent standards for a given aquifer classification are not or will not be met in a localized area due to natural water quality or anthropogenic influences, and that designated aquifer uses are suspended in the affected area for the term of the CEA.

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US ARMY Corps of Engineers
New England District
696 Virginia Road
Concord, MA 01742-2751

Regards,

WESTON SOLUTIONS, INC.

Paul Bovitz, CPWS
Principle Project Manager

February 11, 2008

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

OWENS-ILLINOIS C/O GRAHAM PACKING
2401 PLEASANT VALLEY RD
YORK, PA 17402

Subject: **CLASSIFICATION EXCEPTION AREA**
FORMER RARITAN ARSENAL, EDISON, NEW JERSEY
BLOCK 390, LOT 49.A; 2900 WOODBRIDGE AVE

Dear Madam or Sir:

In accordance with the New Jersey Requirements for Site Remediation (N.J.A.C. 7:26E) a Classification Exception Area (CEA) is established in order to provide notice that the constituent standards for a given aquifer classification are not or will not be met in a localized area due to natural water quality or anthropogenic influences, and that designated aquifer uses are suspended in the affected area for the term of the CEA.

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US ARMY Corps of Engineers
New England District
696 Virginia Road
Concord, MA 01742-2751

Regards,

WESTON SOLUTIONS, INC.

Paul J Bovitz

Paul Bovitz, CPWS
Principle Project Manager

February 11, 2008

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

ABRAMS&ZIMMERMAN&BUSSEL C/O BUSINESS REALTY MGMT
2 ETHEL RD STE 202A
EDISON, NJ 08817

Subject: **CLASSIFICATION EXCEPTION AREA**
FORMER RARITAN ARSENAL, EDISON, NEW JERSEY
BLOCK 390, LOT 51; 2850 WOODBRIDGE AVE

Dear Madam or Sir:

In accordance with the New Jersey Requirements for Site Remediation (N.J.A.C. 7:26E) a Classification Exception Area (CEA) is established in order to provide notice that the constituent standards for a given aquifer classification are not or will not be met in a localized area due to natural water quality or anthropogenic influences, and that designated aquifer uses are suspended in the affected area for the term of the CEA.

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Mr. Jim Kelly
US ARMY Corps of Engineers
New England District
696 Virginia Road
Concord, MA 01742-2751

Regards,

WESTON SOLUTIONS, INC.

Paul Bovitz, CPWS
Principle Project Manager

February 11, 2008

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

US GOV'T EPA REGION II
WOODBRIDGE AVE BLDG 209
EDISON, NJ 08837

Subject: **CLASSIFICATION EXCEPTION AREA**
FORMER RARITAN ARSENAL, EDISON, NEW JERSEY
BLOCK 390, LOT 54; WOODBRIDGE AVE
BLOCK 396, LOT 6; WOODBRIDGE AVE
BLOCK 394, LOT 2; MEADOW ROAD

Dear Madam or Sir:

In accordance with the New Jersey Requirements for Site Remediation (N.J.A.C. 7:26E) a Classification Exception Area (CEA) is established in order to provide notice that the constituent standards for a given aquifer classification are not or will not be met in a localized area due to natural water quality or anthropogenic influences, and that designated aquifer uses are suspended in the affected area for the term of the CEA.

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US ARMY Corps of Engineers
New England District
696 Virginia Road
Concord, MA 01742-2751

Regards,

WESTON SOLUTIONS, INC.

Paul Bovitz, CPWS
Principle Project Manager

February 11, 2008

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

151 FIELDCREST, LLC C/O ADLER DEVEL
PO BOX 7808
EDISON, NJ 08837

Subject: CLASSIFICATION EXCEPTION AREA
FORMER RARITAN ARSENAL, EDISON, NEW JERSEY
BLOCK 390.E, LOT 5; 151 FIELDCREST AVE

Dear Madam or Sir:

In accordance with the New Jersey Requirements for Site Remediation (N.J.A.C. 7:26E) a Classification Exception Area (CEA) is established in order to provide notice that the constituent standards for a given aquifer classification are not or will not be met in a localized area due to natural water quality or anthropogenic influences, and that designated aquifer uses are suspended in the affected area for the term of the CEA.

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Mr. Jim Kelly
US ARMY Corps of Engineers
New England District
696 Virginia Road
Concord, MA 01742-2751

Regards,

WESTON SOLUTIONS, INC.

Paul Bovitz, CPWS
Principle Project Manager

February 11, 2008

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

FEDERAL BUSINESS CENTERS, INC
300 RARITAN CENTER PKWY
EDISON, NJ 08837

Subject: **CLASSIFICATION EXCEPTION AREA**
FORMER RARITAN ARSENAL, EDISON, NEW JERSEY
BLOCK 390.E, LOT 4; 165 FIELDCREST AVE
BLOCK 395, LOT 4.B; 304 RARITAN CENTER PKWY

Dear Madam or Sir:

In accordance with the New Jersey Requirements for Site Remediation (N.J.A.C. 7:26E) a Classification Exception Area (CEA) is established in order to provide notice that the constituent standards for a given aquifer classification are not or will not be met in a localized area due to natural water quality or anthropogenic influences, and that designated aquifer uses are suspended in the affected area for the term of the CEA.

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Mr. Jim Kelly
US ARMY Corps of Engineers
New England District
696 Virginia Road
Concord, MA 01742-2751

Regards,

WESTON SOLUTIONS, INC.

Paul Bovitz, CPWS
Principle Project Manager

February 11, 2008

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

MIDDLESEX INTERFAITH PARTNERS
2800 WOODBRIDGE AVE
EDISON, NJ 08837

Subject: **CLASSIFICATION EXCEPTION AREA**
FORMER RARITAN ARSENAL, EDISON, NEW JERSEY
BLOCK 396, LOT 10; 2800 WOODBRIDGE AVE

Dear Madam or Sir:

In accordance with the New Jersey Requirements for Site Remediation (N.J.A.C. 7:26E) a Classification Exception Area (CEA) is established in order to provide notice that the constituent standards for a given aquifer classification are not or will not be met in a localized area due to natural water quality or anthropogenic influences, and that designated aquifer uses are suspended in the affected area for the term of the CEA.

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Mr. Jim Kelly
US ARMY Corps of Engineers
New England District
696 Virginia Road
Concord, MA 01742-2751

Regards,

WESTON SOLUTIONS, INC.

Paul Bovitz

Paul Bovitz, CPWS
Principle Project Manager

February 11, 2008

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

US HOME CORPORATION
800 WEST MAIN STREET
FREEHOLD, NJ 07728

Subject: **CLASSIFICATION EXCEPTION AREA**
FORMER RARITAN ARSENAL, EDISON, NEW JERSEY
BLOCK 396, LOT 7.01; WOODBRIDGE AVE

Dear Madam or Sir:

In accordance with the New Jersey Requirements for Site Remediation (N.J.A.C. 7:26E) a Classification Exception Area (CEA) is established in order to provide notice that the constituent standards for a given aquifer classification are not or will not be met in a localized area due to natural water quality or anthropogenic influences, and that designated aquifer uses are suspended in the affected area for the term of the CEA.

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US ARMY Corps of Engineers
New England District
696 Virginia Road
Concord, MA 01742-2751

Regards,

WESTON SOLUTIONS, INC.

Paul J Bovit

Paul Bovitz, CPWS
Principle Project Manager

February 11, 2008

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

COUNTY OF MIDDLESEX
PO BOX 661 (PARKS DEPT)
NEW BRUNSWICK, NJ 08903

Subject: **CLASSIFICATION EXCEPTION AREA**
FORMER RARITAN ARSENAL, EDISON, NEW JERSEY
BLOCK 395, LOT 1.B2; WOODBRIDGE AVE

Dear Madam or Sir:

In accordance with the New Jersey Requirements for Site Remediation (N.J.A.C. 7:26E) a Classification Exception Area (CEA) is established in order to provide notice that the constituent standards for a given aquifer classification are not or will not be met in a localized area due to natural water quality or anthropogenic influences, and that designated aquifer uses are suspended in the affected area for the term of the CEA.

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New England District
696 Virginia Road
Concord, MA 01742-2751

Regards,

WESTON SOLUTIONS, INC.

Paul Bovitz, CPWS
Principle Project Manager

February 11, 2008

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

110 NEWFIELD ASSOC C/O SUMMIT
RARITAN PLAZA 1
EDISON, NJ 08837

Subject: **CLASSIFICATION EXCEPTION AREA**
FORMER RARITAN ARSENAL, EDISON, NEW JERSEY
BLOCK 395, LOT 32; 110 NEWFIELD AVE

Dear Madam or Sir:

In accordance with the New Jersey Requirements for Site Remediation (N.J.A.C. 7:26E) a Classification Exception Area (CEA) is established in order to provide notice that the constituent standards for a given aquifer classification are not or will not be met in a localized area due to natural water quality or anthropogenic influences, and that designated aquifer uses are suspended in the affected area for the term of the CEA.

This letter serves to notify you that a CEA is being proposed for the area of the Former Raritan Arsenal. A map of the area is attached.

The point of contact for all questions concerning the delineation of the CEA is:

Mr. Jim Kelly
US ARMY Corps of Engineers
New England District
696 Virginia Road
Concord, MA 01742-2751

Regards,

WESTON SOLUTIONS, INC.

Paul Bovitz, CPWS
Principle Project Manager

February 11, 2008

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

NORTHFIELD NEM ASSOC C/O SUMMIT
RARITAN PLAZA 1
EDISON, NJ 08837

Subject: CLASSIFICATION EXCEPTION AREA
FORMER RARITAN ARSENAL, EDISON, NEW JERSEY
BLOCK 395, LOT 36; 45 FERNWOOD AVE
BLOCK 395, LOT 28; 450 RARITAN CENTER PKWY
BLOCK 395.A, LOT 21; 115 NEWFIELD AVFE

Dear Madam or Sir:

In accordance with the New Jersey Requirements for Site Remediation (N.J.A.C. 7:26E) a Classification Exception Area (CEA) is established in order to provide notice that the constituent standards for a given aquifer classification are not or will not be met in a localized area due to natural water quality or anthropogenic influences, and that designated aquifer uses are suspended in the affected area for the term of the CEA.

This letter serves to notify you that a CEA is being proposed for the area of the Former Raritan Arsenal. A map of the area is attached.

The point of contact for all questions concerning the delineation of the CEA is:

Mr. Jim Kelly
US ARMY Corps of Engineers
New England District
696 Virginia Road
Concord, MA 01742-2751

Regards,

WESTON SOLUTIONS, INC.

Paul Bovitz, CPWS
Principle Project Manager

February 11, 2008

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

NEW CARSUN HILLS LP C/O SUMMIT ASSOC
RARITAN PLAZA 1
EDISON, NJ 08837

Subject: **CLASSIFICATION EXCEPTION AREA**
FORMER RARITAN ARSENAL, EDISON, NEW JERSEY
BLOCK 395, LOT 35; FERNWOOD AVE BLDG 503
BLOCK 395, LOT 31.03; SUNFIELD AVE

Dear Madam or Sir:

In accordance with the New Jersey Requirements for Site Remediation (N.J.A.C. 7:26E) a Classification Exception Area (CEA) is established in order to provide notice that the constituent standards for a given aquifer classification are not or will not be met in a localized area due to natural water quality or anthropogenic influences, and that designated aquifer uses are suspended in the affected area for the term of the CEA.

This letter serves to notify you that a CEA is being proposed for the area of the Former Raritan Arsenal. A map of the area is attached.

The point of contact for all questions concerning the delineation of the CEA is:

Mr. Jim Kelly
US ARMY Corps of Engineers
New England District
696 Virginia Road
Concord, MA 01742-2751

Regards,

WESTON SOLUTIONS, INC.

Paul Bovitz, CPWS
Principle Project Manager

February 11, 2008

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

305 CLEARVIEW LTD C/O SUMMIT ASSOC
RARITAN PLAZA 1
EDISON, NJ 08837

Subject: **CLASSIFICATION EXCEPTION AREA**
FORMER RARITAN ARSENAL, EDISON, NEW JERSEY
BLOCK 395, LOT 24; 100 NEWFIELD AVE
BLOCK 395.A, LOT 17; 75 NEWFIELD AVE
BLOCK 395.A, LOT 20; 105 NEWFIELD AVE
BLOCK 395.A, LOT 19; 95 NEWFIELD AVE
BLOCK 395.A, LOT 18; NEWFIELD AVE BLDG 505
BLOCK 395.A, LOT 22; 104 SUNFIELD AVE
BLOCK 395, LOT 20; 90 NEWFIELD AVE
BLOCK 395, LOT 19; 80 NEWFIELD AVE

Dear Madam or Sir:

In accordance with the New Jersey Requirements for Site Remediation (N.J.A.C. 7:26E) a Classification Exception Area (CEA) is established in order to provide notice that the constituent standards for a given aquifer classification are not or will not be met in a localized area due to natural water quality or anthropogenic influences, and that designated aquifer uses are suspended in the affected area for the term of the CEA.

This letter serves to notify you that a CEA is being proposed for the area of the Former Raritan Arsenal. A map of the area is attached.

The point of contact for all questions concerning the delineation of the CEA is:

Mr. Jim Kelly
US ARMY Corps of Engineers
New England District
696 Virginia Road
Concord, MA 01742-2751

Regards,

WESTON SOLUTIONS, INC.

Paul J Bovitz

Paul Bovitz, CPWS
Principle Project Manager

February 11, 2008

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

NEWFIELD NEM ASSOC
RARITAN PLAZA 1
EDISON, NJ 08837

Subject: **CLASSIFICATION EXCEPTION AREA**
FORMER RARITAN ARSENAL, EDISON, NEW JERSEY
BLOCK 395, LOT 7; 70 NEWFIELD AVE

Dear Madam or Sir:

In accordance with the New Jersey Requirements for Site Remediation (N.J.A.C. 7:26E) a Classification Exception Area (CEA) is established in order to provide notice that the constituent standards for a given aquifer classification are not or will not be met in a localized area due to natural water quality or anthropogenic influences, and that designated aquifer uses are suspended in the affected area for the term of the CEA.

This letter serves to notify you that a CEA is being proposed for the area of the Former Raritan Arsenal. A map of the area is attached.

The point of contact for all questions concerning the delineation of the CEA is:

Mr. Jim Kelly
US ARMY Corps of Engineers
New England District
696 Virginia Road
Concord, MA 01742-2751

Regards,

WESTON SOLUTIONS, INC.

Paul Bovitz

Paul Bovitz, CPWS
Principle Project Manager

February 11, 2008

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

375/425 RCP ASSOC, LP C/O SUMMIT
RARITAN PLAZA 1
EDISON, NJ 08837

Subject: **CLASSIFICATION EXCEPTION AREA**
FORMER RARITAN ARSENAL, EDISON, NEW JERSEY
BLOCK 395, LOT 6; 375 RARITAN CENTER PKWY
BLOCK 395.A, LOT 24; 425 RARITAN CENTER PKWY

Dear Madam or Sir:

In accordance with the New Jersey Requirements for Site Remediation (N.J.A.C. 7:26E) a Classification Exception Area (CEA) is established in order to provide notice that the constituent standards for a given aquifer classification are not or will not be met in a localized area due to natural water quality or anthropogenic influences, and that designated aquifer uses are suspended in the affected area for the term of the CEA.

This letter serves to notify you that a CEA is being proposed for the area of the Former Raritan Arsenal. A map of the area is attached.

The point of contact for all questions concerning the delineation of the CEA is:

Mr. Jim Kelly
US ARMY Corps of Engineers
New England District
696 Virginia Road
Concord, MA 01742-2751

Regards,

WESTON SOLUTIONS, INC.

Paul Bovitz, CPWS
Principle Project Manager

February 11, 2008

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

GARDEN STATE BUILDINGS
RARITAN PLAZA 1
EDISON, NJ 08837

Subject: **CLASSIFICATION EXCEPTION AREA**
FORMER RARITAN ARSENAL, EDISON, NEW JERSEY
BLOCK 395.A, LOT 27; SUNFIELD AVE
BLOCK 395.A, LOT 26; 475 RARITAN CENTER PKWY
BLOCK 395, LOT 29; COLUMBUS CIRCLE
BLOCK 395, LOT 31.04; 87 SUNFIELD AVE
BLOCK 395, LOT 37; RARITAN RIVER

Dear Madam or Sir:

In accordance with the New Jersey Requirements for Site Remediation (N.J.A.C. 7:26E) a Classification Exception Area (CEA) is established in order to provide notice that the constituent standards for a given aquifer classification are not or will not be met in a localized area due to natural water quality or anthropogenic influences, and that designated aquifer uses are suspended in the affected area for the term of the CEA.

This letter serves to notify you that a CEA is being proposed for the area of the Former Raritan Arsenal. A map of the area is attached.

The point of contact for all questions concerning the delineation of the CEA is:

Mr. Jim Kelly
US ARMY Corps of Engineers
New England District
696 Virginia Road
Concord, MA 01742-2751

Regards,

WESTON SOLUTIONS, INC.

Paul J Bovitz

Paul Bovitz, CPWS
Principle Project Manager

February 11, 2008

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

350 RCP ASSOC C/O SUMMIT ASSOC
RARITAN PLAZA 1
EDISON, NJ 08837

Subject: **CLASSIFICATION EXCEPTION AREA**
FORMER RARITAN ARSENAL, EDISON, NEW JERSEY
BLOCK 395, LOT 4.C8; 350 RARITAN CENTER PKWY

Dear Madam or Sir:

In accordance with the New Jersey Requirements for Site Remediation (N.J.A.C. 7:26E) a Classification Exception Area (CEA) is established in order to provide notice that the constituent standards for a given aquifer classification are not or will not be met in a localized area due to natural water quality or anthropogenic influences, and that designated aquifer uses are suspended in the affected area for the term of the CEA.

This letter serves to notify you that a CEA is being proposed for the area of the Former Raritan Arsenal. A map of the area is attached.

The point of contact for all questions concerning the delineation of the CEA is:

Mr. Jim Kelly
US ARMY Corps of Engineers
New England District
696 Virginia Road
Concord, MA 01742-2751

Regards,

WESTON SOLUTIONS, INC.

Paul J Bovitz

Paul Bovitz, CPWS
Principle Project Manager

February 11, 2008

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

523 RCP ASSOC
RARITAN PLAZA 1
EDISON, NJ 08837

Subject: **CLASSIFICATION EXCEPTION AREA**
FORMER RARITAN ARSENAL, EDISON, NEW JERSEY
BLOCK 395, LOT 30; 5 SUNFIELD AVE

Dear Madam or Sir:

In accordance with the New Jersey Requirements for Site Remediation (N.J.A.C. 7:26E) a Classification Exception Area (CEA) is established in order to provide notice that the constituent standards for a given aquifer classification are not or will not be met in a localized area due to natural water quality or anthropogenic influences, and that designated aquifer uses are suspended in the affected area for the term of the CEA.

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The point of contact for all questions concerning the delineation of the CEA is:

Mr. Jim Kelly
US ARMY Corps of Engineers
New England District
696 Virginia Road
Concord, MA 01742-2751

Regards,

WESTON SOLUTIONS, INC.

Paul Bovitz, CPWS
Principle Project Manager

February 11, 2008

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

S/K CENTER PARKWAY ASSOCIATES
981 ROUTE 22 PO BOX 6872
BRIDGEWATER, NJ 08807

Subject: **CLASSIFICATION EXCEPTION AREA**
FORMER RARITAN ARSENAL, EDISON, NEW JERSEY
BLOCK 395, LOT 5; 551 RARITAN CENTER PKWY

Dear Madam or Sir:

In accordance with the New Jersey Requirements for Site Remediation (N.J.A.C. 7:26E) a Classification Exception Area (CEA) is established in order to provide notice that the constituent standards for a given aquifer classification are not or will not be met in a localized area due to natural water quality or anthropogenic influences, and that designated aquifer uses are suspended in the affected area for the term of the CEA.

This letter serves to notify you that a CEA is being proposed for the area of the Former Raritan Arsenal. A map of the area is attached.

The point of contact for all questions concerning the delineation of the CEA is:

Mr. Jim Kelly
US ARMY Corps of Engineers
New England District
696 Virginia Road
Concord, MA 01742-2751

Regards,

WESTON SOLUTIONS, INC.

Paul Bovitz, CPWS
Principle Project Manager

February 11, 2008

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

FIRST INDUSTRIAL, LP
43 RT 46 EAST BOX 600
PINE BROOK, NJ 07058

Subject: **CLASSIFICATION EXCEPTION AREA**
FORMER RARITAN ARSENAL, EDISON, NEW JERSEY
BLOCK 395, LOT 4.C20; 400 RARITAN CENTER PKWY
BLOCK 395, LOT 4.C21; 300 COLUMBUS CIRCLE

Dear Madam or Sir:

In accordance with the New Jersey Requirements for Site Remediation (N.J.A.C. 7:26E) a Classification Exception Area (CEA) is established in order to provide notice that the constituent standards for a given aquifer classification are not or will not be met in a localized area due to natural water quality or anthropogenic influences, and that designated aquifer uses are suspended in the affected area for the term of the CEA.

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The point of contact for all questions concerning the delineation of the CEA is:

Mr. Jim Kelly
US ARMY Corps of Engineers
New England District
696 Virginia Road
Concord, MA 01742-2751

Regards,

WESTON SOLUTIONS, INC.

Paul Bovitz, CPWS
Principle Project Manager

7007 2560 0000 0855 8476

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City, State, ZIP+4 EDISON, NJ 08837

PS Form 3800, August 2006 See Reverse for Instructions

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RARITAN PLAZA 1
City, State, ZIP+4 ~~EDISON, NJ 08837~~

PS Form 3800, August 2006 See Reverse for Instructio

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BUSINESS REALTY MGMT
City, State, ZIP+4 2 ETHEL RD STE 202A
EDISON, NJ 08817

PS Form 3800, August 2006 See Reverse for Instructions

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Street, Apt. No.; or PO Box No. FEDERAL BUSINESS CENTERS, INC
300 RARITAN CENTER PKWY
City, State, ZIP+4 EDISON, NJ 08837

PS Form 3800, August 2006 See Reverse for Instruction

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City, State, ZIP+4 EDISON, NJ 08837

PS Form 3800, August 2006 See Reverse for Instructions

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Sent To
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RARITAN PLAZA 1
City, State, ZIP+4 EDISON, NJ 08837

PS Form 3800, August 2006 See Reverse for Instruction

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RARITAN CENTER STATION
FEB 11 2008

Sent To

Street, Apt. No.; or PO Box No.
City, State, ZIP+4
New Jersey Bureau of Safe Drinking Water
401 East State Street
Box 426
Trenton, NJ 08625

PS Form 3800, August 2006 — See Reverse for Instructions

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RARITAN CENTER STATION
FEB 11 2008

Sent To

Street, Apt. No.; or PO Box No.
City, State, ZIP+4
S/K CENTER PARKWAY ASSOCIATES
981 ROUTE 22 PO BOX 6872
BRIDGEWATER, NJ 08807

PS Form 3800, August 2006 — See Reverse for Instructio

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RARITAN CENTER STATION
FEB 11 2008

Sent To

Street, Apt. No.; or PO Box No.
City, State, ZIP+4
Mr. Dennis Pipala
Edison Planning Board
100 Municipal Boulevard
Edison, NJ 08817

PS Form 3800, August 2006 — See Reverse for Instructions

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City, State, ZIP+4
US HOME CORPORATION
800 WEST MAIN STREET
FREEHOLD, NJ 07728

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RARITAN CENTER STATION
FEB 11 2008

Sent To

Street, Apt. No.; or PO Box No.
City, State, ZIP+4
Ms. Diane Zalaskus
New Jersey Bureau of Water Allocation
401 East State Street
Box 426
Trenton, NJ 08625

PS Form 3800, August 2006 — See Reverse for Instructions

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RARITAN CENTER STATION
FEB 11 2008

Sent To

Street, Apt. No.; or PO Box No.
City, State, ZIP+4
Ms. Elaine M. Flynn
County Clerk
Middlesex County Administration Building
75 Bayard Street, PO Box 1110
New Brunswick, NJ 08901

PS Form 3800, August 2006 — See Reverse for Instruction

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FEB 11 2008

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Mr. David Papi
Street, Apt. No.; or PO Box No.
Department of Public Health
Middlesex County Administration Building
City, State, ZIP+4
5th Floor, John F Kennedy Square
New Brunswick, NJ 08901

PS Form 3800, August 2006 See Reverse for Instructions

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RARITAN CENTER STATION
FEB 11 2008

Sent To
Street, Apt. No.; or PO Box No.
Ms. Reina Murphy
Municipal Clerk
City, State, ZIP+4
100 Municipal Boulevard
Edison, NJ 08817

PS Form 3800, August 2006 See Reverse for Instructio

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RARITAN CENTER STATION
FEB 11 2008

Sent To
Street, Apt. No.; or PO Box No.
Ms. Christine Fontecchio
New Jersey Department of Health
City, State, ZIP+4
3635 Quakerbridge Road
Trenton, NJ 08625

PS Form 3800, August 2006 See Reverse for Instructions

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RARITAN CENTER STATION
FEB 11 2008

Sent To
Street, Apt. No.; or PO Box No.
Mr. John Grunn
Edison Health Department
City, State, ZIP+4
100 Municipal Boulevard
Edison, NJ 08817

PS Form 3800, August 2006 See Reverse for Instructio

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RARITAN CENTER STATION
FEB 11 2008

Sent To
Street, Apt. No.; or PO Box No.
NEW CARSUN HILLS LP C/O SUMMIT
ASSOC
City, State, ZIP+4
RARITAN PLAZA 1
EDISON, NJ 08837

PS Form 3800, August 2006 See Reverse for Instructions

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US GOV'T EPA REGION II
WOODBRIDGE AVE BLDG 209
City, State, ZIP+4
EDISON, NJ 08837

PS Form 3800, August 2006 See Reverse for Instructio

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Sent To
Street, Apt. No.; or PO Box No. FIRST INDUSTRIAL, LP
43 RT 46 EAST BOX 600
City, State, ZIP+4 PINE BROOK, NJ 07058

PS Form 3800, August 2006 See Reverse for Instructions

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Sent To
Street, Apt. No.; or PO Box No. COUNTY OF MIDDLESEX
PO BOX 661 (PARKS DEPT)
City, State, ZIP+4 NEW BRUNSWICK, NJ 08903

PS Form 3800, August 2006 See Reverse for Instructio

7007 2560 0000 0855 8469

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APPENDIX G

New Jersey Department of Environmental Protection

Biennial Certification Monitoring Report for a Ground Water Classification Exception Area (CEA)

I. Site Background Information

A. Facility Name and Location:

Site Name at the time the CEA was issued:
Current Site/Property Name *(if different than above):*
Site/Property Street Address:
Municipality (-ies): County (ies):
Blocks (Impacted On-Site): Lots (Impacted On-Site):
Blocks (Impacted Off-Site): Lots (Impacted Off-Site):
Year of Tax map from which this information is obtained:

B. Person Submitting Biennial Certification for the CEA:

Person Responsible (Name of Individual or Legal Entity):
Name of Business responsible for submitting this report:
Relationship to the Site (check as appropriate): Owner ☐, Operator ☐, Lessee ☐, Person Conducting Cleanup ☐, Other ☐(describe)
Street Address:
City: State: Zip:
Telephone Number:
FAX Number:
E-mail Address:

C. All Current Owner, Lessee(s) and Operator(s)

Owner
Contact Person Name:
Contact Person Affiliation:
Business Name:
Street Address:
City: State: Zip:
Telephone Number:
FAX Number:
E-mail Address:

Lessee(s)
Contact Person Name:
Contact Person Affiliation:
Business Name:
Street Address:
City: State: Zip:

Telephone Number:
FAX Number:
E-mail Address:

Operator(s)
Contact Person Name:
Contact Person Affiliation:
Business Name:
Street Address:
City: State: Zip:
Telephone Number:
FAX Number:
E-mail Address:

D. Case Specific Information (Complete all that apply)

- Program Interest Name:
- Program Interest Number:
- Known Contaminant Site List (KCSL) Number (if available):
- Incident Report Number (10 or 12 Digit Case Number):
- Industrial Site Recovery Act Number:
- UST Registration Number (7 digits):
- Date Department approved CEA:
- Name and Bureau of assigned Case Manager at the time the CEA was issued:

E. Existing Site Conditions

- Describe the physical characteristics of the site

- Describe the current site operations

- Describe each remedial action that included the CEA. Please check and describe, as required, the appropriate selection below.

☐ Natural Attenuation
☐ Other (please describe below)

II. CEA Protectiveness Evaluation

A. Inspection and Evaluation of the CEA

(The appropriate box on the left must be checked for each of the following items.)

1. Changes to Laws and Regulations

a. Are there any subsequently promulgated or modified laws or regulations, which apply to the remedial action, which includes the CEA? **Complete Columns 1 and 2 of Attachment 1: Comparison of Applicable Laws and Regulations.**

Yes ☐ No ☐ (If No, proceed to #2 below)

If Yes, complete **Column 3 of Attachment 1: Comparison of Applicable Laws and Regulations** providing the actions taken to demonstrate how the remedial action, which includes the CEA, conforms to current statutes and regulations.

2. Evaluation of Future Water Uses

a. Are there any planned changes within the 25-year water use planning horizon for the aquifer(s), in which the CEA is located, since the Department established the CEA or the last completed biennial review, whichever is more recent? Ensure that all sources in **Attachment 2: Results of the 25-Year Water Use Planning Review** have been reviewed and are checked off.

Yes ☐ No ☐ (If No, proceed to #3)

If **Yes,** provide details of the changes in **Attachment 2: Results of the 25-Year Water Use Planning Review.**

b. Will any of the proposed changes in the ground water use, identified above, possibly influence the protectiveness of the remedial action that includes the ground water CEA?

Yes ☐ No ☐ (If No, proceed to #3)

Provide explanations in **Attachment 2: Results of the 25-Year Water Use Planning Review.**

c. Is there a need to reevaluate the fate and transport of the ground water contamination plume and to revise the CEA to ensure that the remedial action remains protective of the public health and safety and the environment?

Yes ☐ No ☐ (If No, proceed to #3)

If **Yes**, provide a brief explanation below and attach the revised CEA model prepared in accordance with N.J.A.C. 7:26E-8.6(b) 10. Provide calculations and a scaled map including delineation of the plume extent and all Blocks and Lots that are within the extent of the CEA and include this in **Attachment 3: Revised CEA.**

3. Well Search

a. Have there have been any actual changes in ground water use, pursuant to N.J.A.C. 7:26E-8.6(a) 3., since the Department established the ground water CEA or the last completed biennial review, whichever is more recent? Provide results of well searches in **Attachment 4: Well Search**

Yes ☐ No ☐ (If No, proceed to #4 below)

b. Have any of the actual changes in the ground water use, identified above, influenced or may influence the protectiveness of the remedial action that includes the ground water CEA?

Yes ☐ No ☐ (If No, proceed to #4 below)

If **Yes**, provide explanations in **Attachment 4: Well Search.**

4. Ground Water Monitoring Wells associated with the CEA

a. During inspections was the physical integrity of each well acceptable and the security measures adequate as documented in an inspection log? Include the inspection logs in **Attachment 5: Maintenance Records for Monitoring Wells.**

Yes ☐ No ☐ (If Yes, proceed to #5 below)

If No, describe the associated problem(s) and how each of the situations was corrected.

b. Include in **Attachment 6: Well Abandonment Forms** copies of the well abandonment forms for all monitoring well(s) used to establish the ground water CEA that have been decommissioned since the previously submitted biennial certification or establishment of the CEA, whichever is later.

5. Land Use Disturbance

a. Has there been any land use disturbance, such as the installation of a detention basin, that intercepted the water table within the area of the ground water CEA?

Yes ☐ No ☐ (If No, proceed to #6 below)

If **Yes**, present the data and evaluation required in accordance with N.J.A.C. 7:26E-8.6(a) 5 and 8.6(b) 7. Present the sampling results, and the associated reduced laboratory data deliverables Quality Assurance/Quality Control (QA/QC) package as per N.J.A.C. 7:26E-2.1 (a) 13ii. and evaluation in **Attachment 7: Results of Land Use Disturbance Analysis**.

6.CEA Status (check the appropriate box below)

Present the sampling results, the associated reduced laboratory data deliverables Quality Assurance/Quality Control package pursuant to N.J.A.C. 7:26E-2.1 (a) 13ii and evaluation in **Attachment 8: Results of Ground Water Analysis** for the appropriate situation, as necessary.

☐ The currently effective termination date of the CEA has not passed and no ground water sampling has been conducted.

☐ The currently effective termination date of the CEA has passed and the required ground water samples were collected and evaluated in accordance with N.J.A.C. 7:26E-8.6(a) 7ii, or reference 8.6(a) 8. Do the sampling results confirm that the contaminant concentrations are at or below the applicable Ground Water Quality Standards throughout the entire ground water CEA?

Yes ☐ No ☐ If **<u>Yes</u>** provide the results of the analysis in **Attachment 8: Results of Ground Water Analysis** and then proceed to III. Certification, below.

If **<u>No</u>**, present the data, an explanation of why ground water contamination is still present and a re-evaluation of the ground water quality standards pursuant to N.J.A.C. 7:26E-8.3(b), 8.6(b) 10 and 8.6(b) 13. Present this information in **Attachment 8: Results of Ground Water Analysis**

☐ The currently effective termination date of the CEA has not passed, however ground water samples have been voluntarily collected and evaluated in accordance with N.J.A.C. 7:26E-8.6(a) 7ii or 8.6(a) 6ii.

III. Certification

A. Certification, Copying and Reporting Requirement

Provide both a paper and an electronic copy of this certification, in accordance with N.J.A.C. 7:26E-8.6(c)2, to the following people. Provide documentation in **Attachment 9 Name and Address Copy List** confirming that each of the following groups of people received a copy of the Certification:

1. The municipal and county clerks for each municipality and county in which any real property overlying the CEA is located;
2. The local, county and regional health department for each municipality and county in which any real property overlying the CEA is located;
3. Each owner of the real property which is overlying the CEA; and
4. Each current operator at the real property which is overlying the CEA.

B. Person Responsible for the Biennial Certification: *(The following certification shall be signed according to N.J.A.C. 7:26E-1.5, N.J.A.C. 7:26C-1.2 and the covenant not to sue (if issued) as follows:*

1. For a Limited Liability Company a member of the Limited Liability Company; or
2. For a Corporation by a person authorized by a resolution of the board of directors to sign the document. A copy of the resolution, certified as a true copy by the secretary of the corporation, shall be submitted along with the certification; or
3. For a partnership or sole proprietorship, by a general partner or the proprietor, respectively; or
4. For a municipality, State, federal or other public agency by either a principal executive officer or ranking elected Official.

> "I certify under penalty of law that I have personally examined and am familiar with the information submitted herein and all attached documents, and that based on my inquiry of those individuals immediately responsible for obtaining the information, to the best of my knowledge I believe that the submitted information is true, accurate, and complete. I am aware that there are significant civil penalties for knowingly submitting false, inaccurate, or incomplete information and that I am committing a crime of the fourth degree if I make a written false statement, which I do not believe to be true. I am also aware that if I knowingly direct or authorize the violation of any statute, I am personally liable for the penalties."

I also understand that in order to maintain the benefits of the Covenant Not to Sue, the engineering and institutional controls (as applicable) must be evaluated and maintained to remain protective of public health and safety and of the environment.

Based upon all of the information that I have provided above, I hereby certify that the remedial action(s) for which this Classification Exception Area was established remain protective of public health and safety and of the environment.

Name (print or type): ______________________________
Title: ______________________________

Signature: ______________________________
Name of Limited Liability Company, Corporation or General or Limited
Partnership: ______________________________
Date: ______________________________

Sworn to & Subscribed before me

On this ____________ Day of ________ 20 _______

____
Notary

Attachments to the CEA Biennial Certification

Attachment 1: Comparison of Applicable Laws and Regulations

Evaluation of Laws and Regulations must include, but is not limited to the following list. These Statutes and Regulations can be found at the following web sites http://www.njleg.state.nj.us/ or http://www.state.nj.us/dep/legal/nj_env_law.htm.

List all statutes and regulations that are applicable.	Subsequent changes that apply to the CEA	Actions taken to conform the CEA with current statutes and regulations
Spill Compensation Control Act, N.J.S.A. 58:10-23.11 et seq. **Brownfields and Contaminated Site Remediation Act, N.J.S.A. 58:10B-1 et seq.** **Water Pollution Control Act, N.J.S.A. 58:10A-1, et seq.** **Technical Requirements for Site Remediation, N.J.A.C. 7:26E** **Procedures for Department Oversight of the Remediation of Contaminated Sites, N.J.A.C. 7:26C** **Underground Storage Tank Regulations, N.J.A.C. 7:14B** **Industrial Site Recovery Act Regulations, N.J.A.C. 7:26B** ***Others (Specify)***		

Attachment 2: Evaluation of Future Water Uses (Results of the 25-Year Water Use Planning Review)

All plans, records and other relevant information shall be obtained from the following sources, without limitation. Please check the following boxes to confirm that the following sources were evaluated.

☐ i. The New Jersey Water Master Plan;
☐ ii. Department of Environmental Protection, Bureau of Water Allocation
☐ iii. Municipal master plans;
☐ iv. Zoning Plans;
☐ v. Local water purveyor plans and planning data pertaining to the existence of water lines and proposed future installation of water lines;
☐ vi. Local Planning Officials;
☐ vii. Local and county ordinances restricting installation of potable wells; and
☐ viii. County and local boards of health

a. Changes within the 25-year water use planning horizon (as appropriate):

b. Determination of actual or proposed changes in the ground water use above have influenced or may influence the protectiveness of the remedial action that includes the ground water CEA (as appropriate):

Attachment 3: **Revised CEA**

Attachment 4: **Well Search**

Attachment 5: **Maintenance Records for Monitoring Wells**

☐ No monitoring wells, associated with this site, are present.
☐ Monitoring wells and records, associated with this site, are enclosed.

Attachment 6 **Well Abandonment Forms**

☐ No Well Abandonment Forms required at this time
☐ Well Abandonment Forms enclosed

Attachment 7 **Results of Land Use Disturbance**

Attachment 8 **Results of Ground Water Analysis**

Attachment 9 **Name and Address Copy List**

TABLE 3-2
SAMPLE CONTAINER AND PRESERVATION REQUIREMENTS FOR WATER

PARAMETERS	SAMPLE VOLUME REQUIRED	CONTAINER[(1)]	PRESERVATION
TCL VOC	40 mL	3-40 ml vials with septum cap; no headspace	HCL to pH <2, Cool 4°C
SGWS VOC [(2)]	40 mL	3-40 ml vials with septum cap; no headspace	HCL to pH <2, Cool 4°C
TCL SVOC/PAH	1 L	2-1000 ml amber glass	Cool 4°C
TCL Pesticides/PCBs	1 L	2-1000 ml amber glass	Cool 4°C
Metals – Total	300 mL	1-1000 ml poly.	HNO_3 to pH <2, Cool 4°C
pH	--	1-100 ml poly.	Cool 4°C
Explosives	770 mL	1-950 ml amber glass	Cool 4°C
Mustard Breakdown Product - Thiodiglycol	500ml	1-1000ml amber glass	Cool 4°C
TDS	100 mL	1-500 ml poly	Cool 4°C
Hardness	50 mL	1-500 ml poly	HNO_3 to pH <2, Cool to 4°C
Total Chloride/Sulfate	50 mL	1-500 ml poly	Cool 4°C
Sulfide	500 mL	1-500 ml poly	NaOH/Zn Acetate Cool to 4^o C
CO_2	100 mL	1-250 ml amber glass (no headspace)	Cool to 4^o C
Phosphate	50 mL	1-500 ml poly	H_2SO_4 to pH<2, Cool to 4^o C
Nitrate	100mL	1-500 ml poly	Cool to 4^o C
Ammonia	500mL	1-500 ml poly	H_2SO_4 to pH<2, Cool to 4^o C
Methane (with Ethane/Ethene)	100mL	3-40ml vials w/ septum (no headspace)	H_2SO_4 to pH<2, Cool to 4^o C
Alkalinity	100 mL	1-500 mL poly	Cool to 4°C
TOC	25 mL	1-250 mL amber glass	H_2SO_4 to pH <2, Cool 4°C
BOD	1000 mL	1–1000 mL poly	Cool to 4°C
Ferrous Iron	50 mL	1-250 mL amber glass	2 mL conc. HCl/100 mL; no exposure to sunlight
Oil & Grease	1 L	1-1000 ml amber glass	H_2SO_4 to pH <2, Cool 4°C
TRPH	1 L	1-1000 ml amber glass	H_2SO_4 to pH <2, Cool 4°C
Cyanide	500 mL	1-liter poly	NaOH to pH >12, Cool 4°C

NOTES:

(1) Triplicate volumes are required for samples selected for lab QC.

(2) GC methods proposed for SGWS for quick turnaround, low detection limit screening data only.

Reference: SW-846, Third Edition, USEPA; MCAWW; and Standard Methods

TABLE 3-6
ANALYTICAL METHODS FOR WATER

PARAMETERS	PREPARATION METHOD	CLEANUP METHOD	ANALYSIS METHOD	HOLDING TIMES[(1)] (Preparation/Analysis)
VOC	5030	--	8260	14 days (7 days if unpreserved)
SVOC/PAH	3520 or 3510	--	8270	7 days/ 40 days extraction to analysis
PESTICIDES	3520 or 3510	3620[(2)]	8081	7 days/ 40 days extraction to analysis
PCBs	3520 or 3510	3665[(4)]	8082	7 days/ 40 days extraction to analysis
HERBICIDES	-----	-----	8151	7 days/ 40 days extraction to analysis
PP/TAL METALS - TOTAL	3010/3020 [(3)]	--	6010 (7470 for Hg) [(3)]	Hg: 28 days; others: 6 months
pH	--	--	9040	Immediately
EXPLOSIVES	--	--	8330	7 days/ 40 days extraction to analysis
CYANIDE	9010	--	9012	14 days
MUSTARD BREAKDOWN PRODUCT - THIODIGYLCOL	--	--	UW22/LW18 (Mod)	14 days
OIL AND GREASE	--	--	413.1	28 days
HARDNESS	--	--	130.2	6 months
TRPH	--	--	418.1	28 days
TDS	--	--	160.1	7 days
CHLORIDE	--	--	325.3	28 days
ALKALINITY	--	--	310.1	14 days
PHOSPHATE	--	--	365.3	28 days
NITRATE	--	--	353.2	48 hours
AMMONIA	--	--	350.3	28 days
SULFATE	--	--	375.4	28 days
TOC	--	--	415.1	28 days
SULFIDE	--	--	376.1	7 days
BOD_5	--	--	405.1	48 hours
CO_2	--	--	4500-CO_2D	Immediately
FERROUS FE	--	--	3500-FeD	Immediately
METHANE (with ETHANE/ETHENE)	--	--	3810	14 days

NOTES:

(1) Holding times are based on collection dates unless otherwise specified.
(2) Optional Florisil cleanup.
(3) All metals except mercury (7470) will be analyzed by trace ICP Method 6010. Graphite furnace will be used by a NJDEP and USACE certified laboratory for the following analytes if the reporting limits cannot not be met: As – 7060, Pb – 7421, Se - 7740, Tl – 7841, Cd – 7131, Sb - 7041. If graphite furnace is to be used, method 3020 will be used for sample digestion.
(4) Sulfuric acid cleanup is mandatory

Reference: SW-846, Third Edition, U.S. EPA; MCAWW; and Standard Methods.

TABLE 4-1
VOLATILE ORGANIC COMPOUNDS
REGULATORY REQUIREMENTS FOR WATER AND SOIL

Analytes	NJDEP GWQS (µg/L)	NJDEP FW-2 Standard (µg/L)	NJDEP Soil Criteria(1) (mg/kg)	Freshwater Sediment Screening Guidelines(6) LEL (mg/kg)	Marine/Estuarine Screening Guidelines(7) ER-L (mg/kg)
Chloromethane	30	NSA	10	NSA	NSA
Bromomethane	10	48.4(h)	1	NSA	NSA
Vinyl Chloride	5	0.0830(hc)	10	NSA	NSA
Chloroethane	NSA	NSA	NSA	NSA	NSA
Methylene Chloride	3(3)	2.49(hc)	1(4)	NSA	NSA
Acetone	700	NSA	100	NSA	NSA
Carbon Disulfide	NSA	NSA	NSA	NSA	NSA
1,1-Dichloroethene	2	4.81(hc)	10	NSA	NSA
1,1-Dichloroethane	50(3)	NSA	10(4)	NSA	NSA
cis-1,2-Dichloroethene	70(3)	NSA	1(4)	NSA	NSA
trans-1,2-dichloroethene	100(3)	592(h)	50(4)	NSA	NSA
Chloroform	6	5.67(hc)	1	NSA	NSA
1,2-Dichloroethane	2	0.291(hc)	1	NSA	NSA
2-Butanone	300	NSA	50	NSA	NSA
1,1,1-Trichloroethane	30	127(h)	50(4)	NSA	NSA
Carbon Tetrachloride	2	0.363(hc)	1	NSA	NSA
Bromodichloromethane	1	0.266(hc)	1	NSA	NSA
1,2-Dichloropropane	1	NSA	43(2)	NSA	NSA
cis-1,3-Dichloropropene	NSA	0.193(hc)*	1(5)	NSA	NSA
Trichloroethene	1	1.09(hc)	1	NSA	NSA
Dibromochloromethane	10	72.6(h)	1	NSA	NSA
1,1,2-Trichloroethane	3	13.5(h)	1(4)	NSA	NSA
Benzene	1	0.150(hc)	1	NSA	NSA
trans-1,3-Dichloropropene	NSA	0.193(hc)*	1(5)	NSA	NSA
Bromoform	4	4.38(hc)	1	NSA	NSA
4-Methyl-2-pentanone	400	NSA	50	NSA	NSA
2-Hexanone	NSA	NSA	NSA	NSA	NSA
Tetrachloroethene	1	0.388(hc)	1	NSA	NSA
Toluene	1000	7440(h)	500	NSA	NSA
1,1,2,2-Tetrachloroethane	1(3)	1.72(hcc)	1(4)	NSA	NSA
Chlorobenzene	50(3)	22.0(hc)	1(4)	NSA	NSA
Ethyl Benzene	700	3030(h)	100	NSA	NSA
Styrene	100	NSA	97	NSA	NSA
Xylenes (total)	1000(3)	NSA	10(4)	NSA	NSA

See next page for notes.

TABLE 4-1 (continued)
VOLATILE ORGANIC COMPOUNDS
REGULATORY REQUIREMENTS FOR WATER AND SOIL

NOTES:

NSA - No Standard Available
GWQS - Groundwater Quality Standard
LEL – Lowest Effects Levels
ER-L – Effects Range-Low

(1) More stringent of NRDCSCC or IGWSCC (February 1994).
(2) NSA for IGWSCC. The reported criteria are NRDCSCC.
(3) February 1997 Interim Specific Groundwater Criteria.
(4) New IGWSCC are being developed by NJDEP and will likely be higher than the February 1994 criteria.
(5) Criteria is for total (cis and trans).
(6) Table 1, "Guidance For Sediment Quality Evaluations", NJDEP November 1998. Guidelines are based on dry-weight.
(7) Table 2, "Guidance For Sediment Quality Evaluations", NJDEP November 1998. Guidelines are based on dry-weight.
(h) Noncarcinogenic effect-based human health criteria as a 30-day average with no frequency of exceedance at or above the design flows specified in section N.J.A.C. 7:9B-1.5(c)2.
(hc) Carcinogenic effect-based human health criteria as a 70-year average with no frequency of exceedance at or above the design flows specified in section N.J.A.C. 7:9B-1.5(c)2 and are based on a risk level of one-in-one-million.
(hcc) Toxic substances considered to be possible human carcinogens as a 70-year average with no frequency of exceedance at or above the design flows specified in section N.J.A.C. 7:9B-1.5(c)2 and are based on a risk of one-in-one hundred thousand.

TABLE 4-5
EXPLOSIVES COMPOUNDS
REGULATORY REQUIREMENTS FOR WATER AND SOIL

ANALYTE	NJDEP GWQS (μg/L)	NJDEP FW-2 Standard (μg/L)	NJDEP Soil Criteria(1) (mg/Kg)	Freshwater Sediment Screening Guidelines(4) LEL (mg/kg)	Marine/Estuarine Sediment Screening Guidelines(5) ER-L (mg/kg)
HMX	NSA	NSA	NSA	NSA	NSA
RDX	NSA	NSA	NSA	NSA	NSA
1,3,5-TNB	NSA	NSA	NSA	NSA	NSA
1,3-DNB	NSA	2620(h)	NSA	NSA	NSA
Tetryl	NSA	NSA	NSA	NSA	NSA
NB	10	16.0(h)	10	NSA	NSA
2,4,6-TNT	0.4	NSA	10(2)	NSA	NSA
2,6-DNT(3)	10(3)	NSA	4(3)	NSA	NSA
2,4-DNT(3)	10(3)	0.11(h)	4(3)	NSA	NSA
2-Amino-4,6-DNT(2)	0.4(2)	NSA	10(2)	NSA	NSA
4-Amino-2,6-DNT(2)	0.4(2)	NSA	10(2)	NSA	NSA
NG	NSA	NSA	NSA	NSA	NSA
PETN	NSA	NSA	NSA	NSA	NSA

NOTES:

LEL – Lowest Effects Levels
ER-L – Effects Range-Low
(1) More stringent of NRDCSCC or IGWSCC (February 1994).
(2) 2,4,6-TNT and Amino-DNT soil criteria are NJDEP site-specific interim criteria. Draft GWQS for Amino-DNTs is being evaluted by NJDEP and may change.
(3) 2,4-DNT and 2,6-DNT co-elute; criteria is for 2,4-DNT/2,6-DNT mixture.
(4) Table 1, "Guidance For Sediment Quality Evaluations", NJDEP November 1998. Guidelines are based on dry-weight.
(5) Table 2, "Guidance For Sediment Quality Evaluations", NJDEP November 1998. Guidelines are based on dry-weight.
(h) Noncarcinogenic effect-based human health criteria as a 30-day average with no frequency of exceedance at or above the design flows specified in section N.J.A.C. 7:9B-1.5(c)2.

TABLE 4-9
MATRIX SPIKE/MATRIX SPIKE DUPLICATE OBJECTIVES ORGANIC COMPOUNDS

Fraction	Matrix Spike Compound(1)	Percent Recovery Limits(2)		Percent RPD Limits(2)	
		Water	Soil/ Sediment/Tissue	Water	Soil/ Sediment/Tissue
VOA	1,1-Dichloroethene	70-130	70-130	30	50
VOA	Trichloroethene	70-130	70-130	30	50
VOA	Chlorobenzene	70-130	70-130	30	50
VOA	Toluene	70-130	70-130	30	50
VOA	Benzene	70-130	70-130	30	50
BN	1,2,4-Trichlorobenzene	45-135	51-120	50	60
BN	Acenaphthene	45-135	46-135	50	60
BN	2,4-Dinitrotoluene	45-135	38-137	50	60
BN	Pyrene	45-135	24-144	50	60
BN	N-nitroso-di-N-propylamine	45-135	20-150	50	60
BN	1,4-Dichlorobenzene	45-135	25-122	50	60
ACID	Pentachlorophenol	45-135	45-135	50	60
ACID	Phenol	45-135	45-135	50	60
ACID	2-Chlorophenol	45-135	45-135	50	60
ACID	4-Chloro-3-methylphenol	45-135	45-135	50	60
ACID	4-Nitrophenol	45-135	45-135	50	60
PEST	Lindane	40-140	40-140	50	50
PEST	Heptachlor	40-140	40-140	50	50
PEST	Aldrin	40-140	40-140	50	50
PEST	Dieldrin	40-140	40-140	50	50
PEST	Endrin	40-140	40-140	50	50
PEST	4,4-DDT	40-140	40-140	50	50
PCB	Aroclor 1016	40-140	40-140	50	50
	Aroclor 1260	40-140	40-140	50	50

TABLE 4-9 (CONTINUED)
MATRIX SPIKE/MATRIX SPIKE DUPLICATE OBJECTIVESORGANIC COMPOUNDS

Fraction	**Matrix Spike Compound**[1]	**Percent Recovery Limits**[2]		**Percent RPD Limits**[2]	
		Water	**Soil/ Sediment/Tissue**	**Water**	**Soil/ Sediment/Sediment**
EXPLOSIVES	1,3,5-Trinitrobenzene	50-140	50-140	50	50
EXPLOSIVES	1,3-Dinitrobenzene	50-140	50-140	50	50
EXPLOSIVES	2,4,6-Trinitrotoluene	50-140	50-140	50	50
EXPLOSIVES	2,4-Dinitrotoluene*	50-140	50-140	50	50
EXPLOSIVES	2,6-Dinitrotoluene*	50-140	50-140	50	50
EXPLOSIVES	2-amino-4,6-Dinitrotoluene	50-140	50-140	50	50
EXPLOSIVES	4-amino-2,6-Dinitrotoluene	50-140	50-140	50	50
EXPLOSIVES	HMX	50-140	50-140	50	50
EXPLOSIVES	Nitrobenzene	50-140	50-140	50	50
EXPLOSIVES	RDX	50-140	50-140	50	50
EXPLOSIVES	Tetryl	45-140	45-140	50	50
HPLC	Thiodiglycol	50-140	50-140	50	50
	Nitroglycerine	50-140	50-140	50	50
	PETN	50-140	50-140	50	50

NOTE:

RPD – Relative Percent Difference

(1) Compound to be spiked may be project-specific. These are commonly spiked compounds.

(2) The control limits may be established by individual laboratories and may be different from limits provided in this table.

* 2,4-DNT and 2,6-DNT co-elute; control limits are for 2,4-DNT/2,6-DNT mixture.

TABLE 4-10
QC OBJECTIVES FOR ACCURACY IN LCS
ORGANIC COMPOUNDS

Fraction	Spiked Compounds[1]	Water Limits (% Recovery)[2]	Solid Limits (% Recovery)[2]
VOA	Vinyl Chloride	80-120	75-125
	1,1-Dichloroethene	80-120	75-125
	1,1-Dichloroethane	80-120	75-125
	Chloroform	80-120	75-125
	1,2-Dichloroethane	80-120	75-125
	1,1,1-Trichloroethane	80-120	75-125
	Trichloroethene	80-120	75-125
	Benzene	80-120	75-125
	Tetrachloroethene	80-120	75-125
	chlorobenzene	80-120	75-125
	Ethylbenzene	80-120	75-125
	Xylenes (total)	80-120	75-125
	Cis-1,2-dichloroethene	80-120	75-125
	Trans-1,2-dichloroetheen	80-120	75-125
	2-butanone	80-120	75-125
	1,1,2-trichloroethane	80-120	75-125
	Toluene	80-120	75-125
	1,1,2,2-Tetrachloroethane	80-120	75-125
BNA	Nitrobenzene	60-120	60-120
	2,6-Dinitrotoluene	60-120	60-120
	Acenaphthene	60-120	60-120
	2,4-Dinitrotoluene	60-120	60-120
	Anthracene	60-120	60-120
	Fluoranthene	60-120	60-120
	Pyrene	60-120	60-120
	Benzo(a)anthracene	60-120	60-120
	Chrysene	60-120	60-120
	Bis(2-Ethylhexyl)phthalate	60-120	60-120
	Benzo(b)flouranthene	60-120	60-120
	Benzo(k)flouranthene	60-120	60-120
	Benzo(a)pyrene	60-120	60-120
	Indeno(1,2,3-cd)pyrene	60-120	60-120
	Dibenz(a,h)anthracene	60-120	60-120
	Benzo(g,h,I)perylene	60-120	60-120
PEST	Heptachlor	50-130	50-130
	4,4’-DDD	50-130	50-130
	4,4’-DDE	50-130	50-130
	4,4’-DDT	50-130	50-130
PCB	Aroclor 1016	50-130	50-130
	Aroclor 1260	50-130	50-130

TABLE 4-10 (continued)
QC OBJECTIVES FOR ACCURACY IN LCS
ORGANIC COMPOUNDS

Fraction	Spiked Compounds[1]	Water Limits (% Recovery)[2]	Solid Limits (% Recovery)[2]
EXPLOSIVES	2,4,6-Trinitrotoluene	60-120	60-120
	4-Amino-2,6-dinitrotoluene	60-120	60-120
	Nitrobenzene	60-120	60-120
	2-Amino-4,6-dinitrotoluene	60-120	60-120
	2,4-/2,6-Dinitrotoluene	60-120	60-120
HPLC	Thiodiglycol	60-120	60-120
	Nitroglycerine	60-120	60-120
	PETN	60-120	60-120

Sporadic marginal failures (SMF): The number of sporadic marginal failure allowances depends upon the number of target analytes reported from the analysis. Acceptable criteria are based on the number of failures (f) and the number of samples (n) per the table below:

n	f
10-15	1
16-45	2
46-85	3
86-130	4

n = total number of target analytes being simultaneously analyzed
f = maximum number of analytes expected to fall outside of the 3-sigma control limits with 99% confidence if the probability of a random failure is less than or equal to 1%

Notes:
(1) Compound to be spiked may be project-specific. These are commonly spiked compounds.
(2) The control limits may be established by individual laboratories and may be different from limits provided in this table.

TABLE 4-11
QC OBJECTIVES FOR ACCURACY FOR ORGANIC SURROGATE ANALYSES

Fraction	Surrogate Compound(1)	Percent Recovery(2)	
		Low/Medium Water	Low/Medium Soil/Sediment/Tissue
VOA	Toluene-d_8	70-130	70-130
VOA	4-Bromofluorobenzene	70-130	70-130
VOA	1,2-Dichloroethane-d_4	70-130	70-130
BNA	Nitrobenzene-d_5	45-130	45-130
BNA	2-Fluorobiphenyl	45-130	45-130
BNA	p-Terphenyl-d_{14}	45-130	45-130
BNA	Phenol-d_5	35-140	35-140
BNA	2-Fluorophenol	35-140	35-140
BNA	2,4,6-Tribromophenol	35-140	35-140
PEST/PCB	Tetrachloro-m-xylene	40-140	40-140
PEST/PCB	Decachlorobiphenyl	40-140	40-140
EXPLOSIVES	4-Nitroaniline	40-140	40-140

(1) Compound to be spiked may be project-specific. These are commonly spiked compounds.

(2) The control limits may be established by individual laboratories and may be different from limits provided in this table.

TABLE 4-12
INORGANIC ACCURACY AND PRECISION GOALS

SAMPLE TYPE	%RPD	RECOVERY (PERCENT)
Sample Duplicate	Water: 20 Solid: 25	Not Applicable
Laboratory Control Sample	Not Applicable	80 – 120*
MS/MSD	20	75 -125

Sporadic marginal failures (SMF): 60% - 140%. The number of sporadic marginal failure allowances depends upon the number of target analytes reported from the analysis. If between 7 to 15 metals are reported from the ICP analysis, one (1) SMF is allowed to the expanded criteria presented. If greater than 15 metals are reported from the ICP analysis, two (2) SMFs are allowed.

TABLE 4-13
GC/MS CALIBRATION CHECK COMPOUNDS AND SYSTEM PERFORMANCE CHECK COMPOUNDS

VOLATILES	SEMI-VOLATILES
Chloromethane*	Phenol**
Vinyl chloride**	1,4-Dichlorobenzene**
1,1-Dichloroethene**	N-Nitroso-di-n-propylamine*
1,1-Dichloroethane*	2-Nitrophenol**
Chloroform**	2,4-Dichlorophenol**
1,2-Dichloropropane**	Hexachlorbutadiene*
Bromoform*	4-Chloro-3-methylphenol**
1,1,2,2-Tetrachloroethane*	Hexachlorocyclopentadiene*
Toluene**	2,4,6-Trichlorophenol**
Chlorobenzene*	Acenaphthlene**
Ethylbenzene**	2,4-Dinitrophenol*
	4-Nitrophenol
	Diphenylamine**
	Pentachlorophenol**
	Fluoranthene**
	Di-n-octylphthalate**
	Benzo(a)pyrene**

NOTES:

* = System performance check compound
** = Calibration check compound

TABLE 3-2
SAMPLE CONTAINER AND PRESERVATION REQUIREMENTS FOR WATER

PARAMETERS	SAMPLE VOLUME REQUIRED	CONTAINER(1)	PRESERVATION
TCL VOC	40 mL	3-40 ml vials with septum cap; no headspace	HCL to pH <2, Cool 4°C
SGWS VOC (2)	40 mL	3-40 ml vials with septum cap; no headspace	HCL to pH <2, Cool 4°C
TCL SVOC/PAH	1 L	2-1000 ml amber glass	Cool 4°C
TCL Pesticides/PCBs	1 L	2-1000 ml amber glass	Cool 4°C
Metals – Total	300 mL	1-1000 ml poly.	HNO_3 to pH <2, Cool 4°C
pH	--	1-100 ml poly.	Cool 4°C
Explosives	770 mL	1-950 ml amber glass	Cool 4°C
Mustard Breakdown Product - Thiodiglycol	500ml	1-1000ml amber glass	Cool 4°C
TDS	100 mL	1-500 ml poly	Cool 4°C
Hardness	50 mL	1-500 ml poly	HNO_3 to pH <2, Cool to 4°C
Total Chloride/Sulfate	50 mL	1-500 ml poly	Cool 4°C
Sulfide	500 mL	1-500 ml poly	NaOH/Zn Acetate Cool to 4^o C
CO_2	100 mL	1-250 ml amber glass (no headspace)	Cool to 4^o C
Phosphate	50 mL	1-500 ml poly	H_2SO_4 to pH<2, Cool to 4^o C
Nitrate	100mL	1-500 ml poly	Cool to 4^o C
Ammonia	500mL	1-500 ml poly	H_2SO_4 to pH<2, Cool to 4^o C
Methane (with Ethane/Ethene)	100mL	3-40ml vials w/ septum (no headspace)	H_2SO_4 to pH<2, Cool to 4^o C
Alkalinity	100 mL	1-500 mL poly	Cool to 4°C
TOC	25 mL	1-250 mL amber glass	H_2SO_4 to pH <2, Cool 4°C
BOD	1000 mL	1–1000 mL poly	Cool to 4°C
Ferrous Iron	50 mL	1-250 mL amber glass	2 mL conc. HCl/100 mL; no exposure to sunlight
Oil & Grease	1 L	1-1000 ml amber glass	H_2SO_4 to pH <2, Cool 4°C
TRPH	1 L	1-1000 ml amber glass	H_2SO_4 to pH <2, Cool 4°C
Cyanide	500 mL	1-liter poly	NaOH to pH >12, Cool 4°C

NOTES:

(1) Triplicate volumes are required for samples selected for lab QC.

(2) GC methods proposed for SGWS for quick turnaround, low detection limit screening data only.

Reference: SW-846, Third Edition, USEPA; MCAWW; and Standard Methods

TABLE 3-6
ANALYTICAL METHODS FOR WATER

PARAMETERS	PREPARATION METHOD	CLEANUP METHOD	ANALYSIS METHOD	HOLDING TIMES(1) (Preparation/Analysis)
VOC	5030	--	8260	14 days (7 days if unpreserved)
SVOC/PAH	3520 or 3510	--	8270	7 days/ 40 days extraction to analysis
PESTICIDES	3520 or 3510	3620(2)	8081	7 days/ 40 days extraction to analysis
PCBs	3520 or 3510	3665(4)	8082	7 days/ 40 days extraction to analysis
HERBICIDES	-----	-----	8151	7 days/ 40 days extraction to analysis
PP/TAL METALS - TOTAL	3010/3020 (3)	--	6010 (7470 for Hg) (3)	Hg: 28 days; others: 6 months
pH	--	--	9040	Immediately
EXPLOSIVES	--	--	8330	7 days/ 40 days extraction to analysis
CYANIDE	9010	--	9012	14 days
MUSTARD BREAKDOWN PRODUCT - THIODIGYLCOL	--	--	UW22/LW18 (Mod)	14 days
OIL AND GREASE	--	--	413.1	28 days
HARDNESS	--	--	130.2	6 months
TRPH	--	--	418.1	28 days
TDS	--	--	160.1	7 days
CHLORIDE	--	--	325.3	28 days
ALKALINITY	--	--	310.1	14 days
PHOSPHATE	--	--	365.3	28 days
NITRATE	--	--	353.2	48 hours
AMMONIA	--	--	350.3	28 days
SULFATE	--	--	375.4	28 days
TOC	--	--	415.1	28 days
SULFIDE	--	--	376.1	7 days
BOD$_5$	--	--	405.1	48 hours
CO$_2$	--	--	4500-CO$_2$D	Immediately
FERROUS FE	--	--	3500-FeD	Immediately
METHANE (with ETHANE/ETHENE)	--	--	3810	14 days

NOTES:

(1) Holding times are based on collection dates unless otherwise specified.
(2) Optional Florisil cleanup.
(3) All metals except mercury (7470) will be analyzed by trace ICP Method 6010. Graphite furnace will be used by a NJDEP and USACE certified laboratory for the following analytes if the reporting limits cannot not be met: As – 7060, Pb – 7421, Se - 7740, Tl – 7841, Cd – 7131, Sb - 7041. If graphite furnace is to be used, method 3020 will be used for sample digestion.
(4) Sulfuric acid cleanup is mandatory

Reference: SW-846, Third Edition, U.S. EPA; MCAWW; and Standard Methods.

TABLE 4-1
VOLATILE ORGANIC COMPOUNDS
REGULATORY REQUIREMENTS FOR WATER AND SOIL

Analytes	**NJDEP GWQS (µg/L)**	**NJDEP FW-2 Standard (µg/L)**	**NJDEP Soil Criteria(1) (mg/kg)**	**Freshwater Sediment Screening Guidelines(6) LEL (mg/kg)**	**Marine/Estuarine Screening Guidelines(7) ER-L (mg/kg)**
Chloromethane	30	NSA	10	NSA	NSA
Bromomethane	10	48.4(h)	1	NSA	NSA
Vinyl Chloride	5	0.0830(hc)	10	NSA	NSA
Chloroethane	NSA	NSA	NSA	NSA	NSA
Methylene Chloride	3(3)	2.49(hc)	1(4)	NSA	NSA
Acetone	700	NSA	100	NSA	NSA
Carbon Disulfide	NSA	NSA	NSA	NSA	NSA
1,1-Dichloroethene	2	4.81(hc)	10	NSA	NSA
1,1-Dichloroethane	50(3)	NSA	10(4)	NSA	NSA
cis-1,2-Dichloroethene	70(3)	NSA	1(4)	NSA	NSA
trans-1,2-dichloroethene	100(3)	592(h)	50(4)	NSA	NSA
Chloroform	6	5.67(hc)	1	NSA	NSA
1,2-Dichloroethane	2	0.291(hc)	1	NSA	NSA
2-Butanone	300	NSA	50	NSA	NSA
1,1,1-Trichloroethane	30	127(h)	50(4)	NSA	NSA
Carbon Tetrachloride	2	0.363(hc)	1	NSA	NSA
Bromodichloromethane	1	0.266(hc)	1	NSA	NSA
1,2-Dichloropropane	1	NSA	43(2)	NSA	NSA
cis-1,3-Dichloropropene	NSA	0.193(hc)*	1(5)	NSA	NSA
Trichloroethene	1	1.09(hc)	1	NSA	NSA
Dibromochloromethane	10	72.6(h)	1	NSA	NSA
1,1,2-Trichloroethane	3	13.5(h)	1(4)	NSA	NSA
Benzene	1	0.150(hc)	1	NSA	NSA
trans-1,3-Dichloropropene	NSA	0.193(hc)*	1(5)	NSA	NSA
Bromoform	4	4.38(hc)	1	NSA	NSA
4-Methyl-2-pentanone	400	NSA	50	NSA	NSA
2-Hexanone	NSA	NSA	NSA	NSA	NSA
Tetrachloroethene	1	0.388(hc)	1	NSA	NSA
Toluene	1000	7440(h)	500	NSA	NSA
1,1,2,2-Tetrachloroethane	1(3)	1.72(hcc)	1(4)	NSA	NSA
Chlorobenzene	50(3)	22.0(hc)	1(4)	NSA	NSA
Ethyl Benzene	700	3030(h)	100	NSA	NSA
Styrene	100	NSA	97	NSA	NSA
Xylenes (total)	1000(3)	NSA	10(4)	NSA	NSA

See next page for notes.

TABLE 4-1 (continued)
VOLATILE ORGANIC COMPOUNDS
REGULATORY REQUIREMENTS FOR WATER AND SOIL

NOTES:

NSA - No Standard Available
GWQS - Groundwater Quality Standard
LEL – Lowest Effects Levels
ER-L – Effects Range-Low

(1) More stringent of NRDCSCC or IGWSCC (February 1994).
(2) NSA for IGWSCC. The reported criteria are NRDCSCC.
(3) February 1997 Interim Specific Groundwater Criteria.
(4) New IGWSCC are being developed by NJDEP and will likely be higher than the February 1994 criteria.
(5) Criteria is for total (cis and trans).
(6) Table 1, "Guidance For Sediment Quality Evaluations", NJDEP November 1998. Guidelines are based on dry-weight.
(7) Table 2, "Guidance For Sediment Quality Evaluations", NJDEP November 1998. Guidelines are based on dry-weight.
(h) Noncarcinogenic effect-based human health criteria as a 30-day average with no frequency of exceedance at or above the design flows specified in section N.J.A.C. 7:9B-1.5(c)2.
(hc) Carcinogenic effect-based human health criteria as a 70-year average with no frequency of exceedance at or above the design flows specified in section N.J.A.C. 7:9B-1.5(c)2 and are based on a risk level of one-in-one-million.
(hcc) Toxic substances considered to be possible human carcinogens as a 70-year average with no frequency of exceedance at or above the design flows specified in section N.J.A.C. 7:9B-1.5(c)2 and are based on a risk of one-in-one hundred thousand.

TABLE 4-5
EXPLOSIVES COMPOUNDS
REGULATORY REQUIREMENTS FOR WATER AND SOIL

ANALYTE	NJDEP GWQS (µg/L)	NJDEP FW-2 Standard (µg/L)	NJDEP Soil Criteria(1) (mg/Kg)	Freshwater Sediment Screening Guidelines(4) LEL (mg/kg)	Marine/Estuarine Sediment Screening Guidelines(5) ER-L (mg/kg)
HMX	NSA	NSA	NSA	NSA	NSA
RDX	NSA	NSA	NSA	NSA	NSA
1,3,5-TNB	NSA	NSA	NSA	NSA	NSA
1,3-DNB	NSA	2620(h)	NSA	NSA	NSA
Tetryl	NSA	NSA	NSA	NSA	NSA
NB	10	16.0(h)	10	NSA	NSA
2,4,6-TNT	0.4	NSA	10(2)	NSA	NSA
2,6-DNT(3)	10(3)	NSA	4(3)	NSA	NSA
2,4-DNT(3)	10(3)	0.11(h)	4(3)	NSA	NSA
2-Amino-4,6-DNT(2)	0.4(2)	NSA	10(2)	NSA	NSA
4-Amino-2,6-DNT(2)	0.4(2)	NSA	10(2)	NSA	NSA
NG	NSA	NSA	NSA	NSA	NSA
PETN	NSA	NSA	NSA	NSA	NSA

NOTES:

LEL – Lowest Effects Levels
ER-L – Effects Range-Low

(1) More stringent of NRDCSCC or IGWSCC (February 1994).

(2) 2,4,6-TNT and Amino-DNT soil criteria are NJDEP site-specific interim criteria. Draft GWQS for Amino-DNTs is being evaluted by NJDEP and may change.

(3) 2,4-DNT and 2,6-DNT co-elute; criteria is for 2,4-DNT/2,6-DNT mixture.

(4) Table 1, "Guidance For Sediment Quality Evaluations", NJDEP November 1998. Guidelines are based on dry-weight.

(5) Table 2, "Guidance For Sediment Quality Evaluations", NJDEP November 1998. Guidelines are based on dry-weight.

(h) Noncarcinogenic effect-based human health criteria as a 30-day average with no frequency of exceedance at or above the design flows specified in section N.J.A.C. 7:9B-1.5(c)2.

TABLE 4-9
MATRIX SPIKE/MATRIX SPIKE DUPLICATE OBJECTIVES
ORGANIC COMPOUNDS

Fraction	Matrix Spike Compound[1]	Percent Recovery Limits[2]		Percent RPD Limits[2]	
		Water	Soil/ Sediment/Tissue	Water	Soil/ Sediment/Tissue
VOA	1,1-Dichloroethene	70-130	70-130	30	50
VOA	Trichloroethene	70-130	70-130	30	50
VOA	Chlorobenzene	70-130	70-130	30	50
VOA	Toluene	70-130	70-130	30	50
VOA	Benzene	70-130	70-130	30	50
BN	1,2,4-Trichlorobenzene	45-135	51-120	50	60
BN	Acenaphthene	45-135	46-135	50	60
BN	2,4-Dinitrotoluene	45-135	38-137	50	60
BN	Pyrene	45-135	24-144	50	60
BN	N-nitroso-di-N-propylamine	45-135	20-150	50	60
BN	1,4-Dichlorobenzene	45-135	25-122	50	60
ACID	Pentachlorophenol	45-135	45-135	50	60
ACID	Phenol	45-135	45-135	50	60
ACID	2-Chlorophenol	45-135	45-135	50	60
ACID	4-Chloro-3-methylphenol	45-135	45-135	50	60
ACID	4-Nitrophenol	45-135	45-135	50	60
PEST	Lindane	40-140	40-140	50	50
PEST	Heptachlor	40-140	40-140	50	50
PEST	Aldrin	40-140	40-140	50	50
PEST	Dieldrin	40-140	40-140	50	50
PEST	Endrin	40-140	40-140	50	50
PEST	4,4-DDT	40-140	40-140	50	50
PCB	Aroclor 1016	40-140	40-140	50	50
	Aroclor 1260	40-140	40-140	50	50

TABLE 4-9 (CONTINUED)
MATRIX SPIKE/MATRIX SPIKE DUPLICATE OBJECTIVESORGANIC COMPOUNDS

Fraction	Matrix Spike Compound(1)	Percent Recovery Limits(2)		Percent RPD Limits(2)	
		Water	Soil/ Sediment/Tissue	Water	Soil/ Sediment/Sediment
EXPLOSIVES	1,3,5-Trinitrobenzene	50-140	50-140	50	50
EXPLOSIVES	1,3-Dinitrobenzene	50-140	50-140	50	50
EXPLOSIVES	2,4,6-Trinitrotoluene	50-140	50-140	50	50
EXPLOSIVES	2,4-Dinitrotoluene*	50-140	50-140	50	50
EXPLOSIVES	2,6-Dinitrotoluene*	50-140	50-140	50	50
EXPLOSIVES	2-amino-4,6-Dinitrotoluene	50-140	50-140	50	50
EXPLOSIVES	4-amino-2,6-Dinitrotoluene	50-140	50-140	50	50
EXPLOSIVES	HMX	50-140	50-140	50	50
EXPLOSIVES	Nitrobenzene	50-140	50-140	50	50
EXPLOSIVES	RDX	50-140	50-140	50	50
EXPLOSIVES	Tetryl	45-140	45-140	50	50
HPLC	Thiodiglycol	50-140	50-140	50	50
	Nitroglycerine	50-140	50-140	50	50
	PETN	50-140	50-140	50	50

NOTE:

RPD – Relative Percent Difference

(1) Compound to be spiked may be project-specific. These are commonly spiked compounds.

(2) The control limits may be established by individual laboratories and may be different from limits provided in this table.

* 2,4-DNT and 2,6-DNT co-elute; control limits are for 2,4-DNT/2,6-DNT mixture.

TABLE 4-10
QC OBJECTIVES FOR ACCURACY IN LCS ORGANIC COMPOUNDS

Fraction	Spiked Compounds[(1)]	Water Limits (% Recovery)[(2)]	Solid Limits (% Recovery)[(2)]
VOA	Vinyl Chloride	80-120	75-125
	1,1-Dichloroethene	80-120	75-125
	1,1-Dichloroethane	80-120	75-125
	Chloroform	80-120	75-125
	1,2-Dichloroethane	80-120	75-125
	1,1,1-Trichloroethane	80-120	75-125
	Trichloroethene	80-120	75-125
	Benzene	80-120	75-125
	Tetrachloroethene	80-120	75-125
	chlorobenzene	80-120	75-125
	Ethylbenzene	80-120	75-125
	Xylenes (total)	80-120	75-125
	Cis-1,2-dichloroethene	80-120	75-125
	Trans-1,2-dichloroetheen	80-120	75-125
	2-butanone	80-120	75-125
	1,1,2-trichloroethane	80-120	75-125
	Toluene	80-120	75-125
	1,1,2,2-Tetrachloroethane	80-120	75-125
BNA	Nitrobenzene	60-120	60-120
	2,6-Dinitrotoluene	60-120	60-120
	Acenaphthene	60-120	60-120
	2,4-Dinitrotoluene	60-120	60-120
	Anthracene	60-120	60-120
	Fluoranthene	60-120	60-120
	Pyrene	60-120	60-120
	Benzo(a)anthracene	60-120	60-120
	Chrysene	60-120	60-120
	Bis(2-Ethylhexyl)phthalate	60-120	60-120
	Benzo(b)flouranthene	60-120	60-120
	Benzo(k)flouranthene	60-120	60-120
	Benzo(a)pyrene	60-120	60-120
	Indeno(1,2,3-cd)pyrene	60-120	60-120
	Dibenz(a,h)anthracene	60-120	60-120
	Benzo(g,h,I)perylene	60-120	60-120
PEST	Heptachlor	50-130	50-130
	4,4'-DDD	50-130	50-130
	4,4'-DDE	50-130	50-130
	4,4'-DDT	50-130	50-130
PCB	Aroclor 1016	50-130	50-130
	Aroclor 1260	50-130	50-130

TABLE 4-10 (continued)
QC OBJECTIVES FOR ACCURACY IN LCS
ORGANIC COMPOUNDS

Fraction	Spiked Compounds[1]	Water Limits (% Recovery)[2]	Solid Limits (% Recovery)[2]
EXPLOSIVES	2,4,6-Trinitrotoluene	60-120	60-120
	4-Amino-2,6-dinitrotoluene	60-120	60-120
	Nitrobenzene	60-120	60-120
	2-Amino-4,6-dinitrotoluene	60-120	60-120
	2,4-/2,6-Dinitrotoluene	60-120	60-120
HPLC	Thiodiglycol	60-120	60-120
	Nitroglycerine	60-120	60-120
	PETN	60-120	60-120

Sporadic marginal failures (SMF): The number of sporadic marginal failure allowances depends upon the number of target analytes reported from the analysis. Acceptable criteria are based on the number of failures (f) and the number of samples (n) per the table below:

n	f
10-15	1
16-45	2
46-85	3
86-130	4

n = total number of target analytes being simultaneously analyzed
f = maximum number of analytes expected to fall outside of the 3-sigma control limits with 99% confidence if the probability of a random failure is less than or equal to 1%

Notes:
(1) Compound to be spiked may be project-specific. These are commonly spiked compounds.
(2) The control limits may be established by individual laboratories and may be different from limits provided in this table.

TABLE 4-11
QC OBJECTIVES FOR ACCURACY FOR ORGANIC SURROGATE ANALYSES

Fraction	Surrogate Compound(1)	Percent Recovery(2)	
		Low/Medium Water	Low/Medium Soil/Sediment/Tissue
VOA	Toluene-d_8	70-130	70-130
VOA	4-Bromofluorobenzene	70-130	70-130
VOA	1,2-Dichloroethane-d_4	70-130	70-130
BNA	Nitrobenzene-d_5	45-130	45-130
BNA	2-Fluorobiphenyl	45-130	45-130
BNA	p-Terphenyl-d_{14}	45-130	45-130
BNA	Phenol-d_5	35-140	35-140
BNA	2-Fluorophenol	35-140	35-140
BNA	2,4,6-Tribromophenol	35-140	35-140
PEST/PCB	Tetrachloro-m-xylene	40-140	40-140
PEST/PCB	Decachlorobiphenyl	40-140	40-140
EXPLOSIVES	4-Nitroaniline	40-140	40-140

(1) Compound to be spiked may be project-specific. These are commonly spiked compounds.

(2) The control limits may be established by individual laboratories and may be different from limits provided in this table.

TABLE 4-12
INORGANIC ACCURACY AND PRECISION GOALS

SAMPLE TYPE	%RPD	RECOVERY (PERCENT)
Sample Duplicate	Water: 20 Solid: 25	Not Applicable
Laboratory Control Sample	Not Applicable	80 – 120*
MS/MSD	20	75 -125

Sporadic marginal failures (SMF): 60% - 140%. The number of sporadic marginal failure allowances depends upon the number of target analytes reported from the analysis. If between 7 to 15 metals are reported from the ICP analysis, one (1) SMF is allowed to the expanded criteria presented. If greater than 15 metals are reported from the ICP analysis, two (2) SMFs are allowed.

APPENDIX I

July 29, 2005

Mr. Anthony Cinque
New Jersey Department of Environmental Protection
Bureau of Case Management, 5th Floor
401 State Street, CN-0028
Trenton, New Jersey 08625-0028

Dear Mr. Cinque:

On behalf of the U.S. Army Corps of Engineers (USACE), Weston Solutions, Inc. is pleased to present three copies of the updated *Former Raritan Arsenal Project, Comprehensive Sampling and Analysis Plan* (CSAP), dated July 2005. The CSAP has been revised primarily to incorporate ecological and indoor air sampling and analysis procedures. A brief summary of the changes is provided as an attachment to this transmittal letter.

If you have any questions or need additional information, please do not hesitate to contact me at (732) 417-5815.

Very truly yours,

WESTON SOLUTIONS, INC.

Paul Bovitz
Project Manager

cc: James T. Moore, CENAN
Jim Kelly, CENAE
Rosemary Schmidt, CENAE
Robert Davis, CENAE

SUMMARY OF SUBSTANTIVE CHANGES
SEPTEMBER 2002 CSAP TO JULY 2005 CSAP

- Section 1 (Introduction) was updated to incorporate current project focus and purpose.

- Section 2 (Project Organization and Responsibilities) was updated to reflect current project management structure, and to allow for flexibility in use of subcontracted laboratories by identifying laboratory personnel responsibilities by title.

- Section 3 (Field Investigation) was updated (a) to reflect current Weston subsurface utility mark-out protocols, (b) to incorporate use of improved field collection forms and data management software, (c) to incorporate use of EnCore samplers for collection of soil samples for volatile organic compound analysis, (d) to add procedures for collection and analysis of indoor air samples, building subslab soil gas samples, building subslab soil samples associated with the current indoor air quality investigation program, (e) to identify sample collection, processing, and analysis procedures to support the ecological risk assessment, and (f) to update the investigation-derived wastes management plan.

- Section 4 (Data Quality Objectives) Section 5 (Sample Receipt, Handling, and Custody), Section 6 (Laboratory Procedures), and Section 7 (Performance and System Audits), has been reorganized from the 2002 CSAP Sections 4 (Laboratory Analysis) and Section 5 (Mechanical Testing) to more closely align with the USACE Document Engineering Manual 200-1-3, *Requirements for the Preparation of Sampling and Analysis Plans*. The updates include (a) documentation of analytical method modifications, including those that eliminate a method-required detection limit, (b) specification of the remedial criteria that method specific detection limits should meet, (c) addition of analytical methods and remedial criteria for indoor air and tissue samples, (d) identification of required sample receipt, storage, security, and tracking procedures for subcontractor laboratories, and (e) elimination of method specific detection limits.

- Section 8 (Data Management) has been updated from the 2002 CSAP Section 6 (Data Management) to describe the data management system (EnviroData) which has been selected to replace the formerly-used Technical Data Management System (TDMS).

- Section 9 (References) has been added to the CSAP.

- Figures, Tables, and Appendices have been updated to support the changes made in the text.

U.S. Army Corps of Engineers

Draft

FORMER RARITAN ARSENAL PROJECT
COMPREHENSIVE SAMPLING AND ANALYSIS PLAN

New England Contract No. DACA41-92-D-8002/0015-0017
Baltimore Contract No. DACA31-00-D-0023/050, 056, and 069
Baltimore Contract No. W912DR-05-D-0022-0001

July 2005

Prepared by:

WESTON SOLUTIONS
205 Campus Drive
Edison, New Jersey

U.S. ARMY CORPS OF ENGINEERS

FORMER RARITAN ARSENAL PROJECT
COMPREHENSIVE SAMPLING AND ANALYSIS PLAN

New England Contract No. DACA41-92-D-8002/0015-0017
Baltimore Contract No. DACA31-00-D-0023/050, 056, and 069
Baltimore Contract No. W912DR-05-D-0022-0001

July 2005

Prepared for:

U.S. ARMY CORPS OF ENGINEERS

Prepared by:

WESTON SOLUTIONS, INC.
205 Campus Drive
Edison, New Jersey 08837

W.O. No.: 03886.518.069.0008.06

TABLE OF CONTENTS

TABLE OF CONTENTS
(CONTINUED)

TABLE OF CONTENTS
(CONTINUED)

SECTION **TITLE** **PAGE**

TABLE OF CONTENTS
(CONTINUED)

SECTION **TITLE** **PAGE**

TABLE OF CONTENTS

(CONTINUED)

SECTION **TITLE** **PAGE**

TABLE OF CONTENTS

(CONTINUED)

SECTION **TITLE** **PAGE**

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICES

LIST OF ABBREVIATIONS

ags	above ground surface
agw	above groundwater
AOC	Area of Concern
ATV	All Terrain Vehicle
bgs	below ground surface
bgw	below groundwater
BRK	Bedrock Unit
BS	Blank Spike
BSD	Blank Spike Duplicate
C	Celsius
CDAP	Chemical Data Acquisition Plan
CL	Low Plasticity Clay
cm	centimeter
CSAP	Comprehensive Sampling and Analysis Plan
DDA	Drum Disposal Area
DERP	Defense Environmental Restoration Program
DMS	Data Management System
DO	Dissolved Oxygen
DOD	Department of Defense
DWR	Division of Water Resources
EDDs	Electronic Data Deliverables
EMSL	Environmental Monitoring Systems Laboratory
EODT	Explosives Ordnance Demolition Technology, Inc.
ER-M	Effects Range Median
EPA	United States Environmental Protection Agency
FBC	Federal Business Centers
GeoTech	GeoTech Computer Systems, Inc.
GIS	Geographic Information System
GPS	Global Positioning System
GUI	Graphical User Interface
GW	Groundwater Sample
GWQS	Groundwater Quality Standard
IGWSCC	Impact to Groundwater Soil Cleanup Criteria
kg	kilogram
L	Liter
LCS	Laboratory Control Spike
LS	Lower Sand Unit
mg	milligram
mL	milliliter
MM	Meadowmat Unit
MS	Matrix Spike
MSD	Matrix Spike Duplicate
MSL	Mean Sea Level

LIST OF ABBREVIATIONS
(CONTINUED)

MW - Monitoring Well
NAD 83 - North American Datum 1983
NAE - New England District
NGVD - National Geodetic Vertical Datum (1929)
NOAA - National Oceanic and Atmospheric Administration
NJDEP - New Jersey Department of Environmental Protection
NRDCSCC - Non Residential Direct Contact Soil Cleanup Criteria
NTU - Nephelometric Turbidity Units
O.D. - Outside Diameter
OEW - Ordnance Explosive Waste
OVM - Organic Vapor Meter
PAHs - Polycyclic Aromatic Hydrocarbons
PAL - Palisades Sill
PAS - Passaic Formation
PID - Photoionization Detector
PQL - Practical Quantitation Limit
PVC - Polyvinyl Chloride
QA - Quality Assurance
QAPP - Quality Assurance Project Plan
QRR - QAPP Required Recovery
QC - Quality Control
RAWP - Remedial Action Work Plan
RD - Remedial Design
RDCSCC - Residential Direct Contact Soil Cleanup Criteria
RDX - Royal Demolition Explosive
RI - Remedial Investigation
ROI - Report of Investigation
RPD - Relative Percent Difference
s - second
SD - Sediment Sample
SEL - Severe Effects Limit
SG - Staff Gauge
SOP - Standard Operating Procedure
SOW - Scope of Work
SPCC - System Performance Check Samples
SS - Soil Sample
SSHSP - Site Specific Health and Safety Plan
SSP - Site Safety Plan
SW - Surface Water
TDMS - Technical Data Management System
TNT - 2,4,6-Trinitrotoluene
ug - microgram

LIST OF ABBREVIATIONS
(CONTINUED)

US	-	Upper Sand Unit
USACE	-	United States Army Corps of Engineers
USCS	-	Unified Soil Classification System
UXO	-	Unexploded Ordnance
VOC	-	Volatile Organic Compounds
WBK	-	Weathered Bedrock Group
Weston	-	Weston Solutions, Inc.

SECTION 1.0
INTRODUCTION

1.1 PROJECT DESCRIPTION

The Former Raritan Arsenal site was used extensively by the U.S. Army from 1917 to 1963. Previous environmental studies of the site have indicated the presence of buried ordnance and contamination of soil and groundwater with organic and inorganic hazardous substances and explosive compounds.

Weston Solutions, Inc. (Weston®) currently has delivery orders open under contracts with the following U.S. Army Corps of Engineers (USACE) districts:

- New England District contract number DACA41-92-D-8002 - Delivery Orders 0015 through 0017;
- Baltimore District contract number DACA31-00-D-0023 – Delivery Orders 0050, 0056, and 0069; and
- Baltimore District contract number W912DR-05-D-0022-0001.

The delivery orders under these contracts have been developed to carry out an additional environmental evaluation of and restoration at the site. The Raritan Management Action Plan (MAP) document (USACE 2004) provides a description of project investigation and remedial activities already completed since project inception. The work currently covered under the contract Scopes of Work (SOW) includes the professional services necessary for:

- Investigation of contaminated groundwater;
- Investigation of remaining soil issues;
- Ecological risk assessment;
- Investigation of the potential vapor intrusion pathway into indoor air at site buildings;
- Preparation of No Further Action letters.

Weston has been authorized to update this Comprehensive Sampling and Analysis Plan (CSAP) to support the anticipated upcoming field efforts known or anticipated at the time of this update. This CSAP has been developed to provide the information necessary to meet all technical requirements set forth in the *Requirements for the Preparation of Sampling and Analysis Plans* (USACE EM 200-1-3, 1 February 2001) with the understanding that this CSAP provides generic requirements for Field Sampling Plans (FSPs), as well as information required of Quality Assurance Project Plans (QAPPs). Specific information necessary to site-specific or task-specific FSPs, e.g., numbers of samples required for each media/area of concern, will be identified in the site- or task-specific Work Plans developed for each field activity. However, the information included in this CSAP will provide the technical basis and field SOPs to be utilized during field activities, and will identify the minimum laboratory quality assurance acceptable on work assignments at the former Arsenal.

1.2 SITE HISTORY

Prior to the U.S. Army construction of the Raritan Arsenal in 1917, the property consisted of farm land with several residences and clay and sand pit quarries. The former arsenal was used extensively by the Army from 1917 to 1963. The site was developed by the Army to ease congestion of Atlantic seaboard ports and to facilitate military shipments to Europe during World War I. It was originally designed to be a temporary depot for the storage, staging, and shipment of munitions. The Arsenal was considered a permanent military establishment by 1922. Originally comprised of 2,137 acres, it eventually expanded to 3,227 acres (O'Brien & Gere [OBG], 1989).

The marsh areas along the Raritan River were filled with sediments dredged from the Raritan River and Raritan Bay. Roads and railways were built on embankments of fill to elevate them above tides and frequent floods. The majority of the DOD-related construction was from 1917 to the end of World War II. The prospectus issued by the Army in 1961 indicates there were 446 permanent and semi-permanent buildings, 80 miles of railroad track, 3 rail spurs, 108.5 acres of primary and secondary roads, 81.3 acres of parking, over 2.1 million square feet of storage in magazines and warehouse buildings, 2.1 acres of sidewalks, 5 miles of pipe, 22,000 square feet of sewage disposal area, 190,000 linear feet of sewage collection lines, 1.35 million gallons of water storage capacity in two large tanks, 88,000 linear feet of water lines to provide for a daily consumption of 400,000 gallons, and associated infrastructure to provide for 15,000 people (OBG, 1989).

Operations at the site included the receipt, storage, shipment, and/or decommissioning of ordnance, arms, and machinery and their subsequent shipment to Europe. Storage was typically in warehouse and magazine buildings and, in some instances, outdoors. The material was shipped by rail, roadway, and from the dock area on the Raritan River. The decommissioning activities included equipment and ordnance dismantlement for subsequent disposal.

During this period some waste materials, including ordnance and chemical agents (mustard gas, red nitric acid, and miscellaneous chemicals), were reportedly buried on site. It also has been reported that explosive materials routinely were destroyed by surface burning or burning in chambers or pits. Accidental explosions in magazine buildings and outdoor storage areas reportedly scattered explosive materials over large areas, and drove ordnance fragments into the ground (Metcalf & Eddy, 1991).

Operations at the Raritan Arsenal were phased out between 1961 and 1963. Decontamination of the site was initially performed under the direction of Raritan Arsenal personnel in 1963, and later under the direction of personnel from the Letterkenny Army Depot (LEAD) and Army Material Command Safety Office. LEAD designated 17 areas as potentially contaminated in a study during 1963 (LEAD, 1963). Subsequently, the Army recommended that each area be designated for "Unrestricted Use", "Surface-Use Only", or "Non-Use," as deemed appropriate. Areas designated "Surface-Use Only" and "Non-Use" included pits possibly holding potassium cyanide and mustard gas containers, and areas which potentially contained live ordnance.

In 1964, after the decontamination of the site by LEAD, the General Services Administration (GSA) sold 2,000 acres of the former arsenal to the Visceglia family; this family formed Federal Storage Warehouses. In 1975, this company divided into two companies: Summit Associates, Inc. and Federal Business Centers and built Raritan Center, a major industrial park complex. Continuing development is occurring in Raritan Center, which is now mostly light industrial, warehouse, and office space. Fourteen of the 17 sites designated as potentially contaminated are currently owned by either Summit Associates or Federal Business Centers (Metcalf & Eddy, 1991).

GSA also sold a parcel of land, located on the western part of the site, to Middlesex County. The county developed the area into Thomas A. Edison County Park and Middlesex County College (MCC). The Middlesex County College, Thomas A. Edison County Park, U.S. Environmental Protection Agency offices, and Raritan Center occupy the majority of the former Arsenal.

The southern half of the site has remained primarily marshlands, with limited development since the arsenal closed in 1963. The ILR Landfill, operated in the 1970s and closed by a court order in 1985, is located immediately adjacent to the southwest border of the former Arsenal (OBG, 1989).

In addition to the 17 sites identified during the LEAD decontamination activities, eight potentially contaminated sites have been identified during the investigations presented below.

OBG, under contract to the USACE, began a contamination evaluation study in September of 1987. The objectives of this evaluation were to perform field investigations and make preliminary determinations of whether chemical and/or ordnance contamination were present at the site. OBG's findings were presented in their report, *Final Engineering Report, Former Raritan Arsenal Contamination Evaluation, Edison, New Jersey, Project No. CO2NJ008400*, dated August 1989.

Dames & Moore, under contract to the USACE, began a study to characterize and determine the extent of the chemical contamination, including explosive-related contaminants in soil and groundwater, in selected areas of the site. The information gathered from this investigation was to be the basis for a Remedial Investigation/Feasibility Study for the former Arsenal. Dames & Moore's findings were presented in their draft report, *Preliminary Report, Phase I Remedial Investigation of Selected Areas of Former Raritan Arsenal*, Dames & Moore Job No. 19577-014-007, dated 2 October 1992.

1.3 SITE LOCATION AND LAND USE

The former Arsenal is located in Edison and Woodbridge Townships, Middlesex County, New Jersey. The former Arsenal is situated on the banks of the Raritan River and encompasses 3,227 acres. The former Arsenal is bordered to the north and northwest by Woodbridge Avenue and to the southwest by Mill Road and the ILR Landfill.

The former Arsenal property is currently owned or occupied by the following:

- Middlesex County College (MCC); owned by Middlesex County.
- Thomas A. Edison County Park; owned by Middlesex County.
- United States General Services Administration (GSA).
- USEPA.
- Raritan Center; owned primarily by Summit Associates Inc. and Federal Business Centers.
- Several light industrial, warehousing, and hotel operations.

MCC occupies approximately 163 acres in the northwestern-most portion of the former Arsenal. This parcel was purchased by Middlesex County from GSA in 1964. A few buildings previously constructed and utilized by the Army remain and are currently utilized by MCC for various administrative purposes. However, a majority of the buildings utilized by MCC were constructed by Middlesex County in the 1960s and 1970s.

Thomas A. Edison County Park occupies approximately 150 acres immediately south of the College. The Park includes baseball and soccer fields, tennis courts, a running track, a comfort station, parking lots, and common open space.

The USEPA's Region II office obtained Buildings 5, 6, 7, 10, 209, and 210 in the early 1970's for use as field offices. In 1988, the USEPA purchased Building 212 and an additional 164-acre parcel from the GSA. The USEPA and its contractors maintain office and general operations space for over 300 personnel. The Region II Laboratory, Emergency Response Team, Research and Development staff, and Removal and Emergency Response staff occupy this area. GSA also utilizes this area for fleet vehicle storage, sales, and distribution.

In 1989, GSA sold a three-acre plot of land to the Middlesex Interfaith Partners with the homeless, and another 23-acre plot to TWC Realty. The GSA currently owns two parcels of land: 1) a 19-acre plot in the southwest corner of the site, and 2) an 11-acre plot next to MCC.

An area immediately northwest of the USEPA-owned property, along Woodbridge Avenue, has been purchased by various corporations such as Owens-Illinois, Inland Container Corporation, TastyKake, and Ardmore Textured Metals.

Raritan Center, owned and developed by Summit Associates, Inc. and Federal Business Centers, comprises the northeastern, central, and southern portions of the former Arsenal. Raritan Center currently hosts over 90 office buildings, storage warehouses, and light manufacturing facilities and is known as New Jersey's largest office/light industrial center.

The southern portion of this parcel, adjacent to the Raritan River, has remained relatively inactive since the departure of the Army in the 1960s. Much of this area is wetlands and floodplains, making it undesirable for development. A few manufacturing/blending operations have occurred within a few former magazines located along the river's edge. These include operations such as Huber Inks and Blue Spruce. The other magazines remain vacant.

1.4 PURPOSE

The USACE requests a quality assurance program for administering projects such as the Raritan Arsenal RI. Under the Quality Assurance Program (USACE, EM-200-1), a work plan consists of three major elements: a quality assurance project plan (QAPP), a field sampling plan (FSP), and a site specific health and safety plan (SSHSP).

This CSAP for the former Raritan investigation is equivalent to the QAPP and provides details for data collection and handling, including data quality objectives, methods and procedures. Field sampling, sample control, laboratory analysis, and data management/reporting associated with future sampling, are addressed in this CSAP. Specific field sampling plans are issued for each field investigation at the former Arsenal and are reviewed individually by reviewing agencies. The CSAP is referenced in each individual FSP. The SSHSP is updated for each specific field sampling event conducted.

Weston has prepared this CSAP to outline project field sampling and analytical laboratory QA/QC requirements, in effect as of the date of this document for all former Arsenal sites requiring remaining investigation or remedial activites. This CSAP is intended to update procedures provided in the September 2002 CSAP related to the generation of chemical data and has been prepared in a format that may be easily modified in the future should additional procedural modifications be required.

Six of the 25 former Arsenal sites associated with the Phase II RI were investigated on an expedited schedule, and were initially investigated under the July 1993 Chemical Data Acquisition Plan (CDAP). Expedited sites included Areas 4, 10, 17, 18A, Building 118 and XHW. The QA/QC requirements pertaining to the initial investigation of Areas 2, 3, 6, 7, 8, 9, 11, 14, 15, 16, 19, 20, Owens-Illinois and Building 151 were documented in the CDAP dated December 1993. Subsequent investigations were carried out under CDAP Addendums dated July 1995 and April 1996. The draft December 1997 CSAP covered all work carried out from December 1997 through July 1998. The August 1998 CSAP covered all work carried out from August 1998 through February 1999. The March 1999 CSAP covered all work carried out from March 1999 through December 1999. The October 2000 CSAP covered all work carried out from October 2000 through August 2002. The September 2002 CSAP covered remedial actions conducted at Areas 12, 18B, 18C Building 256, and Area 18C Drum Disposal Areas (DDAs), as well as subsequent field investigations.

SECTION 2.0
PROJECT ORGANIZATION AND RESPONSIBILITIES

This section describes the organizational structure, lines of authority, and responsibilities of key individuals for the project. Emphasis is placed on the organization and entities responsible for implementation and administration of this CSAP. The project organization structure showing relationships of persons with key responsibilities for this project is shown in Figure 2-1.

2.1 WESTON PERSONNEL RESPONSIBILITIES

The environmental data generated in the field or by the laboratory will be reviewed, verified, and reconciled with data quality objectives by WESTON personnel in various disciplines. The responsibilities for the key engineering/science personnel are described in the following sections.

2.1.1 Project Manager

Mr. Paul Bovitz is the Weston Project Manager and is responsible for planning, coordinating, integrating, monitoring, and managing project activities. The Project Manager is also responsible for meeting project scope objectives, budget, and for the overall quality of submittals.

2.1.2 Quality Assurance Officer

Laura Amend-Babcock, PE, is the Project QA Officer and is responsible for ensuring conformance with Weston and USACE policies, procedures, and sound practices during project planning (i.e., preparation of the FSP, CSAP, SSHSP), and execution of the RA. The Project QA Officer relies on the Field Team Leader, Laboratory Project Manager, and Laboratory QA Officer to ensure that relevant QA/QC procedures are followed in the field and the laboratory,

2.1.3 Field Team Leader

Field Team Leader - The Field Team Leader is responsible for ensuring field personnel follow procedures established by this CSAP and the project specific work plan/sampling plan for sampling, chain-of-custody, and documentation. The Field Team Leader is assigned on a per-task basis and shall verify entries of field measurements, and entries to logbook, chain-of-custody forms, and other necessary datasheets.

2.1.4 Project Chemist

Mr. Yunru Yang is the Project Chemist and shall be consulted in project scoping and planning stages to assist in developing data quality objectives to be included in the project-specific FSP and the CSAP. The Project Chemist is responsible for examining all laboratory data deliverables to assess data quality. The laboratory is ultimately responsible for providing data satisfying the data quality objectives documented in this CSAP. Based on project requirements, the Project Chemist may review, verify, and/or validate the laboratory-generated data to determine data usability against the CSAP-specified data quality objectives. A discussion on data assessment can be found in Section 6.5.

2.2 LABORATORY RESPONSIBILITIES

Any contract laboratory performing analyses in compliance with this Quality Assurance Project Plan (QAPP) must be validated, accredited, or certified by one of the following authorities:

- U.S. Army Corps of Engineers (USACE),
- National Environmental Laboratory Accreditation Conference (NELAC), or
- State Agency in which the site is located.

The contract laboratory is chosen by Weston on a per-investigation basis. They may be required to provide the USACE with documented procedures, resumes of personnel, and laboratory QA program information to verify that the laboratory has appropriate experience and expertise to perform the analyses.

In the event that sampling schedules and laboratory capacity conflict, the primary laboratory may subcontract another USACE-certified (or NELAC- or State-certified) laboratory to perform analyses. In this case, the primary laboratory must seek written approval from WESTON with USACE's consent. Any secondary laboratory will be bound by the QA/QC procedures documented in this CSAP.

Responsibilities for the key laboratory personnel are described in the following sections.

2.2.1 Laboratory Director

The Laboratory Director is in charge of all laboratory activities and must sign off the analytical deliverables. This person is ultimately responsible for making sure all tasks are conducted in compliance with this QAPP.

2.2.2 Laboratory Project Manager

The Project Manager is responsible for scheduling project requirements, monitoring analytical status/deadlines, approving laboratory reports, and coordinating data revisions/corrections and resubmitting packages to project staff. The Project Manager will ensure that laboratory personnel understand and conform to this QAPP. This person, or his designees, will also inform WESTON regarding field practice (e.g., sample preservation) not conforming to this QAPP.

The Project Manager shall be the point of contact with WESTON technical and subcontract lab personnel on technical issues pertaining to laboratory analytical work, and has overall responsibility of implementing the QAPP at the laboratory.

2.2.3 Laboratory Quality Assurance Officer

The Laboratory Quality Assurance Officer (QAO) is assigned by the contracted laboratory on a per-investigation basis. They will ensure conformance with authorized policies, procedures, and sound practices, and will recommend improvements as necessary. The QAO will inform the Project Manager of nonconformance to the QA program and introduce control samples into the sampling train. In addition, the QAO will approve laboratory data before reporting or transmittal to permanent storage and be responsible for retention of supporting information such as control charts and other performance indicators to demonstrate that the systems that produced the data were in control. The QAO will also review results of internal QA audits and recommended corrective actions and schedules for their implementation. This person must be independent of the laboratory's daily operation.

2.2.4 Area Supervisors

The laboratory technical staff in sample management, sample preparation, organic analysis, metal analysis, and other non-metal chemical analyses must be supervised by persons familiar with the prescribed procedures, the calibration, or test methods, and the assessment of the results.

These area supervisors are to ensure data reporting is in compliance with prescribed analytical method and to communicate project-related difficulties and/or non-conformance that may impact data quality or project progress to the Project Manager (and the QAO if applicable), who in turn shall inform WESTON Project Manager about these difficulties and/or non-conformance.

SECTION 3.0
FIELD INVESTIGATIONS

3.1 NON-INVASIVE DATA COLLECTION METHODS

3.1.1 Surveying

Groundwater investigations require surveying to ensure accurate data collection. The location and elevation of the top of the innermost casing of all new monitoring wells will be surveyed by a New Jersey licensed surveyor. Elevations will be surveyed to within ± 0.01 foot and reported in feet above Mean Sea Level (MSL) using the National Geodetic Vertical Datum of 1988 (NGVD 88). Staff gauges will be surveyed in the same manner as monitoring wells. The locations and elevations of all monitoring wells will be determined with respect to on-site benchmarks. The horizontal coordinates will be measured to within ± 1 foot using the State Planar coordinate system, and will be referenced to the North American Datum of 1983 (NAD83).

Soil borings, surface soil, and sediment sample locations will also be horizontally surveyed. Locations of soil and sediment samples may be recorded using a global positioning system (GPS) unit with submeter accuracy, properly calibrated and operated by a qualified user. Approval for survey data collection using GPS should be obtained by reviewing agencies in advance.

GIS Reporting Requirements

All map figures included in the RI sampling reports will be scaled and will contain an orientation designation (e.g., North arrow). Sample locations, sample depths, field identification numbers, and contaminant concentrations will be plotted on the appropriate figures. Where an entire contaminant class is not detected or is less than the applicable remediation standard, contaminants may not be listed individually. All individual maps will have a common coordinate system and contain details and features contained on the site base map.

3.1.2 Surface Geophysics

Surface geophysical instruments/methods measure the response of the earth to induces electrical or acoustical energy, or measure variations in natural potential fields. Changes in the parameters that are measured can be related to the variations in the local geology, the extent of contaminant plumes, or the presence of buried materials. Geophysical methods are most effective when used in conjunction with conventional drilling or boring programs, and can be used to guide such programs. A detailed SOP for several surface geophysical techniques is presented in Appendix A of this document.

3.2 INVASIVE DATA COLLECTION METHODS

The following subsections detail specific procedures and protocols used as guidance for activities and equipment utilized for obtaining environmental samples. Prior to conducting any invasive subsurface investigations, the position of any underground utilities within easements and public roadways will be located by a representative from the respective utility company. The process of initiating the utility mark-out involves a single phone call to a service that notifies the utility companies that may potentially have utilities in the intended area of work; this phone call must be made by the entity performing the invasive activity (e.g., drilling subcontractor). This is important since utility markouts usually end at the roadway, and utilities may extend from the roadway to the site buildings. If activities are proposed on private property, direct contact is made with property owners to ensure that utility lines are not present within the proposed work area. Utility blue-prints are typically used by contractors, utility representatives, and property owners to locate the buried utilities. These require ground-truthing at the site. If utilities are suspected in the area, hand augering should be used prior to intrusive activities to confirm that the proposed sample point or excavation is not intersected by a utility. Upon arrival at the site, observations are made around the area, as well as over head, to ensure that no obvious potential hazards exist. Geophysical surveys may also be performed to check for possible underground utilities/conduits prior to initiating invasive subsurface work

3.2.1 Conventional Drilling and Sampling Methods

There is no ideal drilling technique for all conditions; therefore, overburden, bedrock, and hydrogeologic conditions at the site, as well as project objectives should be considered before deciding which drilling method is appropriate. Based on information provided during previous drilling at the former Arsenal, hollow stem augering will be utilized for the installation of shallow overburden monitoring wells (<30 feet) unless another well installation method is proposed and authorized by the project-specific FSP. Conventional drilling methods may also be used for soil sampling depending on the geologic conditions expected to be encountered and proposed sample depth. It is anticipated that hollow stem augering will be utilized for soil sampling at depths greater than 30 feet below ground surface (bgs). Mud or air rotary drilling may be utilized for the installation of overburden wells greater than 30 feet if hollow stem augering is ineffective. Rotary methods will also be utilized for installing bedrock wells. Lithologic description and all field measurements and comments will be recorded on the Borehole Logging Forms.

Hollow-Stem Augering

The hollow-stem augering method involves the use of a hollow-stem auger with a cutting head mounted on the bottom. A plug is inserted into the hollow center of the cutter head to prevent soil from coming up inside the auger. The plug is connected to drill rods that rise through the auger flights to the top-head drive unit to ensure that the drill rods and the plug rotate with the flights. The center plug may be omitted in stiff or dense formations since very little soil will enter the stem.

The NJDEP requires that boreholes be a minimum of 4 inches (in diameter) larger than the well materials (e.g., screen and riser casing) being installed. Therefore, if a 2-inch monitoring well is being installed, the borehole must be at least 6 inches outside diameter (O.D.) to ensure proper emplacement of the filter pack, seal, and grout. Typically, hollow-stem augers that are 4 ¼ -inch inside diameter (I.D.) provide a borehole approximately 6 inches O.D., and provide enough annular space (i.e., within the hollow stem of the auger flights) to properly build the well with filter pack, seal, and grout. In general, subsurface soil sampling at the former Arsenal has been conducted using either 2-inch O.D. or 3-inch O.D. split spoon samplers. Typically, 4 ¼-inch minimum I.D. hollow-stem augers are used so that a 3-inch split spoon sampler can fit through the flights with no difficulty. Appendix B contains NJDEP well construction diagrams depicting acceptable protocols for both overburden and bedrock monitoring wells installed in New Jersey (*NJDEP Field Sampling Procedures Manual (May 1992)*).

Rotary Drilling

Rotary drilling techniques typically consist of drilling rods, a bit, and some type of circulation media (usually mud or air) to return cuttings up and out of the borehole.

Mud Rotary Method

The mud rotary method rapidly rotates the drill bit to advance the borehole by cutting and pounding the material at the bottom of the hole into smaller pieces. Cuttings are removed by pumping drilling fluid (potable water or potable water mixed with bentonite) down through the drill rods and bit, and up the annulus between the borehole and the drill rods. The drilling fluid also serves to cool the drill bit and, in unconsolidated formations, prevents the borehole from collapsing. Two types of bits may be used, the tricone or the hammer-head. The mud used during this process will be high-grade pure bentonite fluids of acceptable quality.

Air Rotary Method

The air rotary method is the same as the mud rotary method except that compressed air is pumped down the drill rods and returns with the drill cuttings up through the annulus. The air rotary method is generally limited to consolidated and semi-consolidated formations. Casing is sometimes used to prevent borehole collapse in semi-consolidated formations. The air must be filtered to prevent introduction of contamination into the borehole.

3.2.2 Soil Sampling and Handling

Soil samples may be collected using a variety of methods and equipment. The methods and equipment used are dependent on the depth of the desired sample, the type of sample required (disturbed versus undisturbed), and the soil type. Near-surface soils may be easily sampled using a spade, trowel, and scoop (for non-volatile parameters). Sampling at greater depths may be performed using a hand auger, continuous flight auger, a split-spoon, or, if required, a backhoe.

All soil samples retrieved from split-spoon samplers will be described by a qualified Weston geologist utilizing Weston's Standard Soil Logging Form (Appendix C). Using this form will help to ensure that all soil lithology for the project is recorded in a consistent and concise manner. Logs completed in the field will be brought back to the office and entered into the WINLOG™ software package created by the company GAEA Technologies Ltd for graphical presentation (Section 3.4.3).

3.2.2.1 Surface Soil Sampling (Trowels, Augers)

Collection of samples from near-surface soil will be accomplished with tools such as stainless steel trowels, coring devices and scoops. Surface material will be removed to the required depth with this equipment. Non-volatile organic fractions will be collected from zero to six inches bgs while volatile organic fractions will be collected from 18 to 24 inches bgs. Volatile organic fractions will be collected with a coring device.

The following procedure will be used to collect surface soil samples:

- Carefully remove the top layer of soil or debris to the desired sample depth with a pre-cleaned spade. If soils are to be collected from zero to six inch bgs, debris will be removed prior to sample collection.

- Volatile organic fractions will be collected with a coring device to minimize agitation and decrease volatilization. Except for samples approved under work plans in effect prior to the 19 May 1996 adoption of the NJDEP Technical Requirements (N.J.A.C. 7:26E) volatile organic fractions will be retrieved first from the sampling device (e.g., split spoon, direct push sampling sleeve), using an EnCore® sampling device. EnCore samplers should be used strictly in accordance with the manufacturer's direction. Alternatively, soil samples for volatiles analysis may be collected in accordance with the NJDEP methanol-preservation method (N.J.A.C. 7:26E-2.1(a)4) presented in Appendix D to allow for operational flexibility in the field. Care will be taken to ensure that the volatile organic fraction is collected from 18 to 24 inches bgs, except that post-excavation soil samples for volatile organic analysis will be collected from 0 to 6 inches below the bottom of the excavation if collected within 24 hours of excavation, or from the 6 to 12 inch interval if collected more than 24 hours following excavation. The samples will be placed in coolers and chilled to 4°C. If no other analytical parameter is being collected, or if volatile organic fraction samples are being analyzed at a separate laboratory from the remainder of the environmental samples, then a sample for percent moisture must also be collected and shipped with the aliquots sent for volatile fraction analysis.

- Following collection of the volatile organic fraction, the remainder of the sample will be placed into a decontaminated stainless steel or other appropriate homogenization container, and mixed in accordance with the "coning and quartering" method. After the non-volatile fractions of sample are placed in the container, the sample is mixed. The sample is then quartered, with each quarter mixed again. Once each quarter is mixed, each quarter is rolled to the center of the container and the entire sample is mixed again.

The remainder of the sample containers should then be filled by precedence of volatility in the following order:

- Purgeable organic carbons (POC),
- Purgeable organic halogens (POX),
- Total organic halogens (TOX),
- Total organic carbon (TOC),
- Base neutral/acid extractables (BNA) also referred to as semivolatile organic compounds (SVOC), of which polynuclear aromatic compounds (PAH) are a subset,
- Total petroleum hydrocarbons (TPHC)/ Oil and grease,
- Polychlorinated biphenyls (PCBs)/pesticides/herbicides,
- Explosives,
- Metals,
- Phenols,
- Cyanide, and
- Radionuclides.

Sample fractions will be placed into appropriate, labeled containers, and caps will be tightly secured. The samples will then be placed in coolers and chilled to 4°C.

For collection of volatile fraction soil samples, EnCore is preferred over the use of the field-preservation with methanol since samples collected using EnCore generally have detection limits an order of magnitude lower than those preserved in the field with methanol. However, the sample volume requirements from the laboratory should be closely evaluated; generally 2 or 3 EnCore sampling devices are required per sample to obtain sufficient sample volume for analysis, with additional volume required for matrix spike/matrix spike duplicate samples. The cost of multiple EnCore sampling devices for each sample should be taken into account during project planning/budgeting.

3.2.2.2 <u>Subsurface Soil Sampling (Augers, Thin-Wall Tube Samplers, and Split-Spoon Samplers)</u>

This sampling system consists of an auger, or a thin-wall tube sampler, a series of extensions, and a "T" handle. The sampler shall be constructed of teflon or stainless steel and will be decontaminated before use. The auger is used to bore a hole to a desired sampling depth, and the sample may be collected directly from the auger. If a core sample is to be collected, the auger tip is then replaced with a thin-wall tube sampler. The system is then lowered down the borehole, and driven into the soil to the completion depth. The system is withdrawn and the core is collected from the thin-wall tube sampler.

The following procedure will be used for collecting soil samples with the auger:

1. Attach the auger bit to a auger extension rod, and attach the "T" handle to the rod.

2. Clear the area to be sampled of any surface debris (e.g., twigs, rocks, litter). It may be advisable to remove the first several inches of surface soil for an area approximately six inches in radius around the drilling location.

3. Begin augering, periodically removing and depositing accumulated soils onto a plastic sheet spread near the hole. This prevents accidental brushing of loose material back down the borehole when removing the auger or adding extension rods. It also facilitates refilling the hole, and avoids possible contamination of the surrounding area.

4. After reaching the desired depth, slowly and carefully remove the auger from the boring. When sampling directly from the auger, collect the sample after the auger is removed from the boring and proceed to Step 10.

5. Remove auger tip from the rods and replace with a pre-cleaned thin-wall tube sampler. Install the proper cutting tip.

6. Carefully lower the tube sampler down the borehole. Gradually force the tube sampler into soil. Care should be taken to avoid scraping the borehole sides. Avoid hammering the rods to facilitate coring as the vibrations may cause the boring walls to collapse.

7. Remove the tube sampler, and unscrew the rods.

8. Remove the cutting tip and the core from the device.

9. Discard the top of the core (approximately one inch), as this possibly represents material collected before penetration of the layer of concern.

10. Samples for chemical analysis should be collected as described in Section 3.2.2.1

11. If another sample is to be collected in the same hole, but at a greater depth, reattach the auger bit to the extension rod assembly, and follow steps 3 through 11, making sure to decontaminate the auger and tube sampler between samples.

12. Abandon the hole according to applicable NJDEP regulations.

When drilling in an area where no geologic information has been previously collected, continuous split-spoon samples will be collected and described. The procedure for split-spoon sampling consists of the collection and extraction of undisturbed soil cores of 18 or 24 inches in length. A series of consecutive cores may be extracted with a split-spoon sampler to give a complete soil column profile, or an auger may be used to drill down to the desired depth for sampling. The split spoon is then driven to its sampling depth through the bottom of the augered hole and the core extracted.

When split-spoon sampling is performed to gain geologic information, all work will be performed in accordance with ASTM D 1586-67 (reapproved 1974). Split spoons will be constructed of stainless or carbon steel.

The following procedures will be used for collecting soil samples with a split spoon:

1. Assemble the sampler by aligning both sides of barrel and then screwing the drive shoe on the bottom and the head piece on top.

2. Place the sampler in a perpendicular position on the sample material.

3. Using a well ring, drive the tube.

4. Record in the site logbook or Soil Logging Form the length of the tube used to penetrate the material being sampled, and the number of blows required to obtain the interval sampled.

5. Withdraw the sampler, and open by unscrewing the bit and head and splitting the barrel. The amount of recovery and soil type will be recorded on the Soil Logging Form. If a split sample is desired, a cleaned, stainless steel knife will be used to divide the tube contents in half, longitudinally. This sampler is typically available in two and 3.5 inch diameters. However, in order to obtain the required sample volume, use of a larger barrel may be required.

6. Collect the sample as described earlier in this section. Collect volatile organic fractions first, then retrieve the remainder of the sample, homogenize, using the "coning and quartering" method and place into sample containers.

3.2.3 Direct Push Sampling Technology

3.2.3.1 Geoprobe Equipment

Several screening techniques are available at the present time. A device referred to as Geoprobe®, manufactured by Geoprobe Systems located in Salina, Kansas, has been selected as the preferred sample collection device for use during environmental media investigations at the former Arsenal. An assortment of sampling devices provided with the system allows for the collection of soil gas, groundwater, and soil samples. Weston intends to use this system for the collection of shallow groundwater and soil samples.

The Geoprobe system consists of a hydraulically powered percussion hammer which is truck- (or smaller vechicle-) mounted. The vehicles use hydraulic pumps belt-driven by the vehicle engine to provide power to the probing unit. However, auxiliary engine type probe units are also utilized.

One function of the carrier vehicle is to provide static weight for advancement of the probing tools. In practice, probing tools are advanced as far as possible using only the static weight of the carrier vehicle. Applied static force varies with the weight and cargo of the carrier, as well as, the distance that the probe unit is positioned from the carrier. This static force is often sufficient to advance a one-inch diameter tool string to depths of 20 feet in soils consisting of silts or low friction clayey silts.

Greater depth is achieved using the combined effect of the vehicle weight and hydraulic hammer percussion. Although various hammer configurations have been used in the field, the most common in use today applies an impulse force of 600 to 1,200 pounds on the top of the probing tool string at a frequency of 30 Hertz.

Percussion is often required when probing through hard packed soil and gravel zones. The probe is allowed to penetrate using only static force until refusal is encountered, at which time percussion is reapplied. Percussion is applied as required when probing through sands, gravels, hard pans, high friction clays, tills, fill materials, and surface frost. Advancement of probing tools beyond a depth of 20 feet without the use of percussion is rare in all geologic settings. Depths up to 75 feet can be obtained using percussion.

3.2.3.2 Shallow Groundwater Screening Technique

The Geoprobe system will be utilized to determine the extent of contamination of concern in the shallow groundwater at the former Arsenal. The following discussion describes the shallow groundwater sampling technique.

The shallow groundwater sampling will follow NJDEP methods presented in the *Alternative Ground Water Sampling Techniques Guide, NJDEP, July 1994.* The shallow groundwater samples will be collected in accordance with either NJDEP Method Number AGWST 4.00 (groundwater sampling with the use of a passively placed, narrow-diameter point [PPNDP]) or AGWST 5.00 (groundwater sampling with the use of a small-diameter direct-push point [SDDPP]).]). The project team will determine the preferred method for each field assignment based on a variety of factors; the recommended method will be specified in the project-specific work plan.

AGWST 5.00 utilizes a SDDPP with an expendable point which is detached from the probe at the base of the borehole. Either a telescoping screened point or mill-slotted casing is then allowed to fill with formation water. Weston will utilize the method which is appropriate for the local subsurface conditions. If the AGWST 5.00 method does not work in the local geology, then AGWST 4.00 may be utilized. Method AGWST 4.00 utilizes a PPNDP, which is a small diameter screened casing, passively placed in a borehole. The casing can be constructed of stainless steel, carbon steel, or PVC.

Once the shallow groundwater points have been installed, they will be purged (if necessary) and sampled in accordance with the *NJDEP Field Sampling Procedures Manual, May 1992.* All down-hole equipment including rods, well points, and bailers will be decontaminated prior to use. Installation of the shallow groundwater sampling points will be temporary (less than 48 hours) and the boreholes will be abandoned in accordance with NJDEP procedures.

Care should be taken to avoid or minimize property damage (e.g., lawns) from drilling activities in developed areas of the site. Drilling activities should be discouraged immediately after heavy precipitation events that allow ruts to form in soft soils.

3.2.3.3 Soil Sampling Technique

Soil samples may be collected during the RI using the Geoprobe system. Soil samples will be collected using 2-inch diameter 4-foot or 5-foot long macro samplers. The macro samplers will have acetate liners. After driving and retrieving the macro sampler using the Geoprobe system, the acetate liner will be cut open, the soil screened for VOCs using either a FID or PID, and then the appropriate soil samples will be collected for immunoassay/laboratory analyses. Soil sampling will follow the procedures discussed in Section 3.2.2.1.

If called for in the project-specific work plan, headspace screening will be performed with either a PID or FID, at a frequency specified in the work plan. If soil samples are to be collected beneath a building slab, then a hole saw or other appropriate tool will be used to penetrate the building slab prior to use of the Geoprobe to collect the soils samples beneath the building slab. Following subslab sampling, the building floor will be patched with concrete.

3.2.4 Monitoring Well/Piezometer Construction

Well Construction

Two types of monitoring wells will be installed by Weston: overburden wells and bedrock wells. Piezometers (or observation wells) may also be installed in the overburden in certain areas throughout the former Arsenal for the primary purpose of collecting static water level data. The construction and development of these piezometers/observation wells will be identical to a 2-inch overburden monitoring well so that, if necessary, groundwater samples may be obtained from them.

Well construction information is included on the Well Construction Form for each well installed. At a minimum, the well construction information will show depth from surface grade, the bottom of the boring, the screened interval, casing material, casing diameter, gravel pack location, grout seal and height of riser pipe above the ground.

Bedrock Wells

Wells completed in bedrock will be drilled using drilling methods such as the air or mud rotary method. Bedrock wells may be completed as an open-hole, providing that borehole cave-in is not a problem. If the open borehole is subject to cave-in, the well(s) will be completed as screened and cased sand-packed wells.

Boreholes for bedrock wells will be advanced until a minimum of 10 feet of competent rock has been drilled. Minimum borehole diameter will be six inches. The drill string will then be pulled from the borehole and 2-inch I.D. Schedule 40 PVC casing inserted. A NJDEP specified cement/bentonite grout will be tremied into the hole up the annular space outside the casing.

After the grout has set (minimum of 24 hours), the borehole will be advanced to provide a 10-foot open borehole.

If the bedrock well needs to be completed with riser and screen, the casing will be 2-inch ID PVC. Screen size will be 0.010 inch (ten-slot) or as determined by the site hydrogeologist. The standard length of screen used will be 10 feet unless otherwise specified in the work plan. Casing sections will be flush-threaded. Screw-threaded bottom plugs will be used. To prevent introduction of contaminants into the well, no glue-connected fittings will be used.

Once the casing/screen is in place in the wells, sand pack will be added. Only washed and bagged, rounded silica sand with a grain-size distribution compatible with the screen and formation will be utilized. Sand will be placed using the tremie method. The pack material will extend from one foot below the bottom of the screen to a minimum of two feet above the screen.

A bentonite slurry seal of a minimum 2-foot vertical thickness will be placed in the annular space above the sand pack to separate the sand pack from the cement surface seal and to prevent infiltration of cement into the filter pack and the well screen. The slurry will be prepared by mixing powdered or granular bentonite with potable water. The slurry must be of sufficiently high specific gravity and viscosity to prevent its displacement by the grout to be emplaced above it. The bentonite slurry will be pumped through a tremie pipe and emplaced directly above the sand pack. This seal will be allowed to “set up” (or begin to solidify) for approximately 30 to 60 minutes prior to grouting up the remaining annular space.

An NJDEP-approved cement/bentonite grout will be used to seal the remaining well annulus. Only high-grade bentonite will be used for this grout. The final mixture will be wet enough to be pumpable. The grout will be pumped through a tremie pipe which will be placed just above the top of the bentonite seal after the seal has been allowed to set. The grout will be pumped until undiluted grout is detected at the surface. The tremie pipe will then be removed, and additional grout will be added to compensate for the volume of the tremie pipe.

A protective steel casing will be placed around the exposed PVC well casing and will extend a minimum of 3 feet bgs. The protective casing will be grouted in and a cement pad will be constructed around each protective casing ensuring cement slopes away from the casing. Vent holes will be drilled in the riser pipe and protective casing to vent moisture. In addition, a small hole will be drilled into the base of the protective casing to drain rain water between the casing and well. The protective casing will include a hinged cap which will be padlocked for protection. The padlocks will either have identical keys, or be keyed for opening with one master key. Flush mounted well completions may be used for wells installed within high traffic areas. All wells will be constructed in a manner which prevents damage from thaw/freeze conditions (i.e., frost sleeve installation).

If a semi-confining unit such as clay is encountered above bedrock during the installation of the bedrock well in an area where contaminants have been identified or are suspected, an 8-inch steel casing will be installed into the upper portion of the confining/semi-confining unit (minimum of 2 feet) to prevent cross contamination of water bearing zones. The annular space around the casing will be grouted to the surface. A 6-inch bit will then be placed inside the steel casing and the bedrock well will be completed as previously specified.

The number of each well and permit number will be clearly marked on the well protective casing by impact numbering.

Overburden Well Construction

Any of the drilling methods discussed in this SOP can be used to drill and/or set a well in the overburden. The hollow-stem auger method is the preferred choice for shallow (<30 ft.) overburden wells.

The annular space between the well screen and the boring is filled with a uniform gravel/sand pack to serve as a filter media. For wells deeper than approximately 50 feet, or when recommended by the site geologist, the sand pack is emplaced using a tremie pipe. A sand slurry composed of sand and potable water is pumped through the tremie pipe into the annulus throughout the entire screened interval, and over the top of the screen. It is necessary to pump sufficient sand/gravel slurry to cover the screen after the sand/gravel pack has densified and settled.

The depth of the top of the sand shall be determined, thus verifying the thickness of the sand pack. Additional sand shall be added to bring the top of the sand pack to approximately two to three feet above the top of the well screen. Under no circumstances should the sand pack extend into any aquifer other than the one to be monitored. In most cases, the well design can be modified to allow for a sufficient sand pack without threat of crossflow between producing zones through the sand pack.

In materials that will not maintain an open hole using hollow-stem augers, the temporary or outer casing is withdrawn gradually during placement of sand pack/grout. For example, after filling two feet with sand pack, the outer casing should be withdrawn two feet. This step of placing more gravel and withdrawing the outer casing should be repeated until the level of the sand pack is approximately three feet above the top of the well screen. This ensures that there is no locking of the permanent (inner) casing in the outer casing.

A bentonite slurry seal of a minimum 2-foot vertical thickness will be placed in the annular space above the sand pack to separate the sand pack from the cement surface seal and to prevent infiltration of cement into the filter pack and the well screen. The slurry will be prepared by mixing powdered or granular bentonite with potable water. The slurry must be of sufficiently high specific gravity and viscosity to prevent its displacement by the grout to be emplaced above it. The bentonite slurry will be pumped through a tremie pipe and emplaced directly above the sand pack. This seal will be allowed to “set up” (or begin to solidify) for approximately 30 to 60 minutes prior to grouting up the remaining annular space.

For wells installed in the lower sands located beneath the extensive peat unit at the site, the bentonite seal shall extend to the top of the peat unit. This construction will eliminate the potential for migration of contaminants between the upper water-bearing zone and lower water-bearing zone.

A cement/bentonite grout will be placed from the top of the bentonite seal to the ground surface. Grout is pumped through a tremie pipe until undiluted grout flows from the annulus at the ground surface. In materials that will not maintain an open hole, the temporary steel casing should be withdrawn in a manner that prevents the level of grout from dropping below the bottom of the casing. Additional grout may be added to compensate for the removal of the temporary casing and the tremie pipe to ensure that the top of the grout is at or above ground surface. After the grout has set (about 24 hours), any depression due to settlement is filled with a grout mixture similar to that described above.

A protective steel casing will be placed around the exposed PVC well casing and will extend a minimum of 3 feet bgs. The protective casing will be grouted in and a cement pad will be constructed around each protective casing ensuring cement slopes away from the casing. Vent holes will be drilled in the riser pipe and protective casing to vent moisture. In addition, a small hole will be drilled into the base of the protective casing to drain rain water between the casing and well. The protective casing will include a hinged cap which will be padlocked for protection. The padlocks will either have identical keys, or be keyed for opening with one master key. Flush mounted well completions may be used for wells installed within high traffic areas. All wells will be constructed in a manner which prevents damage from thaw/freeze conditions (i.e., frost sleeve installation).

3.2.5 Monitoring Well Development

Well development is the process by which fine soil materials are removed from in and around the screen allowing water to flow freely into the well. This process is accomplished by moving water or air through the well screen into and out of the surrounding material. The well development process:

- Removes materials that have built-up in the openings of the screen during the well drilling and installation processes.

- Removes fines from the sides of the borehole that resulted from the drilling procedures, (e.g., drilling mud).

- Increases the hydraulic conductivity of adjacent geologic materials and the filter pack by removing fine materials.

- Stabilizes the fine materials that remain in the vicinity of the well and retards their movement into the well.

The benefits of well development are increased yields, reduced pumping of fines that can damage pumps, decreased corrosion and encrustation, and production of low-turbidity groundwater samples. The results of the development process is a layer of coarse particles adjacent to the screen. The percentage of finer particles increases with distance away from the well. Well development is necessary in any well because clogging can occur regardless of the drilling method used or the formation being penetrated.

Weston will initiate well development as soon as practical after installation, but no sooner than 48 hours after grouting is completed. Existing wells may also require development. This determination will be made following inspection by the field geologist.

There are a variety of methods that can be used in well development. Several are discussed below; however, pumping combined with surge blocking will be the preferred method. If well development goals are not met using this combined method, others will be utilized.

- Bailing - This method involves removing turbid water from a well using a bailer (usually the large type used on drill rigs rather than the type used for sample collection). The process of lowering and raising the bailer helps to move water into and out of the filter pack which flushes finer material into the well for removal. Bailing is a relatively ineffective method of well development; however, Weston may use bailing as a starting method in wells with very turbid water.

- Mechanical Surging - In this method, also called block surging, a surge block or surge plunger is pushed in and pulled out of the well in a plunger-like fashion. The plunger can be solid or valved. Valved plungers allow action on the downstroke and strong action on the upstroke, but care will be taken on the upstroke because screens can be collapsed. As fines are flushed into the well, they will be bailed or pumped.

- Overpumping - This method involves pumping at high rates, then allowing the well to recover before pumping again. This method assumes that the hydrogeologic system will then be stable at normal pumping rates. When the pumps are stopped, backwash helps overcome bridging. While this method is simple and quick, it is also minimally effective. Overpumping may be used as a finishing method.

Criteria used to determine when development is complete are provided below. These criteria will be considered as goals.

- Water appearance (e.g., continue until opaque or translucent water becomes transparent or clear).

- Turbidity (e.g., goal of less than 50 NTU as determined by a nephelometer).

- Flow rate (e.g., continue until maximum flow rate stabilizes).

- Water volume (e.g., remove at least 3 to 5 times the well volume in high yielding wells).

- Field parameters (e.g., continue until temperature, specific conductance, and pH stabilize). Stabilization is defined as less than 10 percent variation.

Specific procedures to be followed during well development are summarized below:

- Open the monitoring well, take initial measurements (i.e., head space air monitor readings, water level, well depth, pH, temperature, and specific conductivity) and record results in the site logbook.

- Develop the well by the appropriate method (i.e., surging and pumping) to accommodate site conditions and project requirements. Dispersing agents, acids, or disinfectants will not be used to enhance development of the well.

- Continue until the development goals above are achieved.

- Containerize discharge water if required.

- All data will be recorded on a Well Development Form.

- Decontaminate equipment as appropriate prior to use in the next well.

3.2.6 Monitoring Well Abandonment

Periodically during the investigation, there may be a need to abandon selected monitoring wells. Upon approval of the USACE and NJDEP, monitoring wells will be abandoned in accordance with the requirements of N.J.A.C. 7:9-9.1 through 9.4 (Sealing of Abandoned Wells). Abandonment activities will be conducted by a N.J.-licensed and certified Well Driller and Well Sealer. A Well Abandonment Report will be submitted to the NJDEP Division of Water Resources. Specific well abandonment protocols and a copy of a Well Abandonment Report are presented in Appendix E.

3.2.7 Water Level Measurements

A survey mark will be clearly placed on the casing for use as a reference point for measurement. Generally, the reference point is made at the top of the well casing or "stickup" (not the protective casing). All field personnel will be notified of such reference point in order to ensure comparable data and measurements.

Prior to measurement, water levels in monitoring wells will be allowed to stabilize for a minimum of 24 hours after well construction and development. In low yield situations, recovery may take longer. All measurements will be made to an accuracy of 0.01 ft.

In general, measurements should proceed from least to most contaminated wells. Where many wells are to be sampled (i.e., greater than ten), measurements may be taken in a systematic manner to insure efficiency and accuracy. Open the well and monitor headspace with the appropriate monitoring instrument to determine the presence of volatile organic compounds. Measure the total depth of the well using the survey mark and a depth sounder.

Next, lower the water level measuring device into the well until the water surface is encountered. Measure the distance from the water surface to the reference point on well casing and record in the site logbook and/or a groundwater level data form. Remove all downhole equipment, decontaminate as necessary, and replace the casing cap. If floating hydrocarbon product is present, a special dual-phase level indicator will be used. Any physical changes to the protective concrete pad or variation in total depth of the well should also be noted in the logbook and/or form.

3.2.8 Groundwater Sampling Procedures

Prior to sampling a monitor well, the well will be purged to remove water that may have stagnated in the well, and to introduce fresh groundwater into the well for sampling. This can be achieved with one of a number of instruments. The most common of these are the bailer and/or pump. Weston plans to utilize low-flow rate submersible pumps to purge and sample the monitoring wells. Recent research by the EPA has concluded that this method of purging and sampling results in the collection of samples with low turbidity levels. Studies have confirmed that this method produces greater sample quality, accuracy and reproducibility over samples collected through more conventional methods such as bailing (R. Puls and R. Powell, 1992, Groundwater Monitoring Review). According to these studies, samples collected with this method typically contain turbidity levels less than 5 NTUs, even if fine materials are present in the formation. Since the overburden beneath the former Arsenal consists of primarily fine-grained materials and a majority of the samples are being collected for metals analysis, special consideration to turbidity levels is required.

Low-flow rate pumps may include Well Wizards, submersible Johnson Keck, or Grundfos pumps, or other similar equipment. Weston intends to use a 2-inch Grundfos Redi-Flo submersible pump with the BT1/MP1 converter box to regulate flow rates. These pumps will be used for both purging and sampling, unless a well exhibits such low yield/recharge that pumping becomes impractical. In cases where well yield/recharge is very low, a bailer or WaTerra pump (inertial pump) may be used for development, purging, and sampling in accordance with procedures outlined in the NJDEP's *Field Sampling Procedures Manual (May 1992)*. For wells with short water columns above the screens, the pumps will be set immediately above the well screen. For wells with longer water columns, the pump will be initially set at the top of the water column and slowly lowered during purging. The pump will not be lowered into the screened interval. Water level measurements will be taken as appropriate to ensure that the water column does not extend below the top of the well screen, thereby eliminating exposure of the well screen to air.

The wells will be purged until a minimum of three to five well volumes have been removed or field parameters (e.g., temperature, specific conductance, pH, turbidity, D.O., and Eh) stabilize. Stabilization is defined as less than 10 percent variation. Section 3.3.4 discusses how each of these parameters will be measured. Less than three volumes may be removed from low yielding wells. Groundwater samples will be collected immediately following purging using the same adjustable low-flow rate pumping equipment (i.e., within 2 hours if sufficient recharge is available). Flow rates will be approximately 100 ml/min during sampling. The pump will be lowered into the middle of the screened interval during sampling in order to obtain a representative sample. Since flow rates during sampling will be minimal, the potential of exposing the well screen will essentially be eliminated. If water level information obtained during purging indicates otherwise, the pump will be set immediately above the well screen during sampling.

Equipment will be decontaminated prior to use and between monitoring wells. Once purging is completed and the correct laboratory-cleaned sample containers have been prepared, sampling will immediately proceed. The following order of sample fraction collection will generally be followed; however, field conditions and well yield may require field decisions to modify the order on a case by case basis:

1. pH, conductivity and temperature.
2. Volatile organics.
3. Metals.
4. Extractable organics including explosives.
5. Cyanide.
6. FS parameters (oil and grease, TDS, hardness, etc.).

The type of analysis for which a sample is being collected determines the type of bottle, preservative, holding time, and filtering requirements. Samples should be collected directly from the sampling device into appropriate laboratory cleaned containers. Further information concerning sample containers is provided in Section 3.2.17.

Samples shall be appropriately preserved, labeled, logged, and placed in a cooler to be maintained at 4°C. Samples will be shipped well before the holding time is up and in most cases will be shipped within 24 hours of sample collection. The bottles will be shipped with adequate packing and cooling to ensure that they arrive intact.

3.2.9 Hydraulic Conductivity (Slug Tests)

A slug test involves the instantaneous injection or withdrawal of a volume, or slug of water or solid cylinder of known volume. This is accomplished by displacing a known volume of water from a well and measuring the artificial fluctuation of the groundwater level.

There are numerous advantages to using slug tests to estimate hydraulic conductivities. First, estimates can be made in-situ, thereby avoiding errors incurred in laboratory testing of disturbed soil samples. Second, tests can be performed quickly at relatively low costs because pumping and observation wells are not required. And lastly, the hydraulic conductivity of small discrete portions of an aquifer can be estimated (e.g., sand layers in a clay). Appendix F contains a detailed SOP for conducting a standard slug test.

3.2.10 Indoor Air Sampling

This procedure is applicable to collection of representative air sampling for VOC analysis from the breathing zone within buildings. The locations and numbers of samples will be determined during work plan development in accordance with the *Approach for Evaluating Potential Indoor*

Air Quality Impacts, Former Raritan Arsenal (USACE 2004, referred to as the "IAQ Approach"), and will be selected to provide coverage as well as samples that are representative of the building conditions. A background ambient air sample should be collected at each location/building, with NJDEP approval regarding the location. The background air samples should be collected from either the roof (next to the fresh air intake) or at ground level as far from pedestrian and vehicle traffic as possible.

Under the IAQ Approach, buildings are inventoried prior to sampling to determine if there are potential sources of VOCs or other contaminants from products being used or manufactured at the facility being evaluated. The sampling team must secure access to the facility in advance, and coordination with the facility manager is essentially to avoid disrupting their operations and to ensure that sampling is undertaken at appropriate locations. Indoor air sample locations should be agreed upon during the building survey in coordination, with the building owner, tenants, and the NJDEP. Indoor air samples should be located in the breathing zone (3-5') to approximate human risk exposure. Indoor air samples should be placed on tables or desks out of the tenants' way.

Request that occupants follow these instructions 48 hours prior to and during sampling:

- Operate your furnace and whole house air conditioner as appropriate for the current weather conditions.
- Do not use wood stoves, fireplaces or auxiliary heating equipment.
- Do not open windows or keep doors open.
- Avoid using window air conditioners, fans or vents.
- Do not smoke in the building.
- Do not use air fresheners or odor eliminators.
- Do not use paints or varnishes (up to a week in advance, if possible).
- Do not use cleaning products (e.g., bathroom cleaners, furniture polish, appliance cleaners, all purpose cleaners, floor cleaners).
- Do not use cosmetics, including hair spray, nail polish remover, perfume, etc.
- Avoid bringing freshly dry cleaned clothes into the building.
- Do not partake in hobbies indoors that use solvents.
- Do not apply pesticides.
- Do not store containers of gasoline, oil or petroleum based or other solvents within the building or attached garages (except for fuel oil tanks).
- Do not operate or store automobiles in an attached garage.
- Do not operate gasoline powered equipment within the building, attached garage or around the immediate perimeter of the building.

The following procedures are to be followed when collecting samples of indoor air:

1. Attach Regulator to 6-Liter Summa® Canister with wrench.

2. Place Summa Canister in location pre-determined during the building inspection.

3. Open regulator.

4. Ensure that the starting pressure is approximately -30 inches of mercury (or the same as stated on certification label) for the laboratory.

5. Record the canister number, regulator number and starting pressure on the field log sheet.

6. Leave the Summa Canister for 24 hours.

7. Leave a note adjacent to the canister requesting that the canister not be touched during the 24-hour sampling period. Notes should be printed in advance and should have a professional appearance with a Weston or facility contact number in the event that a canister needs to be moved.

8. Collect the air sample after 24-hours, by closing the regulator. The regulator should read between -5 inches of mercury and 0 inches of mercury.

9. Remove Regulator from the Summa Canister.

10. Complete the Sample Tag from the Laboratory and the Field Log Sheet.

A copy of the Field Log Sheet, and the standard operating procedure for indoor air sampling can be found in Appendix G.

3.2.11 Subslab Soil Gas Sampling

The subslab soil gas sampling point installation procedure for new sampling points is to be performed in accordance with the "*Draft NJDEP Vapor Intrusion Guidance Document*" (NJDEP, June 2005). This method is required for long-term monitoring of subslab soil gas as part of a remedial investigation/remedial action. The standard operating procedure for subslab soil gas sampling can be found in Appendix H.

3.2.11.1 Initial Subslab Soil Gas Sampling Procedure

The following procedure should be used during installation and initial sampling of subslab soil gas points:

1. Remove carpeting, if present (this may require cutting a small ½-inch square flap that can be glued back down after the sampling event is completed)

2. Put together vapor probe with thread seal tape [The vapor probe consists of a 3/8 inch by 2½ inch brass or stainless steel Pipe Nipple with a Fip Reducing Coupling (½ inch by 3/8 inch) and a Square Head Plug (½ inch)]. NOTE: The 2005 *Draft NJDEP Vapor Intrusion Guidance Document* calls for stainless steel vapor probes; however, the earlier version of the document allowed brass or stainless steel, and brass probes were installed in some buildings prior to June 2005 in accordance with that earlier document.

3. Drill a 3/8-inch diameter hole through the concrete slab using an electric drill with a ¾-inch drill bit.

4. Advance the drill bit approximately 9 inches through the concrete slab and into the subslab material to create an open cavity (most buildings in the former Raritan Arsenal have approximately 6-inch concrete slabs – the cavity needs to be approximately 3 inches into the subslab soil).

5. Over drill the top 1 inch (vertical) of the probe hole to a diameter of 1 inch.

6. Insert the vapor probe flush with the top of the concrete slab and add a quick-expansive cement to seal the hole. It is imperative that the vapor probe is completed flush with the concrete surface to avoid tripping hazards for the occupants of the building.

7. Allow the test point to cure for 24 hours to secure the vapor probe in place.

8. Connect the vapor probe to the "T" fitting using the Fip to Mip Street Elbow ("All Tube" Nut Sleeve and Insert [3/8-inch]). The "T" fitting is made of stainless steel flexible line and in-line valve.

9. Connect air sampling pump to the "T" setup.

10. Connect regulator to the Summa Canister and connect both to the "T" setup.

11. Open valve to portable vacuum pump.

12. Turn on portable vacuum pump at 100 ml/per minute to purge vapor probe through the purge line. (Calculate the total time based on the calculation in Section 3.2.11.3

13. Turn off vacuum pump and close valve.

14. Open the stainless steel Summa canister valve to collect a one-hour subslab soil gas sample.

15. Ensure that the starting pressure is approximately -30 inches of mercury (or the same as stated on certification label from the laboratory).

16. Record the canister number, regulator number, starting pressure, start date and time on the field log sheet.

17. After one (1) hour collect the sample by closing the regulator on the Summa Canister. The regulator should read between -5 inches of mercury and 0 inches of mercury.

18. Disconnect the "T" setup.

19. Remove the regulator from the Summa Canister.
20. Complete the Sample Tag from the Laboratory and the Field Log Sheet.
21. Place the cap on vapor probe.

3.2.11.2 Subsequent Subslab Soil Gas Sampling Procedure

The following procedure should be used for collecting subslab soil gas samples from locations at which a vapor probe has previously been installed:

1. Connect the vapor probe to the “T” fitting using the Fip to Mip Street Elbow.
2. Connect air sampling pump to the “T” setup.
3. Connect regulator to the Summa Canister and connect both to the “T” setup.
4. Open valve to portable vacuum pump.
5. Turn on portable vacuum pump to purge vapor probe through the purge line. (Purge volume is calculated per Section 3.2.11.3).
6. Turn off vacuum pump and close valve.
7. Open the stainless steel Summa canister valve to collect a one-hour subslab soil gas sample.
8. After one (1) hour close Summa Canister.
9. Ensure that the starting pressure is approximately -30 inches of mercury or the same as stated on certification label from the laboratory.
10. Record the canister number, regulator number and starting pressure on the field log sheet.
11. After one (1) hour collect the sample by closing regulator on the Summa Canister. The regulator should read between -5 inches of mercury and 0 inches of mercury.
12. Disconnect “T” setup.
13. Remove Regulator from the Summa Canister.
14. Complete the Sample Tag from the Laboratory and the Field Log Sheet.
15. Place cap on vapor probe.

3.2.11.3 <u>Calculating Purge Volume</u>

The vapor probe and connecting tubing must be purged at a volume of 100 ml/minute. The purge volume can be calculated using the following formula:

Purge Volume = $1.5*\pi*r^2*h$

Where: r=inner radius of the vapor probe, and
h= length of the vapor probe and connecting tubing

3.2.12 Surface Water Sampling

This standard operating procedure is applicable to the collection of representative liquid samples, both aqueous and non-aqueous from streams, rivers, lakes, ponds, lagoons, and surface impoundments. It includes samples collected from depth, as well as samples collected from the surface.

The sampling of both aqueous and non-aqueous liquids by use of either a Dip Sampler or Direct Method is presented below. Weston anticipates the use of the Direct Method for surface water sampling in all cases where access is not restricted. When surface water and sediment are to be collected from the same location, surface water samples should always be collected prior to sediment sampling at each location.

<u>Direct Method</u>

For streams, rivers, lakes, and other surface waters, the direct method may be utilized to collect water samples from the surface directly into the sample bottle. The direct method will be the preferred method of collection, especially when collecting samples for volatile organic analysis.

Using adequate protective clothing, access the sampling station by appropriate means. For shallow stream stations, collect the sample under the water surface while pointing the sample container upstream; the container must be upstream of the collector. Avoid disturbing the substrate. Sample collection will begin in the most downstream portion of the stream. For lakes and other impoundments, collect the sample under the water surface avoiding surface debris and turbulence.

When using the direct method, sample bottles without preservation will be used. All samples will then be preserved and checked for proper preservation.

<u>Dip Sampler</u>

A dip sampler is useful in situations where a sample is to be recovered from an outfall pipe or along a lagoon bank where direct access is limited. The long handle on such a device allows access from a discrete location. Sampling procedures are as follows:

1. Assemble the device in accordance with the manufacturer's instructions.

2. Extend the device to the sample location and collect the sample by dipping the sampler into the substance.

3. Retrieve the sampler and transfer the sample to the appropriate sample container.

The dip sampler will be constructed of non-reactive materials such as borosilicate glass, stainless steel or teflon. The sampler will be decontaminated prior to use.

3.2.13 Sediment Sampling

Sediment samples may be collected using a variety of methods and equipment, depending on the depth of the aqueous layer, the portion of the sediment profile required (surface versus subsurface), the type of sample required (disturbed versus undisturbed), contaminants present, and sediment type. Sediment samples will always be collected following surface water sampling at that location.

Sediment is collected from beneath an aqueous layer either directly, using a hand held device such as a shovel, trowel, or auger; or indirectly, using a remotely activated device such as an Ekman or Ponar dredge. Following collection, sediment is transferred from the sampling device to a sample container of appropriate size for the analyses requested. Hand held devices such as a hand auger or trowel will be the preferred method of collection when conditions allow.

Sample Collection

Selection of a sampling device is most often contingent upon: (1) the depth of water at the sampling location, and (2) the physical characteristics of the sediment to be sampled. The following procedures may be utilized:

Sampling Surface Sediment with a Trowel or Scoop from Beneath a Shallow Aqueous Layer

For the purpose of this method, surface sediment is considered to range from zero to six inches in depth and a shallow aqueous layer is considered to range from zero to 12 inches in depth. Collection of surface sediment from beneath a shallow aqueous layer can be accomplished with tools such as spades, shovels, trowels, and scoops. Although this method can be used to collect both unconsolidated/consolidated sediment, it is limited somewhat by the depth and movement of the aqueous layer. Deep and rapidly flowing water render this method less accurate than others discussed below. However, representative samples can be collected with this procedure in shallow sluggish water provided care is demonstrated by the sample team member. A decontaminated stainless steel trowel or scoop will suffice in most applications.

The following procedure will be used to collect sediment with a scoop, shovel, or trowel:

1. Using a decontaminated sampling implement, remove the desired thickness and volume of sediment from the sampling area.

2. Transfer the sample into an appropriate sample or homogenization container. Volatile samples will be collected first and transferred immediately to sample containers. Other

fractions will be placed into a decontaminated stainless steel container for homogenization. The "coning and quartering" method will be used.

3. Surface water will be decanted from the sample or homogenization container prior to sealing or transfer; care will be taken to retain the fine sediment fraction during this procedure.

Sampling Surface Sediment with a Bucket Auger or Tube Auger from Beneath a Shallow Aqueous Layer

For the purpose of this method, surface sediment is considered to range from zero to six inches in depth and a shallow aqueous layer is considered to range from zero to 24 inches in depth. Collection of surface sediment from beneath a shallow aqueous layer can be accomplished with a system consisting of bucket auger or tube auger, a series of extensions, and a "T" handle. The use of additional extensions in conjunction with a bucket auger can increase the depth of water from which sediment can be collected from 24 inches to 10 feet or more. However, sample handling and manipulation increases in difficulty with increasing depth of water. The bucket auger or tube auger is driven into the sediment and used to extract a core. The various depths represented by the core are homogenized or a subsample of the core is taken from the appropriate depth.

The following procedure will be used to collect sediment samples with a stainless steel bucket auger or tube auger:

1. Attach the auger head to the required length of extensions, then attach the "T" handle to the upper extension.

2. Insert the bucket auger or tube auger into the sediment at a 0^o to 20^o angle from vertical. This orientation minimizes spillage of the sample from the sampler upon extraction from the sediment and water.

3. Rotate the auger to cut a core of sediment.

4. Slowly withdraw the auger; if using a tube auger.

5. Transfer the sample or a specified aliquot of sample into an appropriate sample container.

3.2.14 Benthic Macroinvertebrate Collection for Taxonomy

For investigations requiring benthic macroinvertebrate community analysis, a work plan will be developed specifying the number of samples, locations, and data quality objectives. In studies of this nature, a minimum of three replicate samples should be collected for community analysis at each sample location. A Petite Ponar dredge will be used to collect standardized sample volumes for each replicate. In shallow (less than 3 ft) areas, the dredge may be operated while wading. At deeper water locations, the Ponar dredge should be operated from a workboat. Each replicate sample will consist of one successful Ponar grab in which the dredge is recovered with a full receptacle of sediment. Samples that do not have sufficient penetration depth, defined as the top of the sediment surface being within 1 inch of the top of the grab bucket, will be discarded and recollected. At each location, the three replicate samples will be collected from within a circular area with an approximate 20-ft radius.

Benthic macroinvertebrates shall be initially processed in the field to reduce the amount of fine sediment particles in the sample. Each sample shall be placed in a benthos wash bucket with a 500-micron stainless steel wire cloth and washed to separate the organisms from fine sediment. Ambient water will be carefully poured through the bucket to separate fine sediment particles from the benthos. To expedite the separation of the organisms from the sediment and debris, a fine stream of water from a spray bottle may be used to break up clumps of sediment. The material retained by the bucket sieve will be transferred to 32-ounce polyethylene containers and preserved with 70% denatured ethanol. To prevent damage to the organisms during transport and ease the sorting task, large debris, stones, and other extraneous material should be removed after ensuring that they were free of attached or clinging organisms.

Benthic macroinvertebrate samples shall be shipped to a subcontracted laboratory for sorting and taxonomic identification. Laboratory analysis of each benthic sample will follow procedures described in the USEPA Rapid Bioassessment Protocols (RBP) (USEPA 1999). Following the RBP for sub-sampling, a maximum of 100 organisms will be picked, sorted, and identified to the lowest practical taxon (generally genus level, although ideally to species when age and condition of specimen allow). In the case of Oligochaetes and other worms, these organisms will only be identified to family.

Ten percent of the sorted samples should be examined (re-picked) by laboratory QC personnel or a qualified co-worker. The QC worker will examine the grids chosen and tray used for sorting and will look for organisms missed by the sorter. Organisms found will be added to the sample vials. If the QC worker finds less than 10 organisms (or 10% in larger subsamples) remaining in the grids or sorting tray, the sample passes; if more than 10 (or 10%) are found, the sample fails. If the first 10% of the sample lot fails, a second 10% of the sample lot will be checked by the QC worker.

Voucher specimens (if extra are available) for identification verification shall be collected and stored in ethanol in glass containers, within appropriate secondary containment. Formalin or formaldehyde products should be avoided due to disposal costs and potential carcinogenic health issues. Voucher specimens will be kept until the final project report has been reviewed and approved or after 3 years, which ever is sooner. Sorted and identified benthic macroinvertebrate collections shall be stored under standard preservation at the taxonomy laboratory for a period of one year.

The following summary community metrics will be calculated for each replicate:

- Number of Individuals (N)
- Number of species/taxa (S)
- Diversity (Shannon-Wiener H')
- Evenness (Pielou's J')

- Hilsenhoff Biotic Index (HBI) as modified for soft-bottom communities (Hilsenhoff, 1987; Bode, 1988).

These resultant metrics will be used to characterize the community structure at each location and will be compared to results from the appropriate reference based on the sediment and habitat characteristics.

In-situ water quality measurements of temperature, pH, DO, and conductivity will be conducted with an electronic water quality analyzer (e.g., Horiba, YSI, etc.) and will be recorded in the site logbook at each sampling location on the day of field sampling.

3.2.15 Chronic Benthic Macroinvertebrate Bioassay Testing

Chronic solid-phase sediment bioassays test nonlethal endpoints such as growth in addition to survival. The objective of the study is to run bioassay tests along a range (gradient) of contamination so that concentrations of individual COPC parameters may be compared to organism survival and/or growth. If significant mortality of test organisms is not observed, then the COPCs can be ruled out as sources of ecological risk to these receptors. In the event that significant mortality or growth impacts are observed relative to the site background reference, the null hypothesis is not supported and further investigation may be required to determine the source of the mortality.

Chronic solid-phase sediment bioassay tests should be conducted on both the selected site locations as well as a reference area location, using the amphipod *Hyalella azteca* and the midge *Chironomus tentans*. These organisms are widespread in freshwater systems throughout the continental United States, and are commonly used in standard bioassay test studies conducted under USEPA oversight (USEPA 2000). Furthermore, *Hyalella azteca* is well suited to use at the former Arsenal because of its tolerance to a range of salinities, from freshwater up to 15 parts per thousand (ppt) (USEPA 1994). For comparison, salinities measured at the site waterways during the July 2004 field visit were not above 2 ppt.

Sediment samples for solid-phase sediment bioassay testing should be collected at each location using a Ponar dredge or alternative sediment sampling device in accordance with sediment sampling procedure described in Section 3.2.13. Approximately 3 gallons of sediment should be collected at each of the locations. The sediment should be homogenized in the field at each location, apportioned into sample jars, and shipped on ice to a contract laboratory for analysis of selected parameters.

The bulk sediment bioassay test samples should be stored at 4°C in tightly sealed buckets with little or no head space and shipped to a subcontracted laboratory for temporary storage prior to test setup. In certain cases, preliminary chemical analysis is conducted on the co-located sediment in order to help select appropriate bioassy test locations. Once analytical results are received, the actual samples for the chronic bioassay tests will be selected, and the tests will be initiated. Bioassay tests will be performed by an accredited laboratory according to procedures modified from those detailed in the USEPA manual, *Methods for Measuring the Toxicity and*

Bioaccumulation of Sediment-Associated Contamination with Freshwater Invertebrates, 2nd Edition, EPA/600/R-99/064, March, 2000 (USEPA 2000).

The currently proposed *Hyalella azteca* chronic bioassay test involves a modification of the 42-day test (Test Method 100.4, USEPA 2000) which ends the test at day 28, at which time survival and growth endpoints are measured. This modified test method has been employed by a number of bioassay testing laboratories that were contacted in relation to this test method (Aquatec Biological Sciences, Williston, VT; American Aquatic Testing, Allentown, PA; and Vizon Scitech, Vancouver, BC). Similarly, the proposed *Chironomus tentans* chronic bioassay test involves a modification of the life-cycle test (Test Method 100.5, USEPA 2000) which ends the test at day 20, at which time survival and growth endpoints are measured. This modified test method has been employed and reported by both State and Federal agencies (US Army ERDC 2003, Era and Serdar 2001, MPCA, 2004).

For the chronic bioassay tests, chambers will consist of 300 milliliter (mL) glass beakers. Eight replicate beakers per treatment will be used. Each beaker will receive 100 mL of sediment and 175 mL of overlying water. Ten organisms will be introduced into each test chamber at the time of test initiation, and survival and growth will be recorded at the end of the 28-day test for *Hyalella azteca* and at the end of the 20-day test for *Chironomus tentans*.

3.2.16 Organism Collection for Tissue Sampling

3.2.16.1 Fish Collection

A variety of collection techniques may be used to obtain a sufficient number of fish for tissue analysis. The preference is to use boat electroshocking (or backpack electrochocking, where applicable) due to its effectiveness in shallow water bodies such as are found across the former Arsenal. However, electroshocking may not be feasible in soft bottom areas or within brackish waters (due to the ineffectiveness of the electrical current circuit). Instead, other methods such as gill netting, trotlining, minnow trapping or even rod and reel sampling may be employed. Each sampling technique will be conducted according to a measurable unit effort so that capture success can be compared for each technique between sampling locations. All fish collection activities will adhere to the Health and Safety Plan (HASP) for the investigation. Field sampling personnel have been trained in the proper and safe use of all fish sampling equipment, including the safe use of electrofishing equipment.

Necessary scientific collecting permit/s will be obtained from the New Jersey Bureau of Freshwater Fisheries before any fish are collected. The names of all personnel involved in the collection activities will be listed on the permit. Permit conditions will be strictly followed during sampling activities.

Electroshocking

When required, electroshocking will be conducted primarily during twilight and daylight hours using a boat-mounted electroshocking unit. This unit consists of a Coffelt Mark XX variable voltage pulsator shocker powered by a Honda 3-horsepower generator fitted with a boom-mounted sphere anode or a hand-held wand, an 18-inch dual hoop anode, and a trailing stainless-steel cable cathode, and with a potential output of 600 volts and 15 amps. Alternatively, individual backpack electroshocking units may be utilized in smaller wadeable locations where boat electroshocking is not possible. Backpack electroshocking will be performed by a two-or three-person crew equipped with a Smith-Root Model 12 backpack electroshocking unit (or equivalent) applying DC current.

Selected water should be sampled by conducting three timed runs along available shoreline habitat. Each run, regardless of electroshocking technique, will consist of a 15-minute run focusing primarily on shoreline habitat. Results will be presented in terms of catch per hour. This will ensure uniform sampling effort between the sampling locations and that the fish caught are representative of similar habitat types. During each specific run, collected fish will be placed in a live well and will be processed following completion of the run. Following each run, all captured fish will be identified by species and enumerated by personnel in the boat. Additional information collected during each timed survey will include date, location, capture method, weather, crew members, and miscellaneous comments. Data forms will be completed during each survey.

Gill Netting

Gill netting may be used if necessary to supplement electroshocking surveys. While gill netting is generally an effective means of capturing fish over a range of sizes, the method does not allow for selection of specific species and may capture many more fish, including non-target species, than are necessary. Furthermore, gill netting quite often results in high mortality as the nets are only retrieved once or twice daily, leaving captured fish hung in the netting for long periods of time. Due to these reasons, and the potential for captured fish to begin the decomposition process prior to collection, gill netting should only be used if necessary to obtain sufficient fish for analysis.

Gill nets should be set for approximately 12 hours (or less if initial catch rates are high) overnight in two transect locations across each water body, and checked during early morning hours. Gill nets provide a passive sampling approach that allows a greater number of individuals to be collected than do individual seining hauls. Gill nets proposed for use will be 100 ft in length by 6 ft in depth with experimental mesh panels (1-inch, 2-inch, 3-inch and 4-inch stretch mesh). Results are reported in catch per unit effort (CPUE) and will be held constant between sites where utilized. Each net will be tagged/labeled with the appropriate information (i.e., permit number, permit holder name, etc.).

Trotlines

Trotlines are long, heavy cords with many baited hooks attached by sections of monofilament line. This is often the only method effective for collecting bottom feeding fish such as bullheads, since electroshocking may cause them to bury themselves deeper in the mud. Trotlines are selective towards bottom-feeding omnivores such as bullheads and generally do not incur high mortality rates on captured fish. Trotlines should be baited in the evening and checked and re-baited the following morning and evening of the following day at each location until the necessary numbers of fish are collected. In the case that not enough bullheads are captured, up to additional trotline set can be made.

3.2.16.2 Fish Preparation for Tissue Analysis

Fish shall be collected and retained in live wells containing location-specific water until sample processing is initiated. Fish containers (e.g., live wells) will be labeled with capture location information and aerated to minimize fish mortality before fish processing. All fish retained for potential sample analysis will be enumerated and separated by species and size class. Fish deemed acceptable for collection will be killed by cervical separation or sharp blow to the head with a stunning rod and placed on ice until processing can occur. All fish not retained for analysis will be released at their approximate capture location unharmed after processing.

The following metrics will be recorded for each individual fish included in any sample:

Total Length (cm)	The greatest dimension of a fish from its anterior-most extremity to the end of the tail fin. For fish with a forked tail, the two lobes should be pressed together, and length of the longest lobe should be recorded.
Total Weight (g)	Fish will be placed in a pre-weighed tared decontaminated tray and weighed to the nearest gram.
Age	Scale samples will be collected to determine the age of sunfish and mummichog, while pectoral spines will be collected to determine the age of bullheads. Age from scales will be determined by a subcontracted laboratory.
Physical Exam	Gross pathological examination of all fish will be conducted by a qualified Weston biologist and documented in the logbook or appropriate field data sheet.

After recording metrics, collected fish will be individually wrapped in aluminum foil or pre-cleaned glass container. Sample ID labels will be placed on the outside of the aluminum foil or glass container and secured with clear tape. If more than one fish is used for a sample (composite), the fish used for the sample will be placed on one piece of aluminum foil or glass container, wrapped and labeled with the appropriate sample ID. To preserve sample integrity, samples will be placed in double resealable plastic bags with a second ID label and placed in either a cooler with dry ice or a suitable freezer until analyzed. Samples will subsequently be shipped in labeled coolers on wet ice to a subcontracted laboratory for analysis. At the subcontracted laboratory, individual specimens will be homogenized and analyzed separately.

Tissues will be analyzed for the required parameters according to the specified analytical methods. Depending on the number of analyses required for each sample, it may be necessary to provide project-specific order of analysis priority to the subcontracted laboratory due to the tissue gram weight requirements necessary to meet project-specific reporting or method detection limit requirements. See Section 4.1.3 (Tissues) for more discussion. Discussion of laboratory tissue sample preparation can be found in Section 5.5 (Sample Preparation for Tissue Samples).

3.2.16.3 *Histopathology and Organismic Indicators*

Following the collection of fish measurements, liver sections (approximately 0.5 g each) should be collected from each individual fish for histopathology analyses and preserved in a labeled 40-ml glass vial filled with ethanol. Tissue sections from the liver will be sent to a subcontracted laboratory for histopathology. Gross necropsies of the fish will then be conducted, and the gastrointestinal contents of each animal will be removed. All observations and measurements will be recorded on data sheets.

3.2.16.4 *Frog Collection*

Prior to frog collection activities, collection permits must be applied for and received from the New Jersey Division of Fish and Wildlife. This process often takes a month or more and must be considered well in advance.

Frogs are primarily captured at night or twilight using the eye-shine technique. A portable spotlight will be used from a boat or shoreline in order to spot and net frogs while they are blinded. Three to 6 volt flashlights rated at 10,000- 50,000 candlepower can be used as a light source, but a rechargeable miner's headlamp (rated at 15,000/45,000 candle power for low and high settings) may give the best results because the investigator can easily focus its light beam for distances up to 60 ft. while leaving both hands free.

If vegetation is too dense for netting, frogs may have to be speared using a long-handled gig or fork. If the latter method is used, the gig will be decontaminated between captures, and the captured frog immediately rinsed with deionized water. A third method consists of walking along the edge of the water with waders and a large hand net and capturing frogs either on the marsh surface or immediately after they jump in the water. This method is limited to daylight or twilight hours for health and safety reasons. As frogs are often more vocal at night, this method would be used only as a supplemental method if sufficient numbers of frogs cannot be obtained.

Upon capture, frogs will be given a unique identification number and returned to a central processing area. If possible, more frogs will be captured from each area than are required for analysis so that the larger (older) individuals can be selected for analysis. The frogs to be retained for analysis will be selected at the processing area based upon a similar weight and sex distribution between areas sampled. The frogs retained for analysis will be processed for analysis immediately thereafter.

3.2.16.5 Frog Processing for Tissue Analysis

Frogs are to be collected and retained in location-specific containers until sample processing is initiated. Frog containers should be labeled with capture location information and kept aerated to minimize frog mortality before processing. All frogs retained for potential sample analysis should be enumerated and separated by species and size class. The largest individuals of the same species should be retained for analysis. All frogs not retained for analysis will be released at their approximate capture location unharmed after processing.

The following metrics will be recorded for each individual frog:

- Weight
- Leg Length
- Total Length (snout to vent)
- Sex
- Abnormalities/Deformities

After metric recording, frogs retained for analysis will be pithed and will be placed individually into separate labeled pre-cleaned glass sample jars or plastic Ziploc bags, and shipped to the subcontracted laboratory on ice. Sample ID labels will be placed on the outside of the glass jar and secured with clear tape. To preserve sample integrity, samples will be placed in double resealable plastic bags with a second ID label and placed in either a cooler with dry ice or a suitable freezer until analyzed. At the subcontracted laboratory, individual specimens will be homogenized and analyzed separately. Tissues will be analyzed for the required parameters according to the specified analytical methods. Depending on the number of analyses required for each sample, it may be necessary to provide project-specific order of analysis priority to the subcontracted laboratory due to the tissue gram weight requirements necessary to meet project-specific reporting or method detection limit requirements. See Section 4.1.3 (Tissues) for more discussion.

All frog samples retained for analysis will be homogenized whole by the subcontracted analytical laboratory and then analyzed for tissue concentrations of target Parameters. Discussion of laboratory tissue sample preparation can be found in Section 5.5 (Sample Preparation for Tissue Samples).

3.2.16.6 Fiddler Crab Collection

Prior to fiddler crab collection activities, collection permits must be applied for and received from the New Jersey Division of Fish and Wildlife. This process often takes a month or more and must be considered well in advance. Fiddler crabs will be primarily captured by hand or net at low tide across the intertidal flats at each sampling location. Upon capture, fiddler crabs from separate areas will be collected in separate containers and given a unique identification number and returned to a central processing area for distribution into composite samples. If possible, more than enough fiddler crabs for three composite samples will be captured from each area, and the fiddler crabs to be retained for analysis will be selected at the processing area based upon a similar weight between areas sampled. The fiddler crabs retained for analysis will be washed with distilled water to remove any sediment or organic material and processed for analysis immediately thereafter.

3.2.16.7 Fiddler Crab Processing for Tissue Analysis

Fiddler crab processing will follow guidance provided by NJDEP (2002) (Appendix I). Fiddler crabs will be collected and retained in location-specific containers until sample processing is initiated. Fiddler crab containers will be labeled with capture location information and kept aerated to minimize mortality before processing. Fiddler crabs remaining alive will be dispatched by freezing the samples over dry ice. Fiddler crabs deemed acceptable for collection will be placed on ice until processing can occur. All fiddler crabs not retained for analysis will be released at their approximate capture location unharmed after measurements are taken.

The following metrics will be recorded for each individual fiddler crab included in any composite sample:

- Carapace Width
- Weight
- Sex
- Abnormalities/Deformities

After field processing, all specimens will be placed in labeled pre-cleaned glass sample jars or plastic Ziploc bags, and shipped to the subcontracted laboratory on ice. Sample ID labels will be placed on the outside of the glass jar and secured with clear tape. To preserve sample integrity, samples will be placed in double resealable plastic bags with a second ID label and placed in either a cooler with dry ice or a suitable freezer until analyzed. At the subcontracted laboratory, individual specimens will be homogenized and analyzed separately. Tissues will be analyzed for the required parameters according to the specified analytical methods. Depending on the number of analyses required for each sample, it may be necessary to provide project-specific order of analysis priority to the subcontracted laboratory due to the tissue gram weight requirements necessary to meet project-specific reporting or method detection limit requirements. See Section 4.1.3 (Tissues) for more discussion.

All whole-body fiddler crab samples retained for analysis will be homogenized by the subcontracted analytical laboratory and then analyzed for tissue concentrations of parameters.

Discussion of laboratory tissue sample preparation can be found in Section 5.5 (Sample Preparation for Tissue Samples).

3.2.16.8 Small Mammal Collection

Prior to small mammal trapping activities, collection permits must be applied for and received from the New Jersey Division of Fish and Wildlife. This process often takes a month or more and must be considered well in advance. Small mammals are generally captured with the use of a combination of live and lethal traps. The two most common traps for the small mammal collection are Sherman traps (H.B. Sherman Traps, Tallahassee, Florida) and snap traps (Museum Special or Victor Traps). To leave open Sherman traps for pre-baiting they must be locked open by applying the 1" spring clamp to the door mechanism or by bending the treadle-trigger. In the latter case the treadle trigger must be bent back to reset the trap. Typically, multiple traps lines, each with 10 traps, are set in each the study areas as well as the reference area. Of the 10 traps set along each line, five will consist of snap traps and five will consist of Sherman live box traps. When placed, the traps will be set alternately (i.e., every other one will be a Sherman trap). Each end of the trap line should be well marked with flagging tape and individual trap locations should be marked with flagging tape or pin flags which are offset from the trap locations. Care must be taken to place traps in likely habitat without unnecessarily trampling or disturbing the area. Gloves should be worn to keep human scent off of traps and bait.

Whole oats or peanut butter mixed with rolled oats are recommended as baits for small mammals. A thick but not dry consistency is key in providing a enough resistance for small mammals to trigger snap trap treadles. In live traps, carrot slices provide moisture to prevent dehydration and stress. Shrews, being primarily insectivorous, may not be as attracted to peanut butter or oats as other species nor will this type of bait provide the appropriate sustenance for shrews. Walnuts, bits of earthworm or insect larvae (meal worms) may prove more attractive and provide shrews with better nourishment. If live-trapping is being conducted for shrews, food should be supplied within the live trap. Bait should be applied or reapplied as needed daily with each live trap or on the trigger treadle of snap traps.

Traps are set for two to three nights with the objective of trapping adequate numbers of adult animals of the same species from each area. Trapping is curtailed as soon as the trapping objectives are reached. The most abundant species trapped will be chosen for analysis, unless a more sensitive indicator species, are caught in sufficient numbers for analysis. The largest individuals will be retained for analysis both because of their larger tissue mass that will facilitate lower achievable detection limits, as well as the fact that larger animals are likely to be older individuals. Older individuals will have been exposed to contamination for a longer period, and thus analysis of older individuals will result in a more conservative assessment of risks.

Once the traps are set, they will be checked twice daily in the field, during early morning and early evening hours. Animal handling containers are necessary when transferring small mammals from live traps and are used to contain captured animals after they are emptied from the trap. Heavy weight plastic bags or tall plastic buckets can be used for this. The bag must be large enough to easily go over the end of the trap and roomy enough for the handler to put a gloved hand in to grasp the animal. Five gallon plastic buckets are excellent for containing animals. These buckets should be of sufficient height to prevent animals from jumping out over the rim. Animals caught live in the field that are selected for analysis will be humanely killed by cervical dislocation with a steel rod. Recovered animals will be labeled and stored on wet ice in coolers before processing; if the animals are to be held more than four hours then they will be retained on dry ice.

3.2.16.9 Small Mammal Processing for Tissue Analysis

Specimens retained for analysis will be transported to the central staging area in coolers. At the staging area they will be measured, and initially dissected in the field. Metrics recorded will include:

- Total body weight,
- Body length,
- Tail length,
- Ear length,
- Body weight,
- Liver weight, and
- Kidney weight.

Liver sections (approximately 0.5 g each) will be collected for histopathology analysis, and immediately preserved in a labeled 40-ml glass vial filled with ethanol or 10% buffered paraformaldehyde (ethanol is preferred due to costs associated with transport and disposal of formaldehyde compounds). Tissue sections should be sent directly to a subcontracted laboratory for histopathology. Gross necropsies will then be conducted, and the gastrointestinal contents of each animal will be removed. All observations and measurements will be recorded on small mammal data sheets.

After field processing, all specimens will be placed in labeled pre-cleaned glass sample jars or plastic Ziploc bags, and shipped to the subcontracted laboratory on ice. Sample ID labels will be placed on the outside of the glass jar and secured with clear tape. To preserve sample integrity, samples will be placed in double resealable plastic bags with a second ID label and placed in either a cooler with dry ice or a suitable freezer until analyzed. At the subcontracted laboratory, individual specimens will be homogenized and analyzed separately. Tissues will be analyzed for the required parameters according to the specified analytical methods. Depending on the number of analyses required for each sample, it may be necessary to provide project-specific order of analysis priority to the subcontracted laboratory due to the tissue gram weight requirements necessary to meet project-specific reporting or method detection limit requirements. See Section 4.1.3 (Tissues) for more discussion.

All samples will be placed in a cooler on ice in the field and shipped under chain-of-custody to the analytical laboratory. Samples will be prepared and analyzed within the analytical holding times. Sample holding times are calculated from the time of collection. Discussion of laboratory tissue sample preparation can be found in Section 5.5 (Sample Preparation for Tissue Samples).

3.2.16.10 Plant Tissue Collection

Plant tissue collected for chemical analysis should be collected using decontaminated equipment (e.g., shovel, knife, etc.). Each sample will be rinsed with distilled water and then placed into a labeled resealable plastic bag or pre-cleaned glass jar. The samples will be submitted for analysis of selected parameters.

3.2.16.11 Earthworm Bioassay Testing

Earthworms should be collected using a clean shovel decontaminated between locations, used to unearth organic soil. The worms will be collected by hand, rinsed with distilled water and composited into samples for analysis. Each composite sample will be collected from the surface litter layer and up to one foot below the ground surface within a 10-ft radius of the corresponding soil analytical sample to which the tissue data will be correlated. If sufficient earthworm populations are still not found at a location, the professional judgment of field personnel will be used to determine if sampling at a location should be suspended or if a reduced sample number will be collected.

Earthworms collected for analysis will be stored in plastic containers with perforated lids that are labeled by plot location until brought to a central location for processing. There they will be transferred to pre-cleaned glass containers or plastic sealable bags that are labeled by location, and placed on dry ice (to inhibit depuration) after collection.

All earthworm tissue samples will be placed in a cooler on ice in the field and shipped under chain-of-custody to the analytical laboratory. Samples should be analyzed within the analytical holding times. Sample holding times are calculated from the time of collection and are listed in Table 3-1. All sample documentation identification, handling, storage, preservation, and shipping procedures will follow the same standard procedures as described in this CSAP.

3.2.17 Sample Volumes and Containers

A sufficient volume of sample, representative of each matrix, will be collected. Sample volumes for the parameters of concern are shown in Tables 3-2, 3-3, and 3-4. All sample containers will be cleaned and comply with the QA/QC requirements of OSWER Directive #9240.0-05A, "Specifications and Guidance for Obtaining Contaminant-Free Sample Containers", 12/92. Only sample containers receiving full EPA QA treatment, such as Eagle Pitcher "Level 1" or I-Chem Superfund-Analyzed®, will be used. A list of the required sample containers is also provided in Tables 3-2 through 3-4

For performing indoor and ind soil gas sampling, cleaned and certified 6-liter Summa canisters and regulators are obtained from a New Jersey Certified Laboratory as outlined in *Indoor Air VOC Sampling and Analytical Requirements* (NJDEP, April 2003).

3.2.18 Sample Preservation

Sample preservation requirements are included in Tables 3-2 through 3-4. Pre-preserved sample bottles containing acids or bases used for chemical preservation will be obtained from the laboratory performing the analyses. The pH of the first 10 percent of all aqueous samples collected into pre-preserved sample bottles will be checked in the field prior to shipping. For VOC groundwater samples, a fourth vial will be filled for one out of every 10 samples for a field check on preserved pH. All VOC vials will be checked for bubbles after filling. Surface water samples will not be collected using pre-preserved sample bottles. The samples will be preserved in the field and the pH of these samples will be checked prior to shipping. Field sampling teams will be prepared to add additional preservatives to samples if necessary.

Field preservation for aqueous VOC samples will be conducted in accordance with the following procedure:

Carefully add 1:1 HCl (12N HCl: demonstrated analyte free deionized water), drop by drop, to a third portion of sample water in a 40ml VOA vial. This additional volume is used to determine the exact number of drops required to attain a pH of <2, and is then discarded. Add the same number of drops of acid to the remaining two vials.

Methanol preservation of soil samples collected for volatile organic analysis will be accomplished in the following manner:

1. Remove rubber retaining ring from syringe, or cut small air vents into the plunger.
2. Using small balance, tare weigh the sampler.
3. Collect 8 - 12 grams of soil (wet weight) of sample. Wipe off outside of syringe.
4. Weigh sample to confirm that you have 10 g ± 2 g of soil in syringe.
5. Slowly extrude soil from syringe into the prepreserved sample bottle. DO NOT SPLASH METHANOL, since the amount of methanol in the jar has been preweighed at the laboratory, and a change in the amount of methanol could affect analytical results.
6. Wipe threads free of soil and seal sample vials. Swirl sample to break up lumps.
7. Collect 2 jars per sample. Also collect a nonpreserved sample for %moisture.
8. Record sample number on jars. DO NOT COVER LABORATORY NUMBERS.
9. An ambient blank, if required by the Site-Specific Sampling and Analysis Plan, is collected by opening and closing ambient blank jars at the same time as sample collection. Log the identification of the sample during which the ambient blank is collected.

10. A trip blank must be collected. The trip blank is provided by the laboratory with the pre-preserved bottles, and consists of a pre-determined amount of methanol preservative. DO NOT OPEN THE TRIP BLANK IN THE FIELD.

11. MS/MSD sample bottles have been prepared with methanol that has been spiked with matrix spike compounds. Do collect the MS and MSD from same sample. You do not need an additional %moisture sample for the MS/MSD samples.

All samples (preserved or unpreserved) will be placed in a cooler on ice as soon as possible. Samples will be analyzed as soon as possible after collection. Sample holding times are calculated from the time of collection. Sample holding times are also included in Tables 3-1, 3-5, and 3-6.

3.2.19 Decontamination Procedures

Field Preparation

The purpose of this standard operating procedure is to provide a description of the methods used for preventing, minimizing, or limiting cross-contamination of samples due to inappropriate or inadequate equipment decontamination and to provide general guidelines for developing decontamination procedures for sampling equipment to be used during hazardous waste operations. This SOP does not address personnel decontamination.

The decontamination procedures described below were developed by the USACE and follow ASTM D-5088-90 and general NJDEP methods. For non-aqueous sampling, a detergent and water wash removes all visible particulate matter and residual oils and grease. (This may be preceded by a steam or high-pressure water wash to facilitate residual removal). This is followed by a generous tap water rinse and a distilled and deionized water rinse to remove the detergent. The following additional step may be completed for grossly contaminated equipment or selected aqueous samples. An acid rinse (1 percent nitric acid dilution), included if metals samples are to be collected, provides a low pH media for trace metals removal. It is followed by another distilled and deionized water rinse. If the sample is not be analyzed for metals, the acid rinse and water rinse can be omitted. Next, a high purity solvent rinse (acetone) is designated for trace organics removal. The solvent must be allowed to evaporate and then a final distilled and deionized water rinse is performed. This rinse removes any residual traces of the solvent.

All equipment utilized for sampling must be decontaminated using distilled and deionized water. Through distillation, all ionized solids and a broad range of organic constituents will be removed thus making it an ideal solvent for use when sampling for organic parameters. Deionized water is water that has been effectively freed from any existing ionic impurities. Deionized water should be used when sampling for inorganic parameters. The use of distilled and deionized water, commonly available as a single product from commercial vendors, is acceptable provided that the lot number and the associated analysis is available upon request to the NJDEP.

Decontamination of Pumps

When submersible pumps are used for purging and sampling, they will be cleaned and flushed prior to and between use. This cleaning process consists of an external laboratory grade glassware detergent wash and tap water rinse, or steam cleaning of pump casing, hose and cables, followed by a 20-gallon flush of potable water through the pump. This flushing will be accomplished by the use of a clean plastic overpack drum or a plastic garbage can filled with potable water. This will be followed by a distilled and deionized rinse of the outside of the pump. For submersible pumps smaller than four inches in diameter, the recommended number of gallons required for flushing may be proportionately reduced. If the evacuation hose is not changed between locations, it must also be decontaminated in the same manner as the pump. Exercise caution to avoid contact with the pump casing and water in the drum while the pump is running (do not use metal drums or garbage cans) to avoid electric shock. Surface pumps used for well evacuation need not be cleaned between well locations if only a check valve is used. The submersible pump and tubing will always be placed on a clean polyethylene sheeting to avoid contact with ground surface. All tubing will be rinsed/wiped with distilled and deionized water to remove any residual material before entering the well.

Decontamination of Heavy Equipment

Other equipment and material associated with sampling episodes are required to be cleaned prior to usage. Items such as drill rigs, auger flights, and backhoes all present potential sources of interference to environmental samples. These items may come in contact with the materials adjacent to the matrix being sampled or may be attached to actual sampling equipment which has been cleaned.

Two options are available to accomplish cleaning of heavy equipment: steam cleaning and manual scrubbing. The use of a high-pressure steam generator can remove visible debris and has several advantages. Steam generators using potable water provide a high-pressure medium which is very effective for residuals removal. They are also efficient in terms of ease of handling and generate low volumes of wash solutions.

A second option involves manual scrubbing of equipment using a non-phosphate detergent solution followed by a thorough water rinse. This procedure can be as effective as steam cleaning or preferred in situations where steam cleaning fails to remove visible materials. Disadvantages to manual scrubbing are that it is labor intensive and it generates large volumes of water and rinse solutions.

Heavy equipment such as drill rods, bits, and augers will be steam cleaned prior to usage onsite and between borehole locations. All drilling/heavy equipment will be steam-cleaned at the completion of the project to ensure that no contamination is transported from the sampling site. PVC well screens and casing will be decontaminated at the manufacturing facility. Following decontamination, the casing and screen will be wrapped in polyethylene wrapper. Weston will obtain specific procedures followed by the manufacturer to ensure that the decontamination was thorough and effective. All well screen and casing will be received at the site in the manufacturer’s polyethylene wrap. If tears are evident, the wrap is unsealed, or visible evidence that decontamination was not adequate, the PVC will be steam cleaned prior to installation.

3.2.20 Investigation-Derived Waste Management Plan

This Waste Management Plan is intended to provide guidance for the appropriate management of contaminated and non-contaminated waste generated during the RI activities planned for the former Arsenal. Wastes covered within this plan include soil boring cuttings; water generated during well development and purging; fluid resulting from decontamination procedures; accumulated rainwater in temporary waste storage areas; and personal protective equipment (PPE). This plan was written to be consistent with the NJDEP’s Field Sampling Procedures Manual (May 1992) and USEPA's "Management of Investigation-Derived Wastes During Site Inspections" (May 1991). It is anticipated that the waste generated during the RI activities will not be RCRA regulated; therefore, this plan addresses non-RCRA regulated wastes only. If determined that RCRA waste has been generated during the activities, storage and disposal requirements under RCRA will take precedence.

Only those personnel who have been trained as specified under the Resource Conservation and Recovery Act (RCRA) and Department of Transportation (DOT) regulations will be permitted to manage (RCRA) hazardous wastes and package and transport (DOT) investigation-derived wastes. Personnel may be provided with function-specific training to allow them to perform specific tasks associated with waste management when accomplishing field activities covered under this CSAP.

3.2.20.1 *Soil Boring Cuttings*

Soil boring cuttings will be continuously screened during drilling activities for evidence of contamination. Screening methods will include visual inspection of soils for staining; sheens or other evidence of contamination; screening of soils using photoionization detectors (PIDs) or organic vapor monitors (OVMs); and monitoring for odors that may indicate contamination. In addition, analytical results of samples collected in the immediate vicinity, if available, will be reviewed to determine if the soils contain concentrations of contaminants exceeding proposed NJDEP surface soil cleanup standards.

If the screening tools and/or previous sampling results indicate that contamination is not present, the soils will be restored to the borehole where possible. If the cuttings can not be returned to the borehole, they may be placed on the ground surface in the immediate area where they were generated. When this is done, the soils will be graded to resemble natural conditions. This is not always possible; however, as sometimes cuttings are generated in locations that have been planted as lawns or are under impervious cover. In such cases, the soil cuttings need to be drummed and disposed of in accordance with applicable state and federal regulations.

If evidence of contamination is observed, the fate of the soils is dependent on surface soil conditions at that location. In accordance with NJDEP protocols, if the following conditions are met, the cuttings may be placed onto the ground surface.

- The surface soils in areas of disposal are known or expected to be contaminated at levels above NJDEP soil standards.

- The disposed soil will not erode/flow off-site or onto uncontaminated areas.

- No potential to contaminate an uncontaminated aquifer exists.

- The potential to create a health hazard to adjoining property owners through airborne exposure is non-existent.

If these conditions cannot be met and the cuttings can not be returned to the borehole, the soils will be placed in NJDOT-approved, 55-gallon drums for evaluation and disposal at a later date. However, the need to containerize soil boring cuttings at the site is expected to be limited.

3.2.20.2 Groundwater

Similar to drill cuttings, an initial determination will be made as to whether the groundwater is potentially contaminated. This determination will be made through field screening (i.e., PID/ OVM, color, pH) and previous sampling results, if available.

Groundwater generated during well development and purging will be released to the surface in the immediate area of generation if the following NJDEP criteria are met:

- The water is not permitted to migrate off-site.

- There is no potential for contamination of a previously uncontaminated aquifer.

- The discharge will not cause an increase to ground surface soil contamination.

If these conditions cannot be met, the groundwater may be containerized in USDOT-approved 55-gallon drums or other adequate containers such as tank trucks and be disposed of accordingly.

3.2.20.3 Decontamination Fluids

Decontamination fluids may be generated during steam cleaning operations and sampling equipment decontamination. Since the decontamination of equipment utilized for soil involves only tap water, DI water, and non-phosphate detergent, this portion of the decontamination fluids will be treated as groundwater discussed above. Residual soils generated during decontamination procedures will be handled as discussed in Section 3.2.20.1.

Decontamination of groundwater sampling equipment requires the use of nitric acid (1 percent) and acetone. Wastewater generated during these decontamination procedures will require containerization in USDOT-approved 55-gallon drums. The acetone should be segregated from aqueous-based decontamination fluids (including nitric acid), since mixture of spent solvent (an "F-listed" hazardous waste) would cause the entire volume of waste to be F-listed waste.

Solvent-based decontamination liquids should be containerized in USDOT-compliant containers, and managed per RCRA requirements pending off-site disposal at a licensed facility.

3.2.20.4 Personal Protective Equipment (PPE)

Work conducted at these sites will be performed primarily in Level D or an upgraded Level D. Items which may require disposal will be limited to gloves and booties. In the event that the level of protection is upgraded to Level C, tyvek coveralls will also require disposal. These coveralls will not be decontaminated prior to disposal. Level D PPE will be placed in plastic trash bags to be disposed of with other non-contaminated trash from the site by a local disposal vendor. Contaminated Level C PPE (i.e., tyveks, booties, gloves) will be placed in 55-gallon drums and be disposed of in accordance with local, state, and federal regulations.

3.2.20.5 On-Site Storage of Wastes

A central storage area will be identified or constructed within the property limits of the project site. Drums storing liquid wastes should be stored in an area of impermeable cover with the property owner's permission. Following activities in each specific area of the former Arsenal, drums containing waste will be transported by either pick-up truck or other heavy equipment, to the storage area. The drums will remain in this secured area until disposal, based on the results of characterization sampling. Each drum will be accurately marked as to the area in which the waste was generated, the date generated, the sample location and depth, and the type of waste contained within the drum. All sampling for disposal purposes will be performed within this staging area. Federal regulations under RCRA and property owners' wishes need to be addressed in establishing the storage duration. However, all investigative-derived wastes shall be disposed of in less than 90 days.

3.2.20.6 Sampling And Disposal of Wastes

All wastes which cannot be returned to the surface or PPE which cannot be thrown away as previously described will be transported off-site and disposed of in accordance with local, state, and federal regulations. The wastes will be sampled as required by the applicable disposal facility. Parameters typically include but may not be limited to total PCBs, total explosives, TCLP, reactivity, ignitability, and corrosivity.

3.3 FIELD SCREENING/FIELD ANALYTICAL METHODS

The following subsections discuss the procedures and associated instrument calibration methods used when conducting field screening/analyses.

3.3.1 Ambient Air, Soil Samples, and Sample Headspace Monitoring

HNu/OVM-PID Air Monitoring and Soil Sample Screening

The HNu and/or OVM PIDs will be used continuously during the field investigation to monitor health and safety conditions. Responses on the instruments in the breathing zone may trigger an upgrade in personal protection. This information is detailed in the SHSP prepared for the investigation.

All soil samples collected for analysis will be screened in open air with either a HNu or OVM. In addition, all split spoon samples retrieved will be opened, split in half lengthwise with a decontaminated knife or spade, and screened immediately with a Photo Ionization Detector (PID). All information will be recorded in a logbook or in the case of describing split spoon samples from a borehole, on a Weston Soil Logging Form.

The instruments will be calibrated on a daily basis as per the manufacturer's instructions. Calibration information for all field instruments will be recorded in a separate Field Calibration Logbook.

Headspace Screening Procedures

For some projects, headspace analysis of soils may be specified instead of open air screening. The following is the recommended procedure for conducting analytical screening of contaminated soil or groundwater in the field utilizing a portable PID or Flame Ionization Detector (FID):

1. Half-fill a clean glass jar with the sample to be analyzed. Quickly cover with one or two sheets of clean aluminum foil and subsequently apply screw cap to tightly seal the jar. A sixteen ounce (16 oz.; approximately 500 ml) soil or “mason” type jar is preferred; jars less than 8 oz. should not be used.

2. Allow headspace development for at least 10 minutes. Vigorously shake jar for 15 seconds both at the beginning and end of the headspace development period. Where ambient temperatures are below 32°F (0°C), headspace development should be within a heated vehicle or building.

3. Subsequent to headspace development, remove screw lid/expose foil seal. Quickly puncture foil seal with instrument sampling probe, to a point about one-half of the headspace depth. Exercise care to avoid uptake of water droplets or soil particulates.

4. Following probe insertion through foil seal and/or sample injection to the probe, record highest meter response as the jar headspace concentration. Using foil seal/probe insertion method, maximum response should occur between 2 and 5 seconds. Erratic meter response may occur at high organic vapor concentrations or conditions of elevated headspace moisture, in which case headspace data should be discounted.

5. PID and FID field instruments should be operated and calibrated to yield “total organic vapors” in ppm (v/v) as benzene. PID instruments must be operated with a 10.0 +/- eV lamp source. Operation, maintenance, and calibration should be performed in accordance with the manufacturer’s specifications. For jar headspace analysis, instrument calibration should be checked/adjusted no less than once every 10 analyses, or daily, whichever is greater.

3.3.2 Immunoassay Tests

Immunoassay technology uses antibodies that are specific to the type of contaminant being measured. In general, a groundwater or soil sample is introduced to a solution consisting of these antibodies and a kit-specific particulate. These particulates/antibodies then bind to the contaminant of concern if it is present in the sample and adhere to the membrane surface of the sample vial. A color-developing solution is then added which varies in intensity based on the contaminant concentration. The resultant color is compared to a range of colors representing approximate concentrations, thus producing a semiquantitative result. Appendix J contains manufacturer-specific details for different types of immunoassay test kits. The parameters to be field screened using immunoassay test kits include PCBs, TNT, and PAHs.

3.3.3 Field-Portable X-Ray Fluorescence

X-ray fluorescence (XRF) is a screening technique for rapid analysis of metals in environmental samples. In general, the technique involves irradiating a sample with source x-rays, which in turn bumps an electron from the innermost shell of an atom creating a vacancy. In this excited state, the atom releases surplus energy by filling the vacancy with an electron from one of the higher-energy shells. This rearrangement of electrons emits "characteristic" x-rays (in terms of energy) that are specific to a given element. This energy can then be measured to determine the presence, and approximate concentration of an element. Appendix K contains an SOP detailing procedures specific to the Spectrace 9000 field-portable XRF instrument.

3.3.4 Groundwater Physicochemical Measurements

<u>Specific Conductance, Temperature, pH, and Eh Measurements</u>

The specific conductance, temperature, pH, and Eh of all liquid samples will be measured with a YSI Model 600XL flow-through cell instrument (or equivalent) where possible. Temperature measurements will also be verified using a laboratory thermometer. Measurements will be performed as monitoring well purging activities are conducted, as well as during sample collection. The meter will be calibrated at the beginning of each day according the manufacturer's guidelines and checked periodically during the day. The probes and flow-through cell assembly will be rinsed with distilled water before and after each use. The probes will be placed in the flow-through sample cell and measurements will be made as purge/sample water flows through the system. Measurements will be recorded in the field logbook and/or Well Purging Form and will be allowed to stabilize prior to collecting the sample. A field laptop computer may also be used to directly record some of the groundwater physiochemical measurements and water level information.

<u>Dissolved Oxygen Measurements</u>

Dissolved oxygen (DO) will also be measured as part of the flow-through cell system using a YSI Model 600XL instrument (or equivalent). The meter will be calibrated at the beginning of each day according the instruction manual and checked periodically during the day. The probe will be rinsed with distilled water before and after each use. The probe will be placed in the flow-through sample cell and measurements will be made as purge/sample water flows through the system. DO will also be measured within the well using a YSI Model 95 downhole DO probe. In 2-inch-diameter wells, DO levels will be measured in-situ before the pump is placed in the well and after it is removed. Due to space limitations in a 2-inch diameter well, continuous downhole DO measurements can not be collected. In 4-inch-diameter wells, the YSI Model 95 DO probe will also be used to measure DO. The probe will be placed below the pump and DO levels will be monitored during well purging. DO colormetric test kits will be used to confirm the DO measurements collected using the YSI probes. A glass vial will be filled with groundwater collected from the discharge tubing prior to the entry point of the flow-through cell system. DO measurements will be recorded in the field logbook and/or Well Purging Form and will be allowed to stabilize prior to collecting the sample. A field laptop computer may also be used to directly record DO measurements.

Turbidity Measurements

Groundwater turbidity will be measured during the purging process along with the parameters discussed above. A turbidity meter manufactured by H.F. Scientific (Model DRT-15CE, or equivalent) will be used. Similarly, the meter will be calibrated at the beginning of each day according the instruction manual and checked periodically during the day. The measuring probe and associated glassware will be rinsed with distilled water before and after each use. Measurements will be recorded in the field logbook and/or Well Purging Form and will be allowed to stabilize prior to collecting the sample. A field laptop computer may also be used to directly record turbidity measurements.

3.4 FIELD DOCUMENTATION

3.4.1 Field Sample Identification Codes

A unique 7-character sample identification code will be assigned to each sample collected. The sample identification code consists of two fields, separated by dashes, in the following format:

____ ____ --- **________________________________**
Sample Matrix Sampling Location and Depth Qualifier

Sample Matrix

The matrices to be sampled include:

SS/SD = Soils/Sediments
GW/SW/FB/TB = Groundwater/Surface Water/Field Blank/Trip Blank
DS = Drum Contents (potential)
PE = Post Excavation Sample (remediation - related)
SP = Soil Pile Sample (remediation - related)

Sampling Location/Depth Qualifier

The first two characters will identify the Raritan Arsenal study area for all matrices except groundwater (Area 10 = 10, Area 4 = 04). If the sample is a groundwater sample, the first two characters will be MW (monitoring well).

The second two characters will identify the sampling location/monitoring well number. (Sampling location 6 = 06, sampling location 84 = 84, monitoring well 24 = 24.)

The final character will serve as a soil or well depth qualifier and will receive a letter designation. (A = surface interval, B = next subsurface interval, etc.) This qualifier will serve for both soil and groundwater samples. Exact depth intervals will be recorded in field logs for later use in reporting and evaluation of sampling results.

All QA split samples that will be sent to a laboratory to be designated by NAE for analysis (plus QC splits) will be labeled in the same manner as the field samples. However, the NAE-assigned LIMS number will precede the client ID.

Examples:	SS-1710A	(Soil Sample, Area 17, Location 10, Depth Interval A)
	GW-MW01B	(Groundwater Sample, Monitoring Well 01, Depth Interval B)
	LIMS#-SS-1004C	(QA or QC Duplicate, Soil Sample, Area 10, Location 4, Depth Interval C)

3.4.1.1 Indoor and Subslab Soil Gas Field Identification

A unique sample identification code will be assigned to each sample collected. The sample identification code consists of four fields, separated by dashes, in the following format:

_______ - ___________-______________ - __________
Round Building ID Sample Matrix Sample ID

3.4.1.2 Sample Matrix

The matrices to be sampled include:

SG = Subslab Soil Gas

VR = Vapor Recovery
IA =– Indoor Air

Sample matrix identification is not marked for indoor air samples and background air samples.

The field sample identification code provides the tracing of the sample from the location in the field, through laboratory analysis, and finally to data evaluation and presentation. It is essential that the integrity of the field sample identification code not be compromised.

Each sample will be assigned a unique field sample identification code and labeled accordingly as previously discussed. This field sample identification code will contain information traceable to the type, location where the sample was collected, and other information appropriate to that sample. This code will be used for references to this particular sample in field and project documentation and reports.

3.4.2 Field Logbooks

Field logbooks will be maintained containing information pertinent to the field sampling program and the equipment preparation efforts. Field logbooks will be bound containing prenumbered pages and entries will be made in indelible ink. Correction will be made by drawing a single line through the incorrect entry and writing in the correct entry. The person making the correction will date and initial the correction. Empty spaces left at the end of the entry will be lined out, initialed, and dated. The Field Team leader will review field log entries daily and initial each page of entries. Field logbooks will be maintained by the Field Team Leader or another designated field team member during field activities and transferred to the project files to provide a record of sampling. Field logbooks will contain the following:

- Name and location of site.
- Date(s) and time(s) of sample collection.
- Name of Field Team Leader and other field team members.
- Field observations.
- Weather conditions.
- Summary of equipment preparation/decontamination procedures.
- Number and type of samples taken and sample identification codes.
- Field screening results.
- A cross-reference of sample identification codes to sampling points composites or grids that may be indicated on annotated maps or sketches.
- A description of sampling methodology, or references to the CSAP.
- A description of the method used for mixing or compositing.
- Record of deviations from work plan/CSAP procedures.
- A cross-reference to photographs, if photographs are taken.

In addition, the following observations about each sample collected for analysis will be recorded in the logbooks, as appropriate:

- Sample type (i.e., soil, sediment, groundwater, etc.)
- Sample depth.
- Color and texture.
- Physical description.
- Type(s) of laboratory analyses requested.
- Any changes in sampling locations (these changes are also to be indicated on annotated maps, if appropriate).

A separate logbook of information pertinent to health and safety may be maintained. Examples of this information include:

- Real-time personnel air monitoring results, when applicable.
- Heat/cold stress monitoring data, if applicable.
- Upgrades or downgrades of personnel protective equipment.
- Reason(s) for upgrades or downgrades (documenting appropriate approvals).

Summa Canister Sampling Field Log Sheets

Indoor air and subslab soil gas sampling data are to be recorded on Summa Canister Sampling Field Log Sheets. The following information will be recorded on the Field Log Sheet:

- Sample ID,
- Location Description,
- Summa canister number,
- Regulator number,
- Starting pressure,
- Ending pressure,
- Starting Date and Ending Date
- Start time and Ending Time for each sample collected.

A Blank Field Log Sheet can be found in Appendix G**.**

3.4.3 Soil Logging Procedures

For the former Arsenal project, WESTON will use a paper logging system for field data collection. This system will consist of standard forms that require the logger to complete the same information at all locations across multiple investigations. For the purposes of this report, it is assumed that the logging of bedrock lithology will no longer be required for the project, however, should the need arise, an amendment will be made documenting proper procedures.

The soil logging procedure is implemented primarily through the use of two forms:

- Soil Logging Form.
- Well Construction Log.

The Soil Logging Form provides a series of fields arranged in a cell structure that allows for describing earth materials. All soils will be described using either the Burmeister System or Unified Soil Classification System (USCS). The Well Construction Log provides a detailed checklist for describing the construction of wells or piezometers placed in a borehole.

These forms will be augmented by logbook entries that include recording times of drilling and materials, cataloging samples, and documenting changes to any of the forms after initial data collection. The forms will be bound together in appropriate numbers so that each borehole can be treated as a separate data package. This approach facilitates QA/QC as well as data management.

Lithologic Data Management Software

All lithology data generated for the Arsenal project will be entered in the WINLOG software for management and presentation. The program uses a Graphical User Interface (GUI) to allow for data entry and a Microsoft Access database as a back-end for storage of the entered information. The advantage of this system is that it allows a user to enter the lithology and well construction information with a minimal amount of database knowledge while still providing easy access and querying of the data by a database administrator. As a result, the data can easily be exported to standard data formats to use in other software packages.

Data Interpretation

Once borehole data is entered and verified, it can be exported to a variety of data formats that are readable by commercially available software for data evaluation and presentation.

For example:

- Geotechnical Graphics - Boring logs, well completion diagrams, cross sections, and fence diagrams can be produced with software such as CAD, gINT, GEOBASE, and STRATIFACT.

- Contour Maps - Structure contour maps, isopach maps, and contour maps of quantitative soil properties (e.g., texture) can be produced with software such as SURFER®, CPS™, GEO-EAS, SAS-GRAPH, and GEOSOFT.

- GIS Maps - GIS maps of qualitative lithologic properties (e.g., color, moisture, sorting, plasticity and strength) can be produced with software such as ESRI ArcView.

- Geotechnical Assessment - Chemical data (e.g., contaminant concentrations) managed with software such as WALIS, eDATA, DART, and WTIMS can be merged with lithologic data to evaluate geotechnical trends.

- Statistical Assessment - Classical statistical models (e.g., ANOVM, regression analysis, discriminant analysis, factor analysis, or cluster analysis), of stratigraphic relationship and lithologic properties can be produced using software such as SAS, SYSTAT, MINITAB, SPSS, and STATGRAPHICS. Geostatistical models (i.e., variogramming and kriging) can be produced using software such as GEOEAS, GEOKRIG, GEOPACK, and TOXIPAC.

3.4.4 ANNOTATION OF MAPS

Copies of site maps or sketches will be used by the field teams to record key site conditions and to show approximate sample locations, buildings and structures; and other appropriate information. The maps or sketches will be maintained by the Field Team Leader during field activities and transferred to the project files for a record of sampling locations.

3.5 CHAIN-OF-CUSTODY DOCUMENTATION

3.5.1 Sample Labeling And Shipping

All samples collected on-site will be given a unique sample identification code. All sample bottles will be differentiated by use of a sample label.

Precautions will be taken to ensure that all samples removed from the site are within the sample container and that no residue remains on the outside of the container.

Samples will be packed and shipped following USEPA-recommended procedures and in accordance with applicable Department of Transportation (DOT) and IATA regulations. It is assumed that both environmental and hazardous materials samples will be collected and will require shipment from the site. Shipment of samples beyond 24 hours after collection is allowable if continuous maintenance of samples at 4°C is guaranteed and if the laboratory will receive the samples in time to ensure conformance with holding times.

After collecting an indoor air, background air, or soil gas sample with a Summa® canister, the canister will be packaged in a box and transported to the selected New Jersey Certified Laboratory for EPA TO-15 Analysis. Samples contained in a Summa canister do not have to be chilled prior to or during shipment.

3.5.2 Sample Chain-Of-Custody

The purpose of the chain-of-custody procedures is to document the history of sample containers and samples from the time of sample collection, through shipment, and analysis. A sample chain-of-custody form is given as Figure 3-1.

Chain of custody is initiated in the field and will travel with the samples. Custody seals will be affixed to the shipping container and sealed with clear tape.

Samples collected for chemical and explosive analyses will either be picked up at the site by a laboratory courier or be shipped to the laboratory via overnight common carrier (e.g., FedEx).

3.5.3 Sample Receipt

A designated sample custodian is responsible for samples received at the laboratory. This individual is aware of custody requirements and the potential hazards of dealing with environmental samples. In addition to receiving samples, the sample custodian will also be responsible for documenting sample receipt, storage before and after sample analysis, and the proper disposal of samples. Upon sample receipt, the sample custodian will:

- Inspect the sample container for integrity and ensure custody seals are in place. The presence of leaking or broken containers will be noted on the chain-of-custody/sample analysis request forms. The sample custodian will sign (with date and time of receipt) the chain-of-custody/sample analysis request forms, thus assuming custody of the samples, and will assign the laboratory sample identification numbers.

- Measure and record the temperature of the cooler. If reading is greater than 10°C, the laboratory will notify Weston's Project Manager who in turn will consult the USACE Project Manager to determine if resampling is necessary.

- Compare the information of the chain-of-custody/sample analysis request forms with the sample tags and labels to verify sample identity. Any inconsistencies will be resolved with a field sampling representative before sample analysis proceeds.

- Alert the Project Manager, Laboratory Managers, and Section Managers for analyses requiring immediate attention because of short holding times, high moisture content, or other special condition.

3.5.4 Sample Storage

Samples will be maintained in a locked refrigerator maintained at 4°C (± 2°C). The temperature is monitored by the laboratory security system and is recorded daily in a bound logbook by the sample custodian. Provisions will be in place to handle emergency conditions. The laboratory will maintain controlled building access. In the event that the refrigerator temperature is not maintained, the laboratory will notify Weston's Project Manager who in turn will notify the USACE Project Manager.

3.5.5 Sample Tracking

Each sample will receive a unique sample number at the laboratory when it is logged into the laboratory computer. Each person handling a sample batch will note the location change, time, date, and reason for movement.

For samples that require extraction or digestion prior to analysis, a sample extraction or digestion record will be prepared at the time of extraction or digestion. Laboratory data will be entered on the sample extraction form via computer and permanently recorded in a bound laboratory logbook.

3.5.6 Recordkeeping

Data related to sample preparation and analysis, as well as observations by laboratory analysts, will be permanently recorded in bound laboratory logbooks. Laboratory logbook pages will be signed and dated daily by laboratory analysts. Corrections to logbook entries will be made by drawing a single line through the erroneous entry and writing the correct entry next to the one crossed out. Corrections will be initialed and dated by the analyst.

3.6 QUALITY ASSURANCE

During field sampling activities, field QC samples consisting of trip blanks, field blanks, and field duplicates will be collected. The samples to be used for matrix spike/matrix spike duplicate will also be designated. These samples will be submitted to the analytical laboratory for analysis concurrently with actual field samples.

3.6.1 Trip Blank

The trip blank is used exclusively for volatile organic analysis (aqueous sampling and soil samples with the methanol extraction/preservation technique). Its purpose is to measure possible cross-contamination of samples during shipping to and from the site. A trip blank consists of a set of sample bottles filled at the laboratory with laboratory demonstrated analyte free water (methanol for soil VOCs using the methanol extraction technique). The trip blank is never opened and travels to the site with the empty sample bottles and back from the site with the collected samples in an effort to simulate sample handling conditions. Trip blanks must return to the lab with the same set of bottles they accompanied to the field. Contaminated trip blanks may also indicated inadequate bottle cleaning or blank water of questionable quality. Trip blanks will be included at a rate of one per VOC sample shipment and will also be included at the same rate for VOC QA split sample shipment to NAE. Trip blanks and associated samples will not be held on site for more than two (2) calendar days.

3.6.2 Field Rinsate Blank (Field Blank)

The purpose of a field blank is to place a mechanism of control on sample equipment handling, preparation, storage, and shipment. The field blank travels and is stored with the sample bottles, and is also representative of bottle shipment effects on sample quality. By being opened in the field and transferred over a cleaned sampling device (where applicable), the field blank is indicative of ambient conditions and/or equipment conditions that may potentially affect the quality of the associated samples.

The primary purpose of this type of blank is to provide an additional check on possible sources of contamination beyond that which is intended for trip blanks. A field blank serves a similar purpose as a trip blank regarding blank water quality and sample bottle preparation. However, it is primarily used to indicate potential contamination from ambient air as well as from sampling instruments used to collect and transfer samples from point of collection into sample containers (it may also be referred to as the field rinsate blank).

HPLC bottled water is sent to the field for use in preparing field blanks. For volatile field blanks, boiled deionized water is sent to the field. The field blank bottles will be identical to those provided for aqueous sample collection. Note: Since field blanks are aqueous, the lab must provide water for volatile analysis in 40 ml septum vials, although for soil VOA sample collection the lab may provide 4 oz. wide mouth bottles. At the field location, in an area suspected to be contaminated, the water is passed from the full set of bottles through the dedicated or field-decontaminated sample. Field blanks must be preserved in the same manner as samples.

With the exception of VOC analysis of soil samples collected with EnCore sampling devices, VOC analysis of soil samples preserved with methanol, aqueous samples collected directly from a source into a sampling container, and all samples collected for waste classification analyses, field blanks must be analyzed for all the parameters requested for all sample matrices. For aqueous samples, field blanks must be collected at a rate of one per parameter per day. For non-aqueous samples, field blanks will be collected at a maximum rate of 10% of the total number of samples if the sampling event lasts more than one day. If, for example, 40 non-aqueous samples are collected over a 6-day period, then only four field blanks would be required. If 40 non-aqueous samples were collected over a 3-day period, then only three field blanks would be required. It is permissible to use the same aliquot of water on all equipment associated with sampling a particular sample matrix for all parameters except volatiles. Equipment blank water must also pass over pans and spoons used for homogenization. For projects where large numbers of samples are required, a case-by-case recommendation for generating field blanks at less than 10% may be incorporated into work plans.

Field blanks are not required for indoor air, subslab soil gas, or background air samples according to the guidelines outlined in the *Indoor Air VOC Sampling Analysis Requirements* (NJDEP, April 2003) and the *NJDEP Draft Vapor Intrusion Guidance Document* (NJDEP, June 2005).

3.6.3 Ambient Blank

An ambient blank is used to determine the potential contamination from ambient air during sampling procedures. This sample provides a means to evaluate non-sample related contamination. For soil and groundwater sampling on this project, the collection of an ambient blank is not required. However, if soil samples are being preserved with methanol in the field, and nearby activities/conditions indicate that there could be potential contamination of the method preservative during sample collection (e.g., significant construction/fueling activities), then it may be advisable to collect an ambient methanol blank. The Site-Specific Sampling and Analysis Plan will identify tasks for which ambient blanks are to be collected. Please see Section 3.2.10 as well for a discussion of ambient blanks as they relate to indoor air samples.

3.6.4 Field Duplicate

For soil, sediment, and water investigations, field duplicate samples will also be collected and will represent approximately five percent per matrix of the investigative samples. Field duplicates will be submitted to the laboratory as "blind" samples.

Duplicates of water samples (monitor well, surface water) should be obtained by alternately filling sample containers from the same sampling device for each parameter. Samples for volatile organics analysis from monitor wells should be the first set of containers filled. When low flow sampling pumps are used, the vials for volatile organics should be alternately filled. If heterogeneity is suspected, separate samples of each phase should be collected as the nature of phased liquids precludes homogenization. It is generally not necessary to homogenize groundwater or surface water samples.

Obtaining duplicate samples in a soil or sediment matrix (extracted/preserved with methanol) requires homogenization of the sample aliquot prior to filling sample containers. Regardless, volatile organic samples must always be taken from discrete locations or intervals without compositing or mixing. This practice is necessary to prevent loss of volatile constituents and to preserve, to extent practicable, the physical integrity of the volatile fraction. Homogenization of the sample for remaining parameters is necessary to generate two equally representative samples. Note that enough sample must be collected at one time in order to fill all the necessary sample containers. It may be necessary to co-locate or depth integrate collection so enough sample volume is available.

Field duplicates are not required for indoor air, subslab soil gas, or background air samples according to the guidelines outlined in the *Indoor Air VOC Sampling Analysis Requirements* (NJDEP, April 2003) and Appendix I of the *Draft Vapor Intrusion Guidance* (NJDEP, June 2005).

3.6.5 Sample Volume

The field sampling team is required to provide additional sample volume for samples designated for MS/MSD analysis by the laboratory. Field designated aqueous MS/MSD samples will be collected at triple their standard volume for organic fractions. This additional volume will be provided once every 20 samples, or every 14 days, whichever comes first. The soil samples must be filled to the rim of the sample containers. For soil samples collected for VOC analysis, procedures outlined in the NJDEP draft method for field extraction/preservation of soil samples (February 1997) must be followed.

The sampling team must fill the aqueous samples to the rim of the sample containers for all analyses so that the laboratory has sufficient sample for sample extraction and analyses. This means that the sampling team may have to prolong sampling time at low yielding groundwater monitoring wells.

SECTION 4.0
DATA QUALITY OBJECTIVES

To generate data that will meet the project-specific requirements, it is necessary to define the types of decisions that will be made and to identify the purpose of the data. Data quality objectives (DQOs) are an integrated set of specifications that define data quality requirements based on the intended use of the data. The DQO process represents a series of planning steps that can be employed throughout the Work Plan and SAP process to ensure that the type, quantity, and quality of environmental data collected are adequate to support the intended application (USEPA 1997).

The DQO process is directed primarily on the acquisition of data that

1. Provides adequate spatial coverage for areas of concern, and
2. Is analyzed using acceptable methods with detection limits at or below risk-based concentrations or applicable benchmark values.

The DQO process leads to the specifications of the following at a minimum: sample handling procedures; preparatory (extraction/digestion), cleanup, and determinative methods; target analytes; method quantitation or reporting limits; field and laboratory quality control samples; measurement quality objectives (QC acceptable limits) for data quality indicators (DQIs); required corrective actions; and data assessment procedures necessary to meet the intended use of the data.

4.1 METHOD DETECTION LIMITS, METHOD QUANTITATION LIMITS AND REPORTING LIMITS

To generate data that will meet the project-specific data quality objectives, the laboratory will demonstrate that the sensitivities of the methodologies used for sample analyses will be at or below the appropriate project-specified action levels. Sensitivity refers to the amount of material necessary to produce a detector response that can be reliably detected or quantified. Many unique definitions exist for these limits. Specific detection limits are highly matrix dependent. To be consistent and report data that are comparable, the definitions described below will be used.

- <u>Method Detection Limit</u> - The method detection limit (MDL) is the minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix containing the analyte. Method detection limit shall be estimated in an interference-free matrix, typically reagent water for water methods and a purified solid matrix (e.g., sand) for soil/sediment methods and shall be estimated for each compound/analyte of interest using the procedures presented in 40 CFR, Part 136, Appendix B. The MDLs shall be extraction/digestion method-specific and shall include any clean-up methods used. The laboratory shall perform MDL studies whenever the basic chemistry of the procedures is changed. If any of the target analytes are not recovered, then the MDL study shall be repeated for the failed target analytes. The MDL Study is currently done on an annual basis.

- Method Quantitation Limit - The method quantitation limit (MQL), also called practical quantitation limit (PQL), is the lowest calibration standard and shall be at least three (preferably five to ten) times greater than the MDLs. Target analytes detected and reported at a concentration less than the PQL must be flagged as an estimated value (i.e., J flag).

- Method Reporting Limit - The method reporting limit (MRL) is a threshold value below which the laboratory reports a result as "<" or "ND". For this project, the MRL shall be the PQL and must be at least one-half the project-specific action levels or pertinent regulatory standards (Tables 4-1 through 4-7). The method reporting limits shall be adjusted based on the sample matrix and any necessary sample dilution. For soil and sediment samples, all reporting limits must be reported on a dry-weight basis. If a soil or sediment sample has high moisture content, the resulting report limits may exceed applicable regulatory standards or guidelines. Even so, the laboratory must attempt to meet reporting limit goals less than NJDEP standards and/or other applicable guidelines for all compounds listed in Tables 4-1 through 4-7. Appendix L summarizes the project-specific Technical Profile to address the issues. The contract laboratories are to adhere to this profile.

4.1.1 Soil/Sediment

When a soil sample contains high moisture content, the PQLs may exceed the NJDEP soil cleanup standards and various sediment criteria, which can be found in Tables 4-1 through 4-5, even though the prescribed sample preparation/digestion procedures are followed. To avoid generating unusable data due to elevated PQLs caused by high soil moisture content, Weston field personnel will inform the contract laboratory verbally by phone and by making notes on the chain-of-custody, about soil samples with potential high moisture. The contract laboratory will perform expedited percent solid analysis prior to other analytical procedures. Where possible, sample volume used for metals digestion will be adjusted to attempt to meet the project action levels. The contract laboratories shall implement all these procedures in a timely manner so that sample extraction/digestion holding times are not jeopardized. Alternatively, the contract laboratories may choose to use an initial calibration standard at a lower concentration to reestablish optimal PQLs (or MRLs). For metal analyses, the contract laboratory may have to use a different type of instrument for analysis (e.g., furnace atomic absorption spectrometer).

Dilution analysis must only be performed to bring the concentrations of target compounds and analytes into the calibration range, not be used routinely as a procedure to remove matrix interferences. If a dilution analysis for an organic analysis is required (as one or more target analytes are out of the calibration range), data from both analyses will be reported when both runs provide usable data. If high concentrations of the non-target compounds cause interferences in the organic analyses, cleanup techniques must be applied before dilution analysis is performed. Appropriated cleanup procedures shall be utilized to minimize the interferences.

4.1.2 Water

The reporting limits of water samples must be less than NJDEP groundwater quality standards (GWQS) and surface water quality standards summarized in Tables 4-1 through 4-5.

Refer to Section 4.1.1 for proper procedures in dealing with matrix interference. If the laboratory receives water samples at less than optimum volumes required for sample preparation, inform the WESTON Project Manager immediately so that a resample can be scheduled promptly.

4.1.3 Tissues

In general tissue samples are treated as solid samples; therefore methods used to prepare and analyze soil/sediment samples may also be used for tissue sample analysis. The contract laboratory may have to reduce the tissue sample to a more workable size prior to sample preparation. The reporting limits developed for soil and sediment samples may be used for tissue samples; however, one has to recognize that many risk-based decision limits are not analytically achievable using conventional testing methods. Typically, low-level tissue analyses should have quantification limits of 20-100 micrograms per kilogram (µg/kg) on a wet weight basis for acid/base/neutral compounds, 0.1-2 µg/kg (wet weight) for most pesticides, and 1-5 µg/kg (wet weight) for PCBs.

Selected ecological risk assessment benchmarks are summarized in Table 4-6. Different decision limits, however, shall be developed based on project needs and, when achievable, the reporting limits of analytes of concern must be at least one-half of the decision limits. The contracted laboratories will be consulted regarding tissue mass requirements for desired methods and reporting limits.

In cases when sufficient sample mass can not be obtained from a single organism, it may be necessary to prioritize the order of analyses. Generally, a laboratory sample of approximately 30 grams (wet weight) is adequate to attain the recommended detection limit and quantification limit for full-scan GC/MS analyses using standard instrumentation. Sensitivity can be improved by decreasing the final extract volume from 1.0 to 0.5 milliliters (mL) and increasing the GC/MS injection volume from 1 to 2 µL. A smaller sample size (e.g., 3 grams) may be adequate if the instrument sensitivity (including alternatives to GC/MS, such as analysis of chlorinated benzenes by GC/ECD) or extract volume can be adjusted appropriately. Small sample sizes may adversely affect the detection limits that can be attained; conversely, large sample sizes may result in interferences from lipid materials that must be removed. The analyst should be cautioned that by increasing sample size and/or injection volumes and concentrating sample extracts will enhance analytical interferences in approximately the same proportion. Collection of at least 100 grams (wet weight) is recommended for samples that must be analyzed in duplicate. Note that tissue detection limits in this document (referenced above) are listed on a wet-weight rather than dry-weight basis.

In addition, to ensure there is sufficient sample mass to achieve the desired reporting limits, field efforts, such as avoiding compositing between animals/species or selecting the largest or oldest animals for analysis, may be implemented. Using the largest or oldest animals can assure the greatest duration of exposure and hence bias the analysis conservatively to minimize risks. In some cases an age verification technique such as fish scale/spine/otolith aging is desirable to ensure this.

4.1.4 Air

The reporting limits of VOCs in air samples, expressed in microgram per cubic meter ($\mu g/m^3$), must be less than the most stringent screening level pertinent to that compound and matrix. Indoor air and subslab soil gas screening levels are summarized in Table 4-7.

4.2 ANALYTICAL METHODS AND HOLDING TIMES

Routine analytical services are performed using standard EPA methodologies subject to USACE approval, where applicable. In some cases, modification of standard methods may be necessary to provide accurate analyses of particularly complex matrices. When modifications to standard analytical methods are performed, the specific alterations, as well as the reason for the change, will be reported with the results of analysis. The staff of contract laboratories shall use professional judgment in determining the need for modification of standard methods. When practical, the USACE Project Chemist will be consulted before modifications are made.

Samples collected under this QAPP will be analyzed following the procedures of USEPA SW-846, 3rd Edition, Final Update III, April 1998 (SW-846) where applicable. The commonly used methods are summarized here:

- Method 6010: Inductively coupled argon plasma-emission spectroscopy (ICP) methodology for metals analysis.
- Method 7470/7471: Cold vapor-atomic absorption (CVAA) method for mercury analysis.
- Method 8081: Gas chromatography/electron capture detector (GC/ECD) for pesticides analysis.
- Method 8082: GC/ECD for PCB analysis.
- Method 8260: GC/mass spectrometer (MS) for volatile organic analysis.
- Method 8270: GC/MS for semi-volatile organic analysis.
- Method 8330: High performance liquid chromatography (HPLC) for explosives analysis.

This QAPP has deliberately omitted method revision numbers from the analytical method designations to enforce its application to any revision of the method in use by this project.

Immunoassay methods for screening of explosives (Method 4050), PCBs (Method 4020), or PAHs (Method 4035) may be utilized during soil investigation or remediation. The standard operating procedures for obtaining samples to be analyzed by this field screening technique will be identical to those proposed for regular soil samples in this CSAP. Samples for confirmatory analysis will be delivered to the laboratory under chain of custody.

For non-metal analyses determined by classical (wet chemistry) techniques, the laboratory shall use USEPA Methods for Chemical Analyses of Waters and Wastes (MCAWW) or Standard Methods for the Examination of Water and Wastewater (Standard Methods).

American Society of Testing and Materials (ASTM) will be used for mechanical analysis such as grain size.

The aforementioned methods are suitable for analyzing previously identified analytes of concern at the Former Raritan Arsenal. These analytes of concern can be found in Table 4-8.

4.2.1 Soil/Sediment/Tissue Samples

All soil/sediment samples collected for pesticides and/or PCBs analyses will be prepared by Soxhlet extraction (SW-846 Method 3540C); semivolatiles and PAHs (by GC/MS) will be prepared by Ultrasonic extraction (SW-846 Method 3550B).

Cleanup procedures must be performed for all soil/sediment/tissue sample extracts prepared for pesticides/PCBs analysis. Tissue extracts contain high concentrations of lipids and require a reduction in the levels of biological macromolecules by GPC or HPLC prior to analysis. Otherwise, gel permeation cleanup (GPC, Method 3640A) and other clean-up techniques will be applied based on the laboratory's professional judgment**.** Sulfur cleanup (Method 3660B) is mandatory only when the sulfur is detected in the sample. Other cleanup procedures using adsorption column chromatography techniques may also be necessary. For PCB analysis, the acid cleanup procedure outlined in Method 3665A must also be employed. Cleanup procedure usually is not necessary for semivolatile analysis; however, GPC may be necessary to remove some interference. Dilution is not an acceptable practice for removing the interferences.

4.2.2 Water Samples

The water quality parameters will be analyzed by using various Standard Methods and/or MCAWW.

All water samples collected for the analyses of pesticides, PCBs, semivolatiles, and PAHs (by GC/MS) will be prepared by continuous liquid-liquid extraction (Method 3520C), which is routinely used for the aforementioned analyses for USACE and New Jersey regulated projects. Separatory funnel liquid-liquid extraction (Method 3510C) is also acceptable for sample preparation of aqueous samples analyzed for pesticides, PCBs, semivolatiles, and PAHs (by GC/MS).

Cleanup procedures such as Florisil may be necessary for pesticides analysis to remove potential matrix interferences. For PCB analysis, the acid cleanup procedure outlined in Method 3665A must be employed.

4.2.3 Air Samples

Ambient and indoor air samples will be collected in canisters and analyzed by using the EPA Organic Compendium Method (TO)-15 for volatile organic compounds.

4.2.4 Holding Times

Holding time is defined as the time elapsed from the time of sampling to the time of sample preparation or analysis, as appropriate. The holding times are dictated by sample matrices and the sample preparation and analysis methods. It should be noted that this is the maximum allowable time that samples may be held prior to analysis and still be considered valid or not compromised. Tables 3-1, 3-5, and 3-6 summarize the applicable method holding times.

If samples cannot be prepared or analyzed within the method-required holding times, the Laboratory Project Manager shall be immediately notified so that an appropriate corrective action plan can be generated. If holding time requirement was not met and results reported, the resulting data shall be flagged, and a discussion of the impact included in the case narrative.

4.2.5 Mechanical Tests

Data on the physical characteristics of the site and surrounding areas may be collected to the extent necessary to define potential transport pathways and receptor populations and to provide sufficient engineering data for development and screening of remedial action alternatives. The grain size and the permeability of the soil may be determined to achieve these goals. These testing will be conducted by a subcontract laboratory utilizing the appropriate ASTM methods.

4.2.5.1 Grain Size

Two ASTM methods can be used to determine the particle size distribution and the soil constants in soils.

ASTM method D421 can be used for the dry preparation of soil samples received from the field for particle-size analysis and the determination of the soil constants.

ASTM method D422 can be used to quantitatively determine the distribution of particle sizes in soils. The distribution of particle sizes larger than 75 μm (retained on the No. 200 sieve) is determined by sieving, while the distribution of particle sizes smaller than 75 μm is determined by a sedimentation process, using a hydrometer to secure the necessary data.

4.2.5.2 Permeability

ASTM method D5084 can be used for laboratory measurement of the hydraulic conductivity (also referred to as coefficient of permeability) of water-saturated porous materials with a flexible wall perimeter. This method may be utilized with undisturbed or compacted specimens that have a hydraulic conductivity less than or equal to 1×10^{-5} m/s (1×10^{-3} cm/s).

4.3 QUALITY OBJECTIVES FOR CHEMICAL DATA MEASUREMENT

To ensure that quality data are continuously produced during analysis and allow the eventual compliance review, systematic QC checks are incorporated into the sampling and analyses to show that procedures and test results remain reproducible and that the analytical method is actually measuring the quantity of target analytes without unacceptable bias. Systematic QC checks include the scheduled analyses of field and laboratory replicates, standards, surrogates, spiked samples, and blanks. Measurement quality objectives (acceptable criteria or ranges) for these systematic QC checks are established for DQIs to support data usability and contract compliance. The systematic QA checks may be viewed from two aspects, batch QC and matrix-specific QC, and are further clarified below.

4.3.1 Batch QC

General batch QC may be viewed as those QC procedures applied to an interference-free matrix or a matrix of known composition (e.g., blanks, laboratory control samples or LCS, standard reference materials, calibration verification standards, etc.). They ensure the sampling procedures are appropriate and the analytical methods are being performed in an in-control mode of operation. However, these QC checks provide no information on how well the method is performing with respect to the project sample matrix. QC checks that exceed measurement acceptable criteria must be clearly documented within the case narrative along with corrective actions taken.

4.3.2 Matrix-Specific QC

Matrix-specific QC procedures are incorporated into the sampling and analysis protocols to provide information on the precision and bias of the analyses on project samples. These procedures include analyses of field samples in association with surrogate compounds, matrix spikes (MS), matrix spike duplicates (MSD), or matrix duplicates (MD). Matrix-specific procedures performed on samples not related to the project are of no value, for they do not provide information on the matrix under observation. It should be noted that these analyses may require the submittal of an additional replicate sample to enable the laboratory adequate sample volumes to perform the requisite analysis.

4.3.3 Data Quality Indicators

As previously noted, QC procedures are employed during chemical analysis to support and document the attainment of established measurement quality objectives. Whether these QC procedures support an assessment of general batch control or matrix-specific application, documentation includes calculating DOIs to verify data usability and control compliance. DQIs were formerly known as precision, accuracy, representativeness, comparability, and completeness (PARCC). To avoid any misunderstandings concerning the level of quality required for the project chemical analyses, all measurement quality objectives for the method QC checks and DQIs for each method used for this project are summarized in Tables 4-9 through 4-12.

These tables summarize the measurement quality objectives for eight SW-846 methods. For analyses (e.g., hardness, total organic carbons, and pH) by general chemistry methods, the measurement quality objectives are summarized in Table 4-12.

4.3.3.1 Precision

Precision refers to the distribution of a set of reported values about the mean, or the closeness of agreement between individual test results obtained under prescribed conditions. Precision reflects the random error and may be affected by systematic error. Precision also characterizes the natural variation of the matrix and how the contamination exists or varies within that matrix. In order to assess the effect these variables have on the total precision of data, both field and laboratory replicates will be acquired. To assess matrix heterogeneity or sample handling procedures, field precision is commonly determined from field duplicate samples or quality assurance split samples. For environmental samples, laboratory precision is commonly determined from laboratory duplicate samples (MS/MSD or MD). Precision is usually expressed as the relative percent difference (RPD) or relative standard deviation (RSD). The laboratory QC samples are used to demonstrate acceptable method performance and are used to trigger corrective action when control limits are exceeded.

$$RPD = \left\{ \frac{|R1 - R2|}{(R1 + R2)/2} \right\} x100\%$$

4.3.3.2 Accuracy

Accuracy is a measure of the bias in a system and is measured through the analyses of fortified reagent-free matrices and fortified field samples. Results from these measurements are calculated as percent recovery. The laboratory QC samples are used to demonstrate acceptable method performance and are used to trigger corrective action when control limits are exceeded.

4.3.3.3 Representativeness

Representativeness refers to the degree to which sample data accurately and precisely describe the characteristics of a population of samples, parameter variations at a sampling point, or environmental condition. Samples that are not properly collected or preserved or are analyzed beyond acceptable holding times should not be considered to provide representative data. Representativeness is a parameter that is concerned primarily with the proper design of the sampling program or subsampling of a given sample. Representativeness can be assessed by a review of the precision obtained from the field and laboratory duplicate samples. In this way, they provide both precision and Representativeness information. Existing project data and geostatistics may be employed to assess the Representativeness of a population by defining the continuity of data from point to point. Geostatistical techniques can then be used to predict spatial distribution of contaminants, aid in the development of future project sampling design, identify sample locations, optimize sample spacing, estimate probabilities, etc. Applicability of

Representativeness in assessing a contaminant population is improved by using a larger number of samples.

4.3.3.4 Comparability

Comparability is a qualitative objective of the data, expressing the confidence with which one data set can be compared with another. Sample data should be comparable for similar samples and sample conditions. This goal is achieved through the use of standard techniques to collect representative samples, consistent application of analytical method protocols, and reporting analytical results with appropriate units. Comparability is unknown unless precision and accuracy are provided. When this information is available, the data sets can be compared with confidence.

4.3.3.5 Completeness

Completeness is the percentage of measurements that are judged to be useable (i.e., which meet project-specific requirements) compared to the total number of measurements planned. The minimum goal for completeness is 80 percent, with 90-percent goal for critical samples, and the ability to exceed this goal is dependent upon the applicability of the analytical methods to the sample matrices analyzed.

SECTION 5.0
SAMPLE RECEIPT, HANDLING, AND CUSTODY

5.1 SAMPLE RECEIPT

A designated sample custodian is responsible for samples received at the laboratory. This individual is aware of custody requirements and the potential hazards of dealing with environmental samples. In addition to receiving samples, the sample custodian will also be responsible for documenting sample receipt, storage before and after sample analysis, and the proper disposal of samples. Upon sample receipt, the sample custodian will:

- Inspect the sample container for integrity and ensure custody seals are in place. The presence of leaking or broken containers will be noted on the chain-of-custody/sample analysis request forms. The custodian will inform Laboratory Project Manger about these condition who in turn will communicate with WESTON for further instruction. The sample custodian will sign (with date and time of receipt) the chain-of-custody/sample analysis request forms, thus assuming custody of the samples, and will assign the laboratory sample identification numbers.

- Measure and record the temperature of the cooler. If reading is greater than 10^{o}C, the laboratory will notify WESTON's Project Manager who in turn will consult the USACE Project Manager to determine if resampling is necessary.

- Compare the information of the chain-of-custody/sample analysis request forms with the sample labels and/or tags to verify sample identity. Any inconsistencies will be resolved with a sampling representative before sample analysis proceeds.

- Alert the Project Manager, Laboratory Managers, and Section Managers for analyses requiring immediate attention because of short holding times, high moisture content, or other special condition.

5.2 SAMPLE STORAGE

The laboratory shall provide an adequate, contamination-free, and well-ventilated workspace for the receipt of samples. All samples and their associated extracts will be maintained in a locked refrigerator maintained at 4°C ($\pm$ 2^{o}C). The soil/sediment samples collected in the EnCore samplers must be frozen within 48 hours of collection if chemical preservation is not performed. The temperature shall be monitored following the laboratory standard operating procedures and shall be recorded daily in a bound logbook. Provisions shall be in place to handle emergency conditions. The laboratory will maintain controlled building access. In the event that the refrigerator temperature is not maintained, the laboratory shall notify WESTON's Project Manager who in turn will notify the USACE Project Manager.

Samples shall not be stored with standards. Samples designated for volatile organic analysis shall be segregated from other samples. In the absence of project-specific criteria, samples and their associated extracts shall be stored for a minimum 60 days after receipt of the final data report for those samples. After that time, the laboratory is responsible for proper disposal of the samples and their associated extracts in compliance with all Federal, State, and local regulations unless arrangements have been made for the return of any unused sample porting to the site.

For tissues, samples for chemical analysis are to remain frozen until analysis; however, histopathology samples need to be collected prior to freezing (to prevent cellular damage) and immediately stored in ethanol.

5.3 SAMPLE SECURITY AND TRACKING

The laboratory shall maintain the integrity of the samples received, their associated extracts, and the data generated. Limited and controlled access to all laboratory areas shall be maintained. Each sample will receive a unique sample number at the laboratory when it is logged into the laboratory computer. Each person handling a sample batch shall note the location change, time, date, and reason for movement.

For samples that require extraction or digestion prior to analysis, a sample extraction or digestion record shall be prepared at the time of extraction or digestion. Laboratory data shall be entered on the sample extraction form and permanently recorded in a bound laboratory logbook.

5.4 RECORDKEEPING

Data related to sample preparation and analysis, as well as observations by laboratory analysts, shall be permanently recorded in bound laboratory logbooks. Laboratory logbook pages shall be signed and dated daily by laboratory analysts. The person who made corrections to logbook entries shall do so by drawing a single line through the erroneous entry and writing the correct entry next to the one crossed out. Corrections shall be initialed and dated by the analyst.

Voucher specimens (if extra are available) for identification verification shall be collected and stored in ethanol in glass containers, within appropriate secondary containment Voucher specimens will be kept until the final project report has been reviewed and approved or after 3 years, which ever is sooner. Sorted and identified benthic macroinvertebrate collections shall be stored under standard preservation at the taxonomy laboratory for a period of one year. Histopathology samples shall be archived on slides that will remain with the project file until the final project report has been reviewed and approved or after 3 years, which ever is sooner.

5.5 SAMPLE PREPARATION FOR TISSUE SAMPLES

Tissue samples must be homogenized prior to extraction to ensure that aliquots for analysis are representative of the organism and to improve extraction efficiency. If samples are to be analyzed for other parameters, in addition to organics, contamination issues from sample handling must be considered during the homogenization step. Frozen samples must be thawed immediately before homogenizing. When homogenizing the samples, the laboratory must include any liquid that is present with the sample; however, sample handling should be minimized during this step to reduce the risk of contamination. Where possible, the laboratory should homogenize the sample in the sampling container. For organic analysis, the laboratory should choose a grinder with blades made of titanium, tantalum or high quality stainless steel. A Waring®-type blender with stainless steel blades and a glass jar can be used. A rinsate blank should be collected from the homogenization apparatus to verify that decontamination procedures are sufficient. The sample should be homogenized to a paste-like consistency. Larger samples may be cut into 2.5 cm cubes with titanium or high quality stainless steel or ceramic knives before grinding. No chunks should remain in the sample because these may not be extracted or digested efficiently. Homogenized samples must be stored frozen, thawing only for analysis.

There are times when the amount of sample available may be severely limited, such as with organ tissue. If this is the case, it is particularly important to conserve sample mass during the homogenization step. Choose a grinder that is designed for small sample sizes and homogenize the sample in the original sample container to avoid losing sample in the process of transferring sample from one container to another.

Subcontracted laboratories will be selected for tissue sample preparation and analysis based on prior experience, experience with tissue samples, volume capabilities, ability to meet holding times, appropriate preparation and sample clean-up experience

SECTION 6.0
LABORATORY PROCEDURES

The ability to generate valid analytical data requires that all analytical instrumentation be properly and regularly maintained. In addition, the instrument must be properly calibrated so that the quantity of a target analyte detected in the sample can be correctly measured.

6.1 PREVENTIVE MAINTENANCE

The laboratory shall implement documented procedures to ensure that setup, maintenance, and adjustments to instrument operating parameters are documented, and that adjustments to instruments do not exceed the limits specified in the approved SOPs. The laboratory will maintain full-service contracts on all major instruments. These service contracts not only provide routine preventive maintenance, but also emergency repair service. The elements of the maintenance program are discussed in the following sections.

6.1.1 Instrument Maintenance Logbooks

Each analytical instrument shall be assigned an instrument logbook. All maintenance activities shall be performed by qualified personnel and are recorded in the instrument logbook. The information entered in the instrument logbook includes, but not limited to, following information:

- Date of service.
- Person performing service.
- Type of service performed and reason for service.
- Replacement parts installed (if appropriate).
- Miscellaneous information.

If the service contract personnel perform a routine maintenance, a copy of the service record shall be taped into the notebook page where the above information is entered.

6.1.2 Instrument Maintenance

Preventive maintenance and calibration by manufacturer service representatives shall be provided on a routine basis, when applicable.

The laboratory service vendors must provide preventive maintenance, emergency service, and emergency shipping of spare parts. For emergency response, service contracts on the GCs, GC/MS, and AA-ICP require on-site response within 48 to 72 hours. (Typically, service representatives are on-site within 24 hours of a service call.) The service contracts also provide for 24-hour delivery of critical spare parts in response to a service request.

Any item of the equipment that has been subjected to overloading or mishandling, which gives suspect results, or has been shown by verification or otherwise to be defective, shall be taken out of service, clearly identified and wherever possible stored at a specified place until it has been repaired and shown by calibration, verification or test to perform satisfactorily. The laboratory shall examine the effect of this defect on previous calibrations or tests.

Maintenance routinely performed by the chemist may include replacing light source, septum, and analytical column; cleaning the detector (but never ECD used for pesticides and/or PCB analysis); and flushing the system after sample overload.

6.1.3 Spare Parts

The laboratory must maintain an inventory of routinely required spare parts (for example, spare sources, vacuum pumps, and filaments for GC/MS; spare torches, burner heads for AA-ICP).

The instrument operators have the responsibility, with the appropriate supervisor, to ensure that an acceptable inventory of spare parts is maintained.

6.2 CALIBRATION PROCEDURES AND FREQUENCY

Before any instrument is used as a measurement device on the site samples, the instrument's response to known reference materials must be determined. The manner in which various instruments are calibrated is dependent upon the particular type of instrument and its intended use. All sample measurements are made within the calibrated range of the instrument. Preparation of all reference materials used for calibration will be documented in the standards preparation notebook.

Instrument calibration typically consists of two types: initial calibration and continuing calibration. Initial calibration procedures establish the calibration range of the instrument and determine instrument response over that range. Typically, three to five analyte concentrations are used to establish instrument response over a concentration range. The instrument response over the range is generally absorbance, peak height, peak area, etc., which can be expressed as a linear model with a correlation coefficient (e.g., for atomic absorption, inductively coupled plasma, UV-visible-infrared spectrophotometry, ion chromatography) or as a response factor or amount versus response plot (e.g., for gas chromatography, gas chromatography/mass spectrometry, high-performance liquid chromatography).

Continuing calibration usually includes measurement of the instrument response to fewer calibration standards and requires instrument response to compare with certain limits (e.g., ± 10%) of the initial measured instrument response. Continuing calibration may be used within an analytical sequence to verify stable calibration throughout the sequence and/or to demonstrate that instrument response did not drift during a period of nonuse of the instrument.

Specific instrument calibration procedures for various instruments follow.

6.2.1 Gas Chromatography/Mass Spectrometry (GC/MS)

6.2.1.1 Tuning and GC/MS Mass Calibration

Mass spectrometers are calibrated with perfluorotributylamine (FC-43) as required to ensure correct mass assignment. In addition, once per 12-hour shift these instruments are tuned with decafluorotriphenylphosphine (DFTPP) for semivolatiles analysis and 4-bromofluorobenzene for volatiles analysis. Ion abundances will be within the limits dictated by the specific method requirements.

6.2.1.2 Initial Calibration

Once an instrument has been tuned, initial calibration curves for analytes appropriate to the analyses to be performed are generated for at least five solutions containing known concentrations of authentic standards of compounds of concern. These solutions are generally cocktails of the method target analytes. The calibration curves will bracket the anticipated working range of analyses. For some compounds in the calibration standard cocktail, such as benzoic acid, 2,4-dinitrophenol, 2,4,5-trichlorophenol, 2-nitroaniline, 4-nitroaniline, 4-nitrophenol, 4,6-dinitro-2-methylphenol, and pentachlorophenol, the detection is difficult at the lowest calibration appropriate for the majority of the compounds in the mix. In these instances, a four-point initial calibration will be acceptable. Linearity is verified by evaluating the response factors (RFs) for the initial calibration standards. For an acceptable calibration, % RSD for the RFs of specified calibration check compounds (CCCs) will be less than 30%. In addition, a minimum average RF of 0.050 must be demonstrated for specified system performance check compounds (SPCCs). The CCCs and SPCCs are listed in Table 4-13. Compounds that are poor responders, such as ketones, may have average response factors of less than 0.05 but not less than 0.01. Calibration data, to include linearity verification, will be maintained in the laboratory's permanent records of instrument calibrations.

6.2.1.3 Continuing Calibration

A daily midpoint calibration standard is analyzed during each 12-hour operating shift to verify that the instrument responses are still within the initial calibration determinations. The RF for each target compound in the daily standard is calculated and recorded, then compared to the average RF from the initial calibration. If significant (>20% difference, or >20% D) RF drift is observed for the CCCs, appropriate corrective actions will be taken to restore confidence in the instrumental measurements. In addition, a minimum RF of 0.050 must be reported for SPCCs. If the corrective action is ineffective, another initial calibration is required.

6.2.1.4 Quality Control (QC)

All GC/MS analyses will include analysis of a method blank, a method blank spike (semivolatiles and pesticides/PCBs), a matrix spike, and a laboratory duplicate (or matrix spike duplicate) in each lot of 20 or fewer samples. The matrix spike solutions will be used for both matrix spikes and blank spikes. In addition, appropriate surrogate compounds will be spiked into each sample. Recoveries from method spikes and surrogate compounds are calculated and recorded on control charts to maintain a history of system performance.

The method blanks will be examined to determine whether contamination is being introduced in the laboratory. The concentration of target analyte detected in the method blank must be less than one-half of the reporting limits. The concentrations of the common laboratory contaminants such as acetone, methylene chloride, 2-butanonol, toluene, and phthalates must be less than the reporting limits.

6.2.2 Gas Chromatography/High Performance Liquid Chromatography

Since DDT, DDD, and DDE are all contaminants of concern, a DDT degradation check shall be performed at the beginning of each analytical sequence. The DDT degradation shall not exceed 20%.

6.2.2.1 Initial Calibration

Gas chromatographs (GCs) will be calibrated prior to each day of use with a 5-point calibration if the continuing calibration fails. Calibration standard mixtures will be prepared from appropriate reference materials and will contain analytes appropriate for the method of analysis. Working calibration standards for initial calibration will be prepared fresh every six months or if evidence of degradation is present. The working standards will include five calibration standards covering the anticipated range of measurement. At least one of the calibration standards will be at or slightly above the desired instrument detection limit. The correlation coefficient of this calibration must be equal to or greater than 0.995 or a RSD <20% to consider the response linear over a range. If these requirements cannot be achieved, additional standards must be analyzed to define the calibration curve.

High performance liquid chromatographs (HPLC) will be calibrated prior to each day of use. Calibration standard mixtures will be prepared from appropriate reference materials and will contain analytes appropriate for the method of analysis. Working calibration standards for initial calibration will be prepared from stock solutions, traceable to the manufacturer. The working standards will include a calibration blank and five calibration standards covering the anticipated range of measurement. At least one of the calibration standards will be at or slightly above the desired reporting limit. The calibration criteria, as listed in SW-846 method 8330, will be applied to explosive analyses.

6.2.2.2 Continuing Calibration

The response of the instrument will be verified for each analysis sequence by evaluation of a midrange calibration check standard. To demonstrate that the initial calibration curve is still valid, the GC calibration check standard must be within ± 15% D of the initial calibration for the compounds of interest, or the instrument must be re-calibrated. For multi-analyte methods, this check standard may contain a representative number of target analytes rather than the full list of target compounds. Optionally, initial calibration can be performed at the beginning of the analysis sequence.

Within the analysis sequence, instrument drift will be monitored by analysis of a midrange calibration standard every 10 samples for both GC and HPLC. The percent difference (%D) in calibration factors (CFs) for the continuing calibration standard compared to the average CF from the initial calibration will be calculated and recorded. If significant (>15% D) calibration factor drift is observed for the compounds of interest, appropriate corrective actions will be taken to restore confidence in the instrumental measurements. If the corrective action is ineffective, another initial calibration is required.

6.2.2.3 Quality Control

For GC analysis, at least one method blank and one method spike will be included in each laboratory lot of samples. The method spikes and blanks will be in the same matrix as the samples. Method spikes will be at a concentration of approximately the midpoint range of the initial calibration curve. For HPLC analysis, at least one method blank and two method spikes will be included in each batch of samples. Regardless of the matrix being processed, the method spikes and blanks will be in aqueous media. Method spikes will be at a concentration of approximately five times the detection limits.

The method blanks will be examined to determine whether contamination is being introduced in the laboratory. The concentration of target analyte detected in the method blank must be less than one-half of the reporting limits.

The method spikes will be examined to determine both precision and accuracy. Accuracy will be measured by the % R of the spikes. These recoveries will be plotted on control charts to monitor method accuracy. Precision will be measured by the reproducibility of both method spikes and will be calculated as % RPD. These measurements will be compared to the laboratory-generated control limits.

6.2.3 Atomic Absorption Spectrophotometer: Flame and Furnace

6.2.3.1 Initial Calibration

Atomic absorption (AA) spectrophotometers will be calibrated prior to each day of use. Calibration standards will be from appropriate reference materials and working calibration standards prepared fresh daily. Initial calibration will include analysis of a calibration blank and a minimum of three calibration standards covering the anticipated range of measurement. Duplicate injections will be made for each concentration. At least one of the calibration standards will be at or below the reported detection limit. The calibration curve generated must have a correlation coefficient equal to or greater than 0.995 to consider the responses linear over a range. If the correlation requirement of 0.995 is not met, the instrument will be re-calibrated prior to analysis of samples.

Prior to analysis of samples, the initial calibration will be verified using a midrange calibration standard from a source other than that used for initial calibration and an initial calibration verification blank (ICB). The analytical result for the initial calibration verification standard (ICV) must be ± 10% recovery of the true value. The ICB must be free of target analytes at and above the reporting limit. If the ICV or ICB is outside these criteria, the initial calibration must be repeated.

Calibration data, to include the correlation coefficient, will be entered into laboratory notebooks to maintain a permanent record of instrument calibration.

6.2.3.2 Continuing Calibration

The initial calibration is verified during the analysis sequence by evaluation of a continuing calibration blank (CCB) and a continuing calibration verification (CCV) standard after every 10 samples are analyzed. The response of the CCV standard must be within ± 10% recovery of the true value. The CCB must be free of target analytes at and above the reported detection limit.

6.2.3.3 Quality Control

At least one method blank, one method blank spike (BS), and one known QC check sample will be included in each laboratory batch of water and soil samples. The known QC check sample will be the same matrix as the samples. The method blank and method blank spikes will be in an aqueous media. The method blank spikes will be at a concentration of approximately five times the detection limit.

The method blanks will be examined to determine whether contamination is being introduced in the laboratory and will be analyzed at a frequency of one per 20 or less samples. The concentration of the target analyte detected in the method blank must be less than one-half of the reporting limits.

The BS will be examined to determined accuracy. Accuracy will be measured by the % R of the spikes. The recovery for BS must be within the range of 80 to 120% to be considered acceptable. The recovery for known QC check sample will be compared to the vendor provided acceptable control limits.

6.2.4 Inductively Coupled Argon Plasma (ICP)

6.2.4.1 Initial Calibration

The ICP spectrophotometer will be calibrated prior to each day of use. Calibration standards will be prepared from reliable reference materials and will contain all metals for which analyses are being conducted. Working calibration standards will be prepared fresh daily. Quarterly calibration will be performed with a blank and a minimum of five concentrations to cover the anticipated range of measurement. Duplicate readings will be made for each concentration. At least one of the calibration standards will be near the reporting limit. The calibration curve generated must have a correlation coefficient equal to or greater than 0.995 to consider the responses linear over a range. If the correlation coefficient criteria of 0.995 are not met, the instrument will be re-calibrated prior to analysis of samples.

On a daily basis, the instrument will be calibrated using a standard at the high end of the calibration range and a blank. Prior to analysis of samples, the initial calibration will be verified using a midrange calibration standard from a source other than that used for initial calibration and an ICB. The analytical result for the ICV standard must be ± 10% recovery of the true value. The ICB must be free of target analytes at and above the reporting limit. If the ICV or ICB is outside these criteria, the initial calibration must be repeated.

Calibration data, to include the correlation coefficient, will be entered into laboratory notebooks to maintain a permanent record of instrument calibration.

6.2.4.2 Continuing Calibration

The initial calibration is verified during the analysis sequence by analysis of a CCB and a CCV standard after every 10 samples are analyzed. The response of the CCV standard must be within ± 10% recovery of the true value. The CCB must be free of target analytes at and above the reported detection limit.

6.2.4.3 Quality Control

At least one method blank, one BS and one Known QC Check sample will be included in each laboratory batch of water and soil samples. The Known QC Check sample will be the same matrix as the samples. The method blank and BS will be in an aqueous media. The BS will be at a concentration of approximately five times the detection limit.

The method blanks will be examined to determine whether contamination is being introduced in the laboratory and will be prepared at a frequency of one per 20 or less samples The concentration of target analyte detected in the method blank must be less than one-half the reporting limits.

The BS will be examined to determined accuracy. Accuracy will be measured by the % R of the spikes. The recovery must be within the range of 80 to 120% to be considered acceptable. The acceptable QC limits for accuracy of the Know QC Check are provided by the vendor.

A low level standard (CRI) and a high level standard (HSA) are routinely analyzed to verify matrix interference by ICP.

6.2.5 Cold Vapor Mercury Analysis: Flameless AA

6.2.5.1 Initial Calibration

The initial calibration procedures are as described in Subsection 6.2.3.1, except that initial calibration requires analyses of a calibration blank and five working standards. The correlation coefficient of the standard curve must be equal to or greater than 0.995. The initial calibration is verified by analysis of a calibration standard from an independent source prior to sample analysis. The response of the initial calibration verification standards must be within ± 20% recovery of the true value. If it is outside these limits, the instrument is re-calibrated.

6.2.5.2 Continuing Calibration

After every 10 samples, a CCB and CCV standard are analyzed. The response of the CCV must be within ± 20% recovery of the true value. The CCB must be free of target analytes at and above the reported detection limits.

6.2.5.3 Quality Control

At least one method blank and one BS will be included in each batch of samples. Regardless of the matrix being processed, the BS and blanks will be in aqueous media. The BS will be at a concentration of approximately five times the detection limit.

The method blanks will be examined to determine whether contamination is being introduced in the laboratory and will be analyzed at a frequency of one per 20 or less samples The concentrations of target analytes detected in the method blank must be less than one-half the reporting limits.

The BS will be examined to determine accuracy that will be measured by the %R. The recovery must be within the range of 80% to 120% to be considered acceptable.

6.2.6 Spectrophotometry

6.2.6.1 Initial Calibration

Spectrophotometers will be calibrated prior to each day of use. The calibration standards will be prepared from reference materials appropriate to the analyses being performed, and working standards will include a minimum of five concentrations that cover the anticipated range of measurement. At least one of the calibration standards will be near the desired detection limit. Additionally, a calibration blank will be analyzed. The requirement for an acceptable initial calibration will be a correlation coefficient equal to or greater than 0.995 to consider the response linear over the measured range. If the correlation coefficient criteria of 0.995 are not met, the instrument will be re-calibrated prior to analysis of samples. Calibration data, to include the correlation coefficient, will be entered into the laboratory notebook with the sample data to maintain a permanent record of instrument calibrations.

Before sample analysis, an initial calibration verification standard is analyzed. The response calculated as % R of this standard must be within ± 15% of the true value or the instrument is re-calibrated.

6.2.6.2 Continuing Calibration

A CCV standard and CCB will be analyzed at a frequency of every 10 samples and at the end of the analysis sequence. The response, calculated as a % R of the true value, must be within 15% of the true value. The response of the blank must be less than the detection limit. The CCB must be free of analytes of interest.

6.2.6.3 Quality Control

At least one method blank and two method spikes will be included in each laboratory lot of samples. Regardless of the matrix being processed, the method spikes and blanks will be in aqueous media. Method spikes will be at a concentration of approximately five times the detection limit.

The method blanks will be examined to determine whether contamination is being introduced in the laboratory. The method spikes must be free of analytes of interest, The method spikes will be examined to determine both precision and accuracy.

The control limit for accuracy, expressed as recovery, will be 80% to 120%. Precision will be measured by the reproducibility of both method spikes and will be calculated as % RPD. Results must agree with within 20% RPD to be considered acceptable.

6.2.7 Balances

Laboratory balances will be calibrated and serviced annually by a factory representative. In addition, the analyst will check the balance daily with two masses: one in the gram range and one in the milligram range. A record of calibrations and daily checks will be kept in the balance log.

The Class P weights used by the analysts for daily balance checks will be calibrated annually against a set of Class S-certified weights.

6.2.8 6.2.8 Thermometers

Oven and refrigerator thermometers will be calibrated annually against a National Institute of Standards and Technology (NIST) certified thermometer in the range of interest. Annual calibrations will be recorded in a calibration notebook. Daily readings will be recorded with the respective oven or refrigerator.

6.3 INTERNAL QC CHECKS

The daily quality of analytical data generated by the laboratory will be controlled by the implementation of this CSAP. This is monitored by the analysis of method blanks, method blank spikes, and known QC check sample. For this project, duplicate samples and fortified samples (MS/MSD) will also be analyzed. These latter types of samples generate matrix-dependent data and will be used to assess analytical precision and accuracy.

The analyses of QC samples shall be entered chronologically by the contract laboratories onto QC charts specifically maintained for each analytical procedure. These control charts shall be labeled with upper and lower warning and control limits, the analysis being charted, and the value (e.g., % R, % RPD, etc.) being monitored. Control charts shall be updated annually and shall be used to demonstrate method performance and can be used to identify system errors.

The definitions of laboratory QC samples are described below.

6.3.1 Method Blanks

The method blank is used to monitor laboratory contamination. Method blanks usually consist of laboratory reagent-grade water or a matrix similar to the associated field samples treated in the same manner as the sample (i.e., digested, extracted, distilled, etc.), which is then analyzed and reported as a field sample would be. One method blank will be prepared and analyzed with each batch of 20 or fewer samples.

6.3.2 Method Blank Spikes

Method blank spikes are analyzed with each batch of 20 or fewer samples. This is a sample of laboratory reagent-grade water fortified (spiked) with the analytes of interest that is prepared and analyzed with the associated sample batch. The analyte recovery from each method blank spike will be used to monitor analytical accuracy, and when the method blank spike is analyzed in duplicate, the duplicate recovery values will be used to monitor analytical precision.

6.3.3 Matrix Spikes

A matrix spike is an aliquot of an investigative sample that is fortified (spiked) with the analytes of interest and analyzed with an associated sample batch to monitor the effects of the investigative sample matrix (matrix effects) on the analytical method. Recovery and/or precision data (RPD) between duplicate matrix spikes for these samples are reported with the data. MS/MSDs for all analyses will be performed at a frequency of 1 per 20 investigative samples. The spike concentration shall be approximately at the mid-point of the calibration range.

6.3.4 Laboratory Duplicate Samples

Duplicate samples are obtained by splitting a field sample into two separate aliquots and performing two separate analyses on the aliquots. The analysis of laboratory duplicates monitors sample precision; however, it may be affected by sample heterogeneity, particularly in the case of non-aqueous samples. This duplicate can either be analyzed spiked (matrix spike duplicates are required for organic analysis) or un-spiked (un-spiked duplicates are required for inorganic analysis). The laboratory duplicates will be performed for inorganic analyses at a frequency of 1 per 20 investigative samples.

6.3.5 Known QC Check Samples

This is a QC sample of known concentration obtained from the EPA, the National Institute of Standards and Technology (NIST), or an independent commercial source. This QC sample is to check the accuracy of an analytical procedure. It is particularly applicable when a minor revision or adjustment has been made to an analytical procedure or instrument and is routinely used for metal and non-metal inorganic analyses.

6.3.6 Surrogate Compounds

For organic analyses, surrogate compounds are added into method blank and field samples prior to extraction and are added to all standards used for analyses. These surrogate compounds are used to monitor method efficiency and potential matrix effects on the target analytes. The surrogate recoveries are compared to the laboratory-generated control limits. If the recoveries are not within the control limits, sample reanalysis is required. If the recoveries are less than 10% in the field samples, the laboratory shall perform re-extraction of the affected samples.

6.4 CORRECTIVE ACTION

The initial responsibility to monitor the quality of an analytical system lies with the analyst. In this pursuit, the analyst will verify that all QC procedures are followed and results of analysis of QC samples are within acceptance criteria. This requires that the analysts assess the correctness of all the following items, as appropriate:

- Sample preparation procedure.
- Initial calibration.
- Continuing calibration.
- Method blank result.
- Duplicate analysis.
- Laboratory control standard.
- Fortified sample result.

6.4.1 Immediate Action

If the assessment reveals that any of the QC acceptance criteria are not met, the analyst must immediately assess the analytical system to correct the problem. The actions may include, but not limited to, reanalyze the samples, stop the analytical procedures or clean/maintain the instrument. The analyst notifies the appropriate supervisor and the Laboratory QA Officer of the problem and, if possible, identifies potential causes and corrective action.

The nature of the corrective action obviously depends upon the nature of the problem. For example, if a continuing calibration verification standard is determined to be out of control, the corrective action may require re-calibration of the analytical system and re-analysis of all samples since the last acceptable continuing calibration verification standard. Blank Spike recoveries will be evaluated against the established control limits. If more than 25% of the compounds exceed the limits, corrective action (including re-extraction and re-analysis) shall be initiated.

When the appropriate corrective action measures have been defined and the analytical system is determined "in control," the analyst must document the problem and the corrective action. Copies of the documentation summarizing these actions must be kept on file and, if requested by Weston, submitted along with data packages.

Data generated concurrently with an out-of-control system will be evaluated for usability in light of the nature of the deficiency. If the deficiency does not impair the usability of the results, data will be reported and the deficiency noted in the case narrative. Where sample results are impaired, the Laboratory Project Manager is notified and appropriate corrective action (e.g., re-analysis) is taken.

6.4.2 Long Term Action

If the problems identified cannot be resolved immediately, the laboratory must implement long term corrective action plan to correct the problems. Weston must be informed regarding the nature of the problem and the action the laboratory intending to take. Should Weston decide, after consultation with USACE, that the proposed action will jeopardize the progress of the project, Weston may request sending samples to other USACE certified subcontract laboratories and must be informed about the progress of the corrective action.

The laboratory must identify responsible personnel in tackling the identified problem and document the progress and the outcome of the corrective action.

6.5 DATA REDUCTION, DATA REVIEW, REPORTING AND VALIDATION,

All project analytical data shall be recorded in bound laboratory notebooks issued by the Laboratory QA Officer. Data are recorded and associated with a unique contract laboratory sample identification number and a client sample identity. These pages minimally contain the following information:

- Analytical method.
- Analyst.
- Date.
- Reagent concentrations.
- Instrument settings (as applicable).
- Raw data.

The laboratory analysts sign and date all notebook entries daily. Copies of instrument outputs (chromatograms, strip-charts, etc.) are maintained on file.

6.5.1 Data Reduction

Data reduction refers to the process of transforming raw data into final sample data. Data reduction is performed by the individual analysts and consists of calculating concentrations in samples from the raw data obtained from the measuring instruments. The complexity of the data reduction will be dependent upon the specific analytical method and the number of discrete operations (extractions, dilutions, and concentrations) involved in obtaining a sample that can be measured.

For those methods using a calibration curve, sample response will be applied to the linear regression line to obtain an initial raw result, which is then factored into equations to obtain the estimate of the concentration in the original sample. Rounding should not be performed until after the final result is obtained to minimize rounding errors, and results will not normally be expressed in more than two significant figures.

Copies of all raw data and calculations used to generate the final results will be retained on file to allow reconstruction of the data reduction process at a later date.

System reviews shall be performed at all levels. The individual analyst constantly reviews the quality of data through calibration checks, QC sample results, and performance evaluation samples. These reviews are performed prior to submission to the area supervisors.

The area supervisors review data for consistency and reasonableness with other generated data and will determine whether project requirements have been satisfied. Selected hardcopy output of data (chromatograms, spectra, etc.) shall be reviewed to ensure that results are interpreted correctly. Unusual or unexpected results shall be reviewed, and a resolution shall be made as to whether the analyses should be repeated.

Procedures shall be established for the Laboratory QA Officer independently conducting a complete review of selected projects to determine whether laboratory and client QA/QC requirements have been met. Discrepancies will be reported to the Laboratory Project Manager for resolution.

6.5.2 Data Reporting

Reports will contain final results (uncorrected for blanks and recoveries), analytical methods, detection limits, surrogate recovery data, matrix spike recoveries and duplicate results, and method blank data. In addition, special analytical problems and/or any modifications of referenced methods will be noted. The number of significant figures reported will be consistent with the limits of uncertainty inherent in the analytical method. Consequently, most analytical results will be reported to no more than two significant figures. Data shall be reported in units commonly used for the analyses performed. Concentrations in aqueous samples are expressed in terms of weight per unit volume [e.g. milligrams per liter (mg/L)]. Concentrations in solid or semisolid matrices are expressed in terms of weight per unit weight of sample [e.g., micrograms per gram (μg/g)]. Concentrations in gaseous (air and soil gas) samples are expressed in terms of weight per unit volume of sample [e.g., micrograms per cubic meter ($\mu g/m^3$)].

The results of the trip blanks collected for the methanol extraction/preservation technique shall be reported as a solid sample, where a sample weight of 10 grams and a 100% dry weight is assumed.

Method reporting limits shall be the concentrations in the original matrix corresponding to the low-level instrument calibration standard after concentration, dilution, and/or extraction factors are accounted for, unless otherwise specified by project requirements.

At a minimum, the final data report provided by the contract laboratories shall be a NJDEP Reduced Laboratory Data Deliverables as required in N.J.A.C. 7:26E-2.1(a)13. The contract laboratories shall provide the data package in compliance with the requirements specified in the Appendix A Section IV of N.J.A.C. 7:26E-2.1.

6.5.3 Data Review and Data Validation

The production of data of “known and acceptable quality” is a primary goal of every environmental sampling effort. In general, some degree of data evaluation is performed for all data collection activities to help ensure that only scientifically and legally defensible data are used to support project decisions. However, the extent of the review will depend upon the project’s data quality objectives and will be limited by the physical contents of the data package. Data validation or comprehensive data evaluation is commonly performed for only a percentage of the data packages generated for a project (e.g., unless there are litigation issues, the data are being used to support critical decisions, or significant QC problems were found during data evaluation).

Data validation typically refers to a comprehensive evaluation of analytical data that is performed to the level of the raw data (e.g., summary QC information, laboratory logbooks, and instrument outputs). Validation is performed with respect to some specified pre-determined set of performance criteria in order to help determine whether the data are appropriate for the intended use. Typically, the validation results in a summary of the quality of the data and the application of “flags” or “qualifiers” which provide the data user with a qualitative assessment of the data (e.g., “estimated” or “rejected”).

Data review typically refers to a partial evaluation of data quality; the evaluation may be contractual in nature, technical in nature, or both. If only “summary data” rather than “comprehensive” or “full” data packages are required from the laboratory, then only data review rather than data validation can be performed.

For optimal results, the data end users should decide in the early planning stages of the project what type of data evaluation (review or validation) is required. It is strongly recommended that data evaluation not be performed as a “last minute” activity that is initiated only after the completion of all sample collection and analysis.

If a data validation is to be performed, the USEPA Region 2 data validation standard operating procedures (SOPs) shall be followed. If the USEPA Region 2 data validation SOP is not available, the principles outlined in the National Functional Guidelines developed for the USEPA Contract Laboratory Program (CLP) Statement of Work (SOW) shall be used to qualify the data.

If a data review is to be performed, limited QC information, such as holding times and/or blank contaminations, will be evaluated. A project-specific QAPP shall define which QC information is to be reviewed. The principles used in data validation shall be used for data review to assess data quality.

SECTION 7.0
PERFORMANCE AND SYSTEM AUDITS

Any laboratory that provides environmental sample analysis must demonstrate its capability of providing data of known quality. To achieve this goal, laboratories often go through vigorous validation or certification process conducted by various governmental agencies. In addition to providing documentation such as QA manual and personnel credentials to validating agencies, laboratories need to demonstrate that they have adequate instruments and facility to perform required analyses. Performance audit and system audit can provide valuable insight to laboratory's QA and QC procedures.

7.1 EXTERNAL AUDITS

Laboratories often participates in several external audits sponsored by the USACE, state regulatory agencies, and/or the EPA. These audits include performance and system audits.

The performance audits are in the form of blind performance samples submitted by the auditing agency. System audits involve on-site evaluation of the laboratory systems. Laboratories may be certified in many states and by many government agencies that perform on-site audits as part of certification requirements.

7.2 INTERNAL AUDITS

The Laboratory QA Officer has overall responsibility for monitoring the internal QA program and QC procedures and is also responsible for scheduling and coordinating external systems audits and reviewing data for performance samples received.

The Laboratory QA Officer shall audit laboratory systems and procedures at least once annually. Unique client audit procedures and data requirements shall be complied with as contractually specified. The internal audit consists of a review of laboratory systems, procedures, and documentation. Any deficiencies and/or deviations are documented and a summary report is prepared.

7.3 CORRECTIVE ACTIONS

Corrective action described earlier is necessary when any measurement system fails to follow an appropriate QA program. Items that may need corrective action vary from system to system and hence the corrective action protocols must be flexible.

7.4 QA REPORTS TO MANAGEMENT

The Laboratory QA Officers shall provide periodical reports to the laboratory management. These reports may summarize QA activities for the reporting period, including results of performance audits (external and internal), results of system audits (external and internal), and recommendations for revision in laboratory procedures to improve the analytical systems. The

Laboratory Project Manager shall be notified immediately of laboratory QA situations requiring immediate corrective action.

SECTION 8.0
DATA MANAGEMENT

All hardcopy data will be archived in a central location for 5 years following laboratory report submission. Data on tape or diskette will be archived for 1 year following report submission.

In order to establish a more efficient and powerful information infrastructure to support the storage, evaluation, and reporting of the results of this project, the USACE has implemented a Data Management System (DMS) for the Raritan Arsenal investigation. All data utilized for analysis, presentation, and reporting on the RI/Remedial Design (RD) project are stored in a central electronic database. Specialized application modules, outlined below, are utilized for automated data collection, data evaluation, and data integration:

- **ENVIRO DATA®** -Enviro Data is a third-party software packaged developed by GeoTech Computer Systems, Inc. (GeoTech). The software stores sampling and analytical data in a relational database to allow for efficient and accurate management to fulfill project needs. For the former Arsenal project, a database has been established that contains analytical data generated at the site during past investigations. This database will be continually updated as new data is generated either thought the use of data collecting devices like GPS or Electronic Data Deliverables (EDDs) provided by project laboratories in the Enviro Data Laboratory Data Transfer Standard (Appendix M). Through the software, data can be retived and reported in a variety of formats based on the projects needs. The software is also linked to the the projects GIS for spatial display.

- **GIS –** A customized GIS has been created for the Arsenal project to allow for efficient and accurate display of project data spatially. The system uses a combination of vector and raster data in conjunction with the Enviro Data database to depict site conditions and investigation results in order to fulfill reporting requirements. Along with Enviro Data, software used to establish the GIS includes ESRI's ArcGIS® as well as customized GIS modules developed by Weston. The GIS has been referenced to the New Jersey State Plan Coordinate System with horizontal control referenced to the North American Datum 1983 (NAD83) and vertical control to the North American Vertical Datum 1988 (NAVD88). All mapping units are in feet.

- **WINLOG™** - WinLog is a program developed by GAEA Technologies Ltd. for the management and graphical display of lithologic sampling and description data of soil as well as monitoring well construction. The program stores all data in a relational database that can be retrieved either through its graphical interface or directly from it database back-end by a database administrator.

These modules combine to establish the DMS for the Arsenal project. It is through this system that all project related field data can be stored electronically allowing for rapid querying and export. This system aids in minimizing manual manipulation resulting in a greater efficiency with fewer errors.

SECTION 9.0
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TABLE 3-1
ANALYTICAL METHODS AND HOLDING TIMES FOR TISSUE AND BIOASSAY SAMPLES

PARAMETERS	PREPARATION METHOD	CLEANUP METHOD	ANALYSIS METHOD	HOLDING TIMES[(1)] (Preparation/Analysis)
VOC	--	--	8260	14 days if frozen within 48 hours
SVOC/PAH	3540	3640 (optional)	8270	14 days/40 days extraction to analysis
PESTICIDES	3540	3640/3660[(2)]	8081	14 days/40 days extraction to analysis
PCBs	3540	3640/3660/3665[(2)]	8082	14 days/40 days extraction to analysis
HERBICIDES	8151	--	8151	14 days/40 days extraction to analysis
PP/TAL METALS – TOTAL	3052	--	6010 (7471 for Hg) [(3)]	Hg: 28 days; others: 6 months
EXPLOSIVES	--	--	8330	14 days/40 days extraction to analysis
CYANIDE	9010B	--	9012	14 days
MUSTARD BREAKDOWN PRODUCT - THIODIGLYCOL	--	--	UW22/LW18 (Mod)	14 days/40 days extraction to analysis
TRPH	--	--	8015	28 days
TOC	--	--	9060	28 days
LIPID CONTENT	--	--	Gravimetric	None
MOISTURE CONTENT	--	--	ASTM D2216	None

NOTES:

(1) Holding times are based on collection dates unless otherwise specified.

(2) GPC (3640) is optional. Acid cleanup method 3665A is mandatory for PCB analysis. Sulfur cleanup (3660) is mandatory only if sulfur peak detected during analysis. Other adsorption column chromatography techniques may be necessary.

(3) All metals except mercury (7471) will be analyzed by trace ICP Method 6010. Graphite furnace will be used by a NJDEP and USACE certified laboratory for the following analytes if the reporting limits cannot be met: As – 7060, Pb - 7421, Se - 7740, Tl - 7841, Cd – 7131, Sb - 7041.

(4) VOC will be by Method 8260 and the holding times are 14 days to leaching and 14 days from leaching to analysis; SVOC by 8270, Pesticides by 8081, Herbicides by 8151, and their holding times are 14 days to leaching, 7 days from leaching to extraction, and 40 days from extraction to analysis; Metals by 6010 and the holding time is 180 days; Hg by 7471 and the holding time is 28 days.

Reference: SW-846, Third Edition, U.S. EPA, MCAWW, and ASTM.

TABLE 3-2
SAMPLE CONTAINER AND PRESERVATION REQUIREMENTS FOR WATER

PARAMETERS	SAMPLE VOLUME REQUIRED	CONTAINER[(1)]	PRESERVATION
TCL VOC	40 mL	3-40 ml vials with septum cap; no headspace	HCL to pH <2, Cool 4°C
SGWS VOC [(2)]	40 mL	3-40 ml vials with septum cap; no headspace	HCL to pH <2, Cool 4°C
TCL SVOC/PAH	1 L	2-1000 ml amber glass	Cool 4°C
TCL Pesticides/PCBs	1 L	2-1000 ml amber glass	Cool 4°C
Metals – Total	300 mL	1-1000 ml poly.	HNO_3 to pH <2, Cool 4°C
pH	--	1-100 ml poly.	Cool 4°C
Explosives	770 mL	1-950 ml amber glass	Cool 4°C
Mustard Breakdown Product - Thiodiglycol	500ml	1-1000ml amber glass	Cool 4°C
TDS	100 mL	1-500 ml poly	Cool 4°C
Hardness	50 mL	1-500 ml poly	HNO_3 to pH <2, Cool to 4°C
Total Chloride/Sulfate	50 mL	1-500 ml poly	Cool 4°C
Sulfide	500 mL	1-500 ml poly	NaOH/Zn Acetate Cool to 4^o C
CO_2	100 mL	1-250 ml amber glass (no headspace)	Cool to 4^o C
Phosphate	50 mL	1-500 ml poly	H_2SO_4 to pH<2, Cool to 4^o C
Nitrate	100mL	1-500 ml poly	Cool to 4^o C
Ammonia	500mL	1-500 ml poly	H_2SO_4 to pH<2, Cool to 4^o C
Methane (with Ethane/Ethene)	100mL	3-40ml vials w/ septum (no headspace)	H_2SO_4 to pH<2, Cool to 4^o C
Alkalinity	100 mL	1-500 mL poly	Cool to 4°C
TOC	25 mL	1-250 mL amber glass	H_2SO_4 to pH <2, Cool 4°C
BOD	1000 mL	1–1000 mL poly	Cool to 4°C
Ferrous Iron	50 mL	1-250 mL amber glass	2 mL conc. HCl/100 mL; no exposure to sunlight
Oil & Grease	1 L	1-1000 ml amber glass	H_2SO_4 to pH <2, Cool 4°C
TRPH	1 L	1-1000 ml amber glass	H_2SO_4 to pH <2, Cool 4°C
Cyanide	500 mL	1-liter poly	NaOH to pH >12, Cool 4°C

NOTES:

(1) Triplicate volumes are required for samples selected for lab QC.

(2) GC methods proposed for SGWS for quick turnaround, low detection limit screening data only.

Reference: SW-846, Third Edition, USEPA; MCAWW; and Standard Methods

TABLE 3-3
SAMPLE CONTAINER AND PRESERVATION REQUIREMENTS FOR SOILS/SOLIDS

PARAMETERS	SAMPLE VOLUME REQUIRED	CONTAINER	PRESERVATION
TCL VOA in EnCore Sampler	10 g	2x5 g EnCore Sampler	Cool 4°C
TCL SVOC/PAH	30 g	8 oz glass	Cool 4°C
TCL Pesticides/PCBs	30 g	8 oz glass	Cool 4°C
PP/TAL Metals – Total	5 g;1 g for Hg	8 oz glass	Cool 4°C
pH	10 g	8 oz glass	Cool 4°C
Explosives	2 g	1-250 mL amber glass	Cool 4°C
Cyanide	30 g	8 oz glass	Cool 4°C
Mustard Breakdown Product - Thiodiglycol	30 g	1-250 mL amber glass	Cool 4°C
Particle Size	--	1-500 mL amber glass	Cool 4°C
TOC	25 g	8 oz glass	Cool 4°C
TRPH	30 g	8 oz glass	Cool 4°C
Triaxial Permeability	--	1-250 mL amber glass	Cool 4°C
Atterburg Limits (1)	--	1-250 mL amber glass	Cool 4°C
Specific Gravity (1)		1-250 mL amber glass	Cool 4°C
TCLP Metals	100 g/300 mL	1-8 oz glass	Cool 4°C
TCLP VOC	>25 g	1-250 mL amber glass	Cool 4°C
TCLP SVOC	>100 g/1L	1-8 oz amber glass	Cool 4°C
TCLP Herbicide/Pesticide	>100 g/1L	1-250 mL amber glass	Cool 4°C
Ignitability	2 g	8 oz glass	Cool 4°C
Corrosivity	10 g	8 oz glass	Cool 4°C
Reactivity	20 g	8 oz glass	Cool 4°C
Moisture Content (1)	>20 g	1-250 mL amber glass	Cool 4°C
Elemental Analysis (1)		1-250 mL amber glass	Cool 4°C
Heating Value (1)		1-250 mL amber glass	Cool 4°C

NOTES:

(1) Can be collected in the same container..

Reference: SW-846, Third Edition, USEPA and ASTM

TABLE 3-4
SAMPLE CONTAINER AND PRESERVATION REQUIREMENTS FOR TISSUES

PARAMETERS	SAMPLE VOLUME REQUIRED	CONTAINER	PRESERVATION
TCL VOA	N/A	N/A	N/A
TCL SVOC/PAH	10 g	8 oz glass	Cool 4°C or freeze on dry ice
TCL Pesticides/PCBs	10 g	8 oz glass	Cool 4°C or freeze on dry ice
PP/TAL Metals – Total	5 g; 1 g for Hg	8 oz glass	Cool 4°C or freeze on dry ice
Explosives	5g		Cool 4°C or freeze on dry ice
Cyanide	5g	8 oz glass	Cool 4°C or freeze on dry ice
Mustard Breakdown Product - Thiodiglycol	5g		Cool 4°C or freeze on dry ice
TOC	3g	8 oz glass	Cool 4°C or freeze on dry ice
TRPH	3g	8 oz glass	Cool 4°C or freeze on dry ice
Moisture Content (1)	2 g	8 oz glass	Cool 4°C or freeze on dry ice
Lipid Content (1)	3 g	8 oz glass	Cool 4°C or freeze on dry ice

NOTES:

(1) Can be collected in the same container.

Reference: SW-846, Third Edition, USEPA

TABLE 3-5
ANALYTICAL METHODS FOR SOILS/SOLIDS

PARAMETERS	PREPARATION METHOD	CLEANUP METHOD	ANALYSIS METHOD	HOLDING TIMES[1] (Preparation/Analysis)
VOC	5030/5035	--	8260	14 days if frozen within 48 hours
SVOC/PAH	3550	3640 (optional)	8270	14 days/40 days extraction to analysis
PESTICIDES	3540	3640/3660[2]	8081	14 days/40 days extraction to analysis
PCBs	3540	3640/3660/3665[2]	8082	14 days/40 days extraction to analysis
HERBICIDES	8151	--	8151	14 days/40 days extraction to analysis
PP/TAL METALS – TOTAL	3050	--	6010 (7471 for Hg) [3]	Hg: 28 days; others: 6 months
pH	--	--	9045	Immediately
EXPLOSIVES	--	--	8330	14 days/40 days extraction to analysis
CYANIDE	9010B	--	9012	14 days
MUSTARD BREAKDOWN PRODUCT - THIODIGLYCOL	--	--	UW22/LW18 (Mod)	14 days/40 days extraction to analysis
TRPH	--	--	8015	28 days
TOC	--	--	9060	28 days
TCLP	1311	--	(4)	(4)
IGNITABILITY	--	--	1010	None
CORROSIVITY	--	--	9045	None
REACTIVITY	--	--		None
PARTICLE SIZE	--	--	ASTM D421/D422	None
ELEMENTAL ANALYSIS	--	--	ASTM D5291(C), D2924, D4239	None
HEATING VALUE	--	--	ASTM D240	None
TRIAXIAL PERMEABILITY	--	--	ASTM D5084	None
ATTERBURG LIMITS	--	--	ASTM D4318	None
SPECIFIC GRAVITY	--	--	ASTM D854	None
MOISTURE CONTENT	--	--	ASTM D2216	None

NOTES:

(1) Holding times are based on collection dates unless otherwise specified.

(2) GPC (3640) is optional. Acid cleanup method 3665A is mandatory for PCB analysis. Sulfur cleanup (3660) is mandatory only if sulfur peak detected during analysis. Other adsorption column chromatography techniques may be necessary.

(3) All metals except mercury (7471) will be analyzed by trace ICP Method 6010. Graphite furnace will be used by a NJDEP and USACE certified laboratory for the following analytes if the reporting limits cannot be met: As – 7060, Pb - 7421, Se - 7740, Tl - 7841, Cd – 7131, Sb - 7041.

(4) VOC will be by Method 8260 and the holding times are 14 days to leaching and 14 days from leaching to analysis; SVOC by 8270, Pesticides by 8081, Herbicides by 8151, and their holding times are 14 days to leaching, 7 days from leaching to extraction, and 40 days from extraction to analysis; Metals by 6010 and the holding time is 180 days; Hg by 7471 and the holding time is 28 days.

Reference: SW-846, Third Edition, U.S. EPA, MCAWW, and ASTM.

TABLE 3-6
ANALYTICAL METHODS FOR WATER

PARAMETERS	PREPARATION METHOD	CLEANUP METHOD	ANALYSIS METHOD	HOLDING TIMES(1) (Preparation/Analysis)
VOC	5030	--	8260	14 days (7 days if unpreserved)
SVOC/PAH	3520 or 3510	--	8270	7 days/ 40 days extraction to analysis
PESTICIDES	3520 or 3510	3620(2)	8081	7 days/ 40 days extraction to analysis
PCBs	3520 or 3510	3665(4)	8082	7 days/ 40 days extraction to analysis
HERBICIDES	-----	-----	8151	7 days/ 40 days extraction to analysis
PP/TAL METALS - TOTAL	3010/3020 (3)	--	6010 (7470 for Hg) (3)	Hg: 28 days; others: 6 months
pH	--	--	9040	Immediately
EXPLOSIVES	--	--	8330	7 days/ 40 days extraction to analysis
CYANIDE	9010	--	9012	14 days
MUSTARD BREAKDOWN PRODUCT - THIODIGYLCOL	--	--	UW22/LW18 (Mod)	14 days
OIL AND GREASE	--	--	413.1	28 days
HARDNESS	--	--	130.2	6 months
TRPH	--	--	418.1	28 days
TDS	--	--	160.1	7 days
CHLORIDE	--	--	325.3	28 days
ALKALINITY	--	--	310.1	14 days
PHOSPHATE	--	--	365.3	28 days
NITRATE	--	--	353.2	48 hours
AMMONIA	--	--	350.3	28 days
SULFATE	--	--	375.4	28 days
TOC	--	--	415.1	28 days
SULFIDE	--	--	376.1	7 days
BOD$_5$	--	--	405.1	48 hours
CO$_2$	--	--	4500-CO$_2$D	Immediately
FERROUS FE	--	--	3500-FeD	Immediately
METHANE (with ETHANE/ETHENE)	--	--	3810	14 days

NOTES:

(1) Holding times are based on collection dates unless otherwise specified.
(2) Optional Florisil cleanup.
(3) All metals except mercury (7470) will be analyzed by trace ICP Method 6010. Graphite furnace will be used by a NJDEP and USACE certified laboratory for the following analytes if the reporting limits cannot not be met: As – 7060, Pb – 7421, Se - 7740, Tl – 7841, Cd – 7131, Sb - 7041. If graphite furnace is to be used, method 3020 will be used for sample digestion.
(4) Sulfuric acid cleanup is mandatory

Reference: SW-846, Third Edition, U.S. EPA; MCAWW; and Standard Methods.

TABLE 4-1
VOLATILE ORGANIC COMPOUNDS
REGULATORY REQUIREMENTS FOR WATER AND SOIL

Analytes	NJDEP GWQS (μg/L)	NJDEP FW-2 Standard (μg/L)	NJDEP Soil Criteria[(1)] (mg/kg)	Freshwater Sediment Screening Guidelines[(6)] LEL (mg/kg)	Marine/Estuarine Screening Guidelines[(7)] ER-L (mg/kg)
Chloromethane	30	NSA	10	NSA	NSA
Bromomethane	10	48.4(h)	1	NSA	NSA
Vinyl Chloride	5	0.0830(hc)	10	NSA	NSA
Chloroethane	NSA	NSA	NSA	NSA	NSA
Methylene Chloride	3[(3)]	2.49(hc)	1[(4)]	NSA	NSA
Acetone	700	NSA	100	NSA	NSA
Carbon Disulfide	NSA	NSA	NSA	NSA	NSA
1,1-Dichloroethene	2	4.81(hc)	10	NSA	NSA
1,1-Dichloroethane	50[(3)]	NSA	10[(4)]	NSA	NSA
cis-1,2-Dichloroethene	70[(3)]	NSA	1[(4)]	NSA	NSA
trans-1,2-dichloroethene	100[(3)]	592(h)	50[(4)]	NSA	NSA
Chloroform	6	5.67(hc)	1	NSA	NSA
1,2-Dichloroethane	2	0.291(hc)	1	NSA	NSA
2-Butanone	300	NSA	50	NSA	NSA
1,1,1-Trichloroethane	30	127(h)	50[(4)]	NSA	NSA
Carbon Tetrachloride	2	0.363(hc)	1	NSA	NSA
Bromodichloromethane	1	0.266(hc)	1	NSA	NSA
1,2-Dichloropropane	1	NSA	43[(2)]	NSA	NSA
cis-1,3-Dichloropropene	NSA	0.193(hc)*	1[(5)]	NSA	NSA
Trichloroethene	1	1.09(hc)	1	NSA	NSA
Dibromochloromethane	10	72.6(h)	1	NSA	NSA
1,1,2-Trichloroethane	3	13.5(h)	1[(4)]	NSA	NSA
Benzene	1	0.150(hc)	1	NSA	NSA
trans-1,3-Dichloropropene	NSA	0.193(hc)*	1[(5)]	NSA	NSA
Bromoform	4	4.38(hc)	1	NSA	NSA
4-Methyl-2-pentanone	400	NSA	50	NSA	NSA
2-Hexanone	NSA	NSA	NSA	NSA	NSA
Tetrachloroethene	1	0.388(hc)	1	NSA	NSA
Toluene	1000	7440(h)	500	NSA	NSA
1,1,2,2-Tetrachloroethane	1[(3)]	1.72(hcc)	1[(4)]	NSA	NSA
Chlorobenzene	50[(3)]	22.0(hc)	1[(4)]	NSA	NSA
Ethyl Benzene	700	3030(h)	100	NSA	NSA
Styrene	100	NSA	97	NSA	NSA
Xylenes (total)	1000[(3)]	NSA	10[(4)]	NSA	NSA

See next page for notes.

TABLE 4-1 (continued)
VOLATILE ORGANIC COMPOUNDS
REGULATORY REQUIREMENTS FOR WATER AND SOIL

NOTES:

NSA - No Standard Available
GWQS - Groundwater Quality Standard
LEL – Lowest Effects Levels
ER-L – Effects Range-Low

(1) More stringent of NRDCSCC or IGWSCC (February 1994).
(2) NSA for IGWSCC. The reported criteria are NRDCSCC.
(3) February 1997 Interim Specific Groundwater Criteria.
(4) New IGWSCC are being developed by NJDEP and will likely be higher than the February 1994 criteria.
(5) Criteria is for total (cis and trans).
(6) Table 1, "Guidance For Sediment Quality Evaluations", NJDEP November 1998. Guidelines are based on dry-weight.
(7) Table 2, "Guidance For Sediment Quality Evaluations", NJDEP November 1998. Guidelines are based on dry-weight.
(h) Noncarcinogenic effect-based human health criteria as a 30-day average with no frequency of exceedance at or above the design flows specified in section N.J.A.C. 7:9B-1.5(c)2.
(hc) Carcinogenic effect-based human health criteria as a 70-year average with no frequency of exceedance at or above the design flows specified in section N.J.A.C. 7:9B-1.5(c)2 and are based on a risk level of one-in-one-million.
(hcc) Toxic substances considered to be possible human carcinogens as a 70-year average with no frequency of exceedance at or above the design flows specified in section N.J.A.C. 7:9B-1.5(c)2 and are based on a risk of one-in-one hundred thousand.

TABLE 4-2
SEMIVOLATILE ORGANIC COMPOUNDS
REGULATORY REQUIREMENTS FOR WATER AND SOIL

ANALYTE	NJDEP GWQS (µg/L)	NJDEP FW-2 Standard (µg/L)	NJDEP Soil Criteria(1) (mg/Kg)	Freshwater Sediment Screening Guidelines(6) LEL (mg/kg)	Marine/Estuarine Screening Guidelines(7) ER-L (mg/kg)
Phenol	4000	20900(h)	50	NSA	NSA
bis(2-Chloroethyl) ether	10	0.0311(hc)	3	NSA	NSA
2-Chlorophenol	40	122(h)	10	NSA	NSA
1,3-Dichlorobenzene	600	2620(h)	100	NSA	NSA
1,4-Dichlorobenzene	75	343(h)	100	NSA	NSA
1,2-Dichlorobenzene	600	2520(h)	50	NSA	NSA
2-Methylphenol	NSA	NSA	10,000(2)	NSA	NSA
Bis(2-chloroisopropyl)ether	300	1250(h)	10	NSA	NSA
4-Methylphenol	NSA	NSA	10,000(2)	NSA	NSA
N-Nitroso-di-n-propylamine	20	NSA	0.66	NSA	NSA
Hexachloroethane	10	2.73(h)	100	NSA	NSA
Nitrobenzene	10	16.0(h)	10	NSA	NSA
Isophorone	100	552(h)	50	NSA	NSA
2-Nitrophenol	NSA	NSA	NSA	NSA	NSA
2,4-Dimethylphenol	100	NSA	10	NSA	NSA
bis(2-Chloroethoxy) methane	NSA	NSA	NSA	NSA	NSA
2,4-Dichlorophenol	20	92.7(h)	10	NSA	NSA
1,2,4-Trichlorobenzene	9	30.6	100	NSA	NSA
Naphthalene	30(3)	NSA	100(4)	(8)	0.16
4-Chloroaniline	NSA	NSA	4200(2)	NSA	NSA
Hexachlorobutadiene	1	6.94(h)	21	NSA	NSA
4-Chloro-3-methylphenol	NSA	NSA	100	NSA	NSA
2-Methylnaphthalene	NSA	NSA	NSA	(8)	0.070
Hexachlorocyclopentadiene	50	245(h)	100	NSA	NSA
2,4,6-Trichlorophenol	20	2.14(hc)	10	NSA	NSA
2,4,5-Trichlorophenol	700	2580(h)	50	NSA	NSA
2-Chloronaphthalene	NSA	NSA	NSA	NSA	NSA
2-Nitroaniline	NSA	NSA	NSA	NSA	NSA
Dimethylphthalate	NSA	313000(h)	50	NSA	NSA
2,6-Dinitrotoluene	10(5)	NSA	4(5)	NSA	NSA
3-Nitroaniline	NSA	NSA	NSA	NSA	NSA
Acenaphthene	400	NSA	100	(8)	0.016
Acenaphthylene		NSA		(8)	0.044
2,4-Dinitrophenol	40	69.7(h)	10	NSA	NSA
4-Nitrophenol	NSA	NSA	NSA	NSA	NSA
Dibenzofuran	NSA	NSA	NSA	NSA	NSA
2,4-Dinitrotoluene	10(5)	0.11(hc)	4(5)	NSA	NSA
Diethylphthalate	5000	21200(h)	50	NSA	NSA
4-Chlorophenyl-phenyl ether	NSA	NSA	NSA	NSA	NSA
Fluorene	300	1340(h)	100	0.190	0.019
4-Nitroaniline	NSA	NSA	NSA	NSA	NSA

TABLE 4-2 (continued)
SEMIVOLATILE ORGANIC COMPOUNDS
REGULATORY REQUIREMENTS FOR WATER AND SOIL

ANALYTE	NJDEP GWQS (µg/L)	NJDEP FW-2 Standard (µg/L)	NJDEP Soil Criteria[(1)] (mg/kg)	Freshwater Sediment Screening Guidelines[(6)] LEL (mg/kg)	Marine/Estuarine Sediment Screening Guidelines[(7)] ER-L (mg/kg)
4,6-Dinitro-2-methylphenol	NSA	13.4(h)	NSA	NSA	NSA
N-Nitrosodiphenylamine	20	4.95(hc)	100	NSA	NSA
4-Bromophenyl-phenylether	NSA	NSA	NSA	NSA	NSA
Hexachlorobenzene	10	0.000748(hc)	2	0.020	(9)
Pentachlorophenol	1	0.282(hc)*	24	NSA	NSA
Phenanthrene	NSA	NSA	NSA	0.560	0.140
Anthracene	2000	9570(h)	100	0.22	0.085
Carbazole	NSA	NSA	NSA	NSA	NSA
Di-n-butylphthalate	900	3530(h)	100	NSA	NSA
Fluoranthene	300	310(h)	100	0.750	0.600
Pyrene	200	797(h)	100	0.490	0.665
Butylbenzylphthalate	100	239(h)	100	NSA	NSA
3,3'-Dichlorobenzidine	60	0.0386(hc)	6	NSA	NSA
Benzo(a)anthracene	NSA	0.0028(hc)	4	0.320	0.261
Chrysene	NSA	0.0028(hc)	40	0.340	0.384
bis(2-Ethylhexyl)phthalate	30	1.76(hc)	100	NSA	NSA
Di-n-octylphthalate	100	NSA	100	NSA	NSA
Benzo(b)fluoranthene	NSA	0.0028(hc)	4	NSA	NSA
Benzo(k)fluoranthene	NSA	0.0028(hc)	4	0.240	(9)
Benzo(a)pyrene	NSA	0.0028(hc)	0.66	0.370	0.430
Indeno(1,2,3-cd)pyrene	NSA	0.0028(hc)	4	0.200	(9)
Dibenz(a,h)anthracene	NSA	0.0028	0.66	0.060	0.063
Benzo(g,h,i)perylene	NSA	NSA	NSA	0.170	(9)

NSA - No Standard Available
GWQS - Groundwater Quality Standard
LEL – Lowest Effects Levels
ER-L – Effects Range-Low

(1) More stringent of NRDCSCC or IGWSCC (February 1994).
(2) NSA for IGWSCC. The reported criteria are NRDCSCC.
(3) February 1997 Interim Specific Groundwater Criteria.
(4) New IGWSCC are being developed by NJDEP and will likely be higher than the February 1994 criteria.
(5) Criteria is for total 2,4-Dinitrotoluene/2,6-Dinitrotoluene mixture.
(6) Table 1, “Guidance For Sediment Quality Evaluations”, NJDEP November 1998. Guidelines are based on dry-weight.
(7) Table 2, “Guidance For Sediment Quality Evaluations”, NJDEP November 1998. Guidelines are based on dry-weight.
(8) See Marine/Estuarine Sediment Screening Guidelines.
(9) See Freshwater Sediment Screening Guidelines.
(h) Noncarcinogenic effect-based human health criteria as a 30-day average with no frequency of exceedance at or above the design flows specified in section N.J.A.C. 7:9B-1.5(c)2.
(hc) Carcinogenic effect-based human health criteria as a 70-year average with no frequency of exceedance at or above the design flows specified in section N.J.A.C. 7:9B-1.5(c)2 and are based on a risk level of one-in-one-million.
* The one-hour average is $e^{(1.005(pH)-4.830)}$; the 4-day average is $e^{(1.005(pH)-5.290)}$

TABLE 4-3
PESTICIDES/PCBs
REGULATORY REQUIREMENTS FOR WATER AND SOIL

ANALYTE	NJDEP GWQS (µg/L)	NJDEP FW-2 Standard (µg/L)	NJDEP Soil Criteria[1] (mg/Kg)	Freshwater Sediment Screening Guidelines[2] LEL (mg/kg)	Marine/Estuarine Sediment Screening Guidelines[3] ER-L (mg/kg)
alpha-BHC	0.02	0.00391(hc)	NSA	0.006	
beta-BHC	0.2	0.137(hcc)	NSA	0.005	
delta-BHC	NSA		NSA	NSA	
gamma-BHC (Lindane)	0.2	2.0(a); 0.080(c)	2.2	0.003	
Heptachlor	0.4	0.52(a); 0.0038(c); 0.000208(hc)	0.65	NSA	
Aldrin	0.04	3.0(a); 0.000135(hc)	0.17	0.002	(4)
Heptachlor epoxide	0.2	0.52(a); 0.0038(c); 0.000103(hc)	NSA	0.005	(4)
Endosulfan I	0.4	0.22(a); 0.0056(c); 0.932(h)	50	NSA	
Dieldrin	0.03	2.5(a); 0.0019(c); 0.000135(hc)	0.18	0.002	(4)
4,4'-DDE	0.1	0.000588(hc)	9	0.005	0.0022
Endrin	2	0.18(a); 0.0023(c); 0.629(h)	50	0.003	(4)
Endosulfan II	0.4	0.22(a); 0.0056(c); 0.932(h)	50	NSA	
4,4'-DDD	0.1	0.000832(hc)	12	0.008	
Endosulfan sulfate	0.4	0.93(h)	NSA	NSA	
4,4'-DDT	0.1	1.1(a); 0.0010(c); 0.000588(hc)	9	0.008 (op+pp)	0.0016 (total)
Methoxychlor	40	0.03(c); 40(h)	50	NSA	
Endrin ketone	NSA		NSA	NSA	
Endrin aldehyde	NSA	0.76(h)	NSA	NSA	
Alpha-Chlordane	NSA	2.4(a); 0.0043(c); 0.000277(hc)*	NSA	0.007*	(4)
Gamma-Chlordane	NSA	2.4(a); 0.0043(c); 0.000277(hc)*	NSA	0.007*	(4)
Toxaphene	3	0.73(a); 0.0002(c); 0.000730(hc)	0.2	NSA	
Aroclor-1016		0.014(c); 0.00017(hc)**	2	0.007	0.023 (total PCB)
Aroclor-1221		0.014(c); 0.00017(hc)**	2	0.070 (total PCB)	0.023 (total PCB)
Aroclor-1232		0.014(c); 0.00017(hc)**	2	0.070 (total PCB)	0.023 (total PCB)
Aroclor-1242		0.014(c); 0.00017(hc)**	2	0.070 (total PCB)	0.023 (total PCB)
Aroclor-1248		0.014(c); 0.00017(hc)**	2	0.030	0.023 (total PCB)
Aroclor-1254		0.014(c); 0.00017(hc)**	2	0.060	0.023 (total PCB)
Aroclor-1260		0.014(c); 0.00017(hc)**	2	0.005	0.023 (total PCB)

NOTES:

NSA - No Standard Available

NR – Not Required

GWQS - Groundwater Quality Standard

LEL – Lowest Effects Levels

ER-L – Effects Range-Low

(1) More stringent of NRDCSCC or IGWSCC (February 1994).

(2) Table 1, “Guidance For Sediment Quality Evaluations”, NJDEP November 1998. Guidelines are based on dry-weight.

(3) Table 2, “Guidance For Sediment Quality Evaluations”, NJDEP November 1998. Guidelines are based on dry-weight.

(4) See Freshwater Sediment Screening Guidelines.

(h) Noncarcinogenic effect-based human health criteria as a 30-day average with no frequency of exceedance at or above the design flows specified in section N.J.A.C. 7:9B-1.5(c)2.

(hc) Carcinogenic effect-based human health criteria as a 70-year average with no frequency of exceedance at or above the design flows specified in section N.J.A.C. 7:9B-1.5(c)2 and are based on a risk level of one-in-one-million.

(hcc) Toxic substances considered to be possible human carcinogens as a 70-year average with no frequency of exceedance at or above the design flows specified in section N.J.A.C. 7:9B-1.5(c)2 and are based on a risk of one-in-one hundred thousand.

(a) Aquatic life protection criteria as a one-hour average.

(c) Chronic aquatic life protection criteria as a four-day average.

* For Chlordane

** For PCBs

TABLE 4-4
METAL ANALYTES
REGULATORY REQUIREMENTS FOR WATER AND SOIL

ANALYTE	NJDEP GWQS (µg/L)	NJDEP FW-2 Standard (µg/L)	NJDEP Soil Criteria[4] (mg/Kg)	Freshwater Sediment Screening Guidelines[5] LEL (mg/kg)	Marine/Estuarine Sediment Screening Guidelines[6] ER-L (mg/kg)
Aluminum	200	NSA	NSA	NSA	NSA
Antimony (1)	20	12.2(h)	340	NSA	NSA
Arsenic (1)	8	0.0170(hc)	20	6	8.2
Barium	2000	2000(h)	47000	NSA	NSA
Beryllium (1)	20	NSA	1	NSA	NSA
Cadmium(1)	4	10(h)	100	0.6	1.2
Calcium	NSA	NSA	NSA	NSA	NSA
Chromium	100	160(h)	500	26	81
Cobalt	NSA	NSA	NSA	NSA	NSA
Copper	1000	NSA	600	16	34
Iron	300	NSA	NSA	NSA	NSA
Lead (1)	10	38(a); 5(h)	600	31	47
Magnesium	NSA	NSA	NSA	NSA	NSA
Manganese	50	100(h)	NSA	NSA	NSA
Mercury (2)	2	0.144(h)	270	0.2	0.15
Nickel	100	516(h)	2400	16	21
Potassium	NSA	NSA	NSA	NSA	NSA
Selenium (1)	50	10(h)	3100	NSA	NSA
Silver	NSA	164(h)	4100	(7)	1.0
Sodium	50000	NSA	NSA	NSA	NSA
Thallium (1)	10	1.70(h)	2	NSA	NSA
Vanadium	NSA	NSA	7100	NSA	NSA
Zinc	5000	NSA	1500	120	150
Cyanide (3)	200	22(a); 5.2(c); 768(h)	21000	NSA	NSA

NOTES:

NSA - No Standard Available
GWQS - Groundwater Quality Standard
LEL – Lowest Effects Levels
ER-L – Effects Range-Low

(1) Trace ICP or Graphite Furnace Atomic Absorption technique may be used.
(2) Cold Vapor Atomic Absorption technique.
(3) Colorimetric spectrophotometric technique.
(4) No NJDEP IGWSCC exists for metals; therefore, the reported criteria are NRDCSCC.
(5) Table 1, "Guidance For Sediment Quality Evaluations", NJDEP November 1998. Guidelines are based on dry-weight.
(6) Table 2, "Guidance For Sediment Quality Evaluations", NJDEP November 1998. Guidelines are based on dry-weight.
(7) See Marine/Estuarine Sediment Screening Guidelines.
(h) Noncarcinogenic effect-based human health criteria as a 30-day average with no frequency of exceedance at or above the design flows specified in section N.J.A.C. 7:9B-1.5(c)2.
(hc) Carcinogenic effect-based human health criteria as a 70-year average with no frequency of exceedance at or above the design flows specified in section N.J.A.C. 7:9B-1.5(c)2 and are based on a risk level of one-in-one-million.
(a) Aquatic life protection criteria as a one-hour average.
(c) Chronic aquatic life protection criteria as a four-day average.

TABLE 4-5
EXPLOSIVES COMPOUNDS
REGULATORY REQUIREMENTS FOR WATER AND SOIL

ANALYTE	NJDEP GWQS (µg/L)	NJDEP FW-2 Standard (µg/L)	NJDEP Soil Criteria$^{(1)}$ (mg/Kg)	Freshwater Sediment Screening Guidelines$^{(4)}$ LEL (mg/kg)	Marine/Estuarine Sediment Screening Guidelines$^{(5)}$ ER-L (mg/kg)
HMX	NSA	NSA	NSA	NSA	NSA
RDX	NSA	NSA	NSA	NSA	NSA
1,3,5-TNB	NSA	NSA	NSA	NSA	NSA
1,3-DNB	NSA	2620(h)	NSA	NSA	NSA
Tetryl	NSA	NSA	NSA	NSA	NSA
NB	10	16.0(h)	10	NSA	NSA
2,4,6-TNT	0.4	NSA	10$^{(2)}$	NSA	NSA
2,6-DNT$^{(3)}$	10$^{(3)}$	NSA	4$^{(3)}$	NSA	NSA
2,4-DNT$^{(3)}$	10$^{(3)}$	0.11(h)	4$^{(3)}$	NSA	NSA
2-Amino-4,6-DNT$^{(2)}$	0.4$^{(2)}$	NSA	10$^{(2)}$	NSA	NSA
4-Amino-2,6-DNT$^{(2)}$	0.4$^{(2)}$	NSA	10$^{(2)}$	NSA	NSA
NG	NSA	NSA	NSA	NSA	NSA
PETN	NSA	NSA	NSA	NSA	NSA

NOTES:

LEL – Lowest Effects Levels
ER-L – Effects Range-Low
(1) More stringent of NRDCSCC or IGWSCC (February 1994).
(2) 2,4,6-TNT and Amino-DNT soil criteria are NJDEP site-specific interim criteria. Draft GWQS for Amino-DNTs is being evaluted by NJDEP and may change.
(3) 2,4-DNT and 2,6-DNT co-elute; criteria is for 2,4-DNT/2,6-DNT mixture.
(4) Table 1, “Guidance For Sediment Quality Evaluations”, NJDEP November 1998. Guidelines are based on dry-weight.
(5) Table 2, “Guidance For Sediment Quality Evaluations”, NJDEP November 1998. Guidelines are based on dry-weight.
(h) Noncarcinogenic effect-based human health criteria as a 30-day average with no frequency of exceedance at or above the design flows specified in section N.J.A.C. 7:9B-1.5(c)2.

TABLE 4-6A
RISK ASSESSMENT BENCHMARKS FOR TISSUES
SURFACE WATER BENCHMARKS

Coumpounds Detected in Surface Water at the Former Raritan Arsenal	**Screening Benchmarks**			
	FRESHWATER (µg/L)		**MARINE** (µg/L)	
VOCs				
Acetone	1,500	2		
2-Butanone	14,000	2		
Carbon disulfide	0.92	2	2	4,d
Chlorobenzene	64	2	105	3
Chloroform	28	2	815	3
Chloromethane	5,500	3	2,700	3
1,1-Dichloroethane	47	2	3,200	3
1,2-Dichloroethane	910	2	1130	3
1,1-Dichloroethene	25	2	22,400	3
1,2-Dichloroethene (total)	590	2	22,400	3
cis-1,2-Dichloroethene	1,160	3	22,400	3
Toluene	9.8	2	37	3
Trichloroethylene	47	2	220	3
Xylenes (Total)	13	2	135	3
Semivolatiles				
Benzo(a)anthracene	0.027	2	8.13	4,d,m
Benzo(a)pyrene	0.014	2	0.021	3
Benzo(b)fluoranthene			30	3
Benzo(k)fluoranthene			30	3
Butylbenzylphthalate	19	2,b	29.4	3
Chrysene			30	3
Diethyl phthalate	210	2	75.9	3
Di-N-butyl phthalate	35	2	3.4	4,d,m
Fluoranthene	398	3	16	4,d,m
Indeno(1,2,3-c,d)pyrene			30	3
Phenanthrene	6.3	4,c,d	4.6	4,d,m
Phenol	256	3	580	3
Pyrene			30	3
Dioxin (pg/mL)				
2,3,7,8-Tetrachlorodibenzo-p-dioxin	2	7	2	7
Metals				
Aluminum	87	1,e		
Antimony	30	2,f	500	4,d
Arsenic	190	1,g	36	1,g
Barium	4	2	1,000	3
Beryllium	0.66	2	1,500	4
Cadmium	1	1,g,h	9.3	1,g
Calcium				
Chromium	11	1,g,I	50.4	3
Cobalt	23	2		
Copper	11	1,g,h	2.4	1,g
Iron	1,000			
Lead	2.5	1,g,h	8.1	1,g
Magnesium				
Manganese	120	2	10	4,a,d,k,l
Nickel	160	1,g,h	8.2	1,g
Potassium				
Selenium	5	1,e	71	1,g
Silver	3.4	1,g,h,j	1.9	1,g,j
Sodium				
Thallium	12	2	213	3
Vanadium	20	2	10,000	4,a
Zinc	100	1,g,h	81	1,g

TABLE 4-6A
RISK ASSESSMENT BENCHMARKS FOR TISSUES
SURFACE WATER BENCHMARKS

Coumpounds Detected in Surface Water at the Former Raritan Arsenal	Screening Benchmarks			
	FRESHWATER (µg/L)		**MARINE** (µg/L)	
Explosives				
1,3,5-Trinitrobenzene	110	5, 6	110	5, 6
1,3-Dinitrobenzene	20	6	20	6
2,4-Dinitrotoluene	230	5	230	5
2,4,6-Trinitrotoluene	90	6	90	6
2,6-Dinitrotoluene	42	5	42	5
2-Amino-4,6-dinitrotoluene	20	5, 6	20	5, 6
HMX				
Nitrobenzene	480	5	480	5
RDX (Cyclonite)	190	5	190	5

Footnotes

(µg/kg) = micorgrams per liter

1 USEPA. April 1999. National Recommended Water Quality Criteria - Correction. EPA 822-Z-99-0001. Chronic Continuous Concentration (CCC) Values.

2 Suter, G.W. & C.L. Tsao, 1996. *Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Aquatic Biota: 1996 Revision.* - Secondary Chronic Values only

3 CH2MHILL. 2000. Technical Memorandum Alternate Screening Values - Ecological Risk Assessment IR Sites 5, 7, 8, 9, 10, 11, 12, 13, 16 and SWMU-3: Naval Amphibious Base (NAB) Little Creek Virginia Beach, Virginia. CTO - 0098.

4 U.S. Environmental Protection Agency (USEPA) Region III. 1995. *Revised Region III BTAG screening levels* . Memorandum from R.S. Davis to Users. 9 August. Flora and Fauna values unless noted

5 USEPA Tier II Secondary Chronic Values

6 Talmage, et.al.,1999. Nitroaromatic Munition Compounds: Environmental Effects and Screening Values. Rev. Environ. Contam. Toxicol. 161:1-156.

7 EPA, 1993, Interim Report on Data and Methods for Assessment of 2,3,7,8-tetrachlorodibenzo-p-dioxin Risks to Aquatic Life and Associated Wildlife(EPA/600R-93/005)

a Fauna only
b Values calculated for OSWER (1996)
c Acute Value
d Chronic Value
e Criterion expressed as total recoverable metal in the water column. It is possible to convert to dissolved metals by using conversion factor or 0.922.

f This value is a draft FAV and FCV value (EPA 1988b)
g Freshwater criteria for metals are expressed in terms of the dissolved metal in the water column.
h Freshwater aquatic life criteria for these metals are expressed as a function hardness (mg/L as CaCO3), in the water column. The value listed here
I Value for Chromium VI used as surrogate benchmark.
j CMC Value
k Marine aquatic life value is dependent on hardness. (Will use site specific hardness data).

TABLE 4-6B
RISK ASSESSMENT BENCHMARKS FOR TISSUES
SOIL BENCHMARKS

Compounds Detected in Soil in the Former Raritan Arsenal	Screening Benchmarks					
	Earthworms (µg/kg)		Plants (µg/kg)		PRGs^4 (µg/kg)	
VOCs						
Acetone						
Benzene	105	2, a	105	2, a		
2-Butanone						
Carbon disulfide						
Carbon tetrachloride	1,000,000	1	300	3		
Chlorobenzene	40,000	1				
Chloroform	1000	2, a	1000	2, a		
Chloromethane						
1,2-Dichloroethene (total)	300	3	300	3		
cis-1,2-Dichloroethene	300	3	300	3		
trans-1,2-Dichloroethene	300	3	300	3		
cis-1,3-Dichloropropene	300	3, b	300	3, b		
Ethyl benzene	5005	2, a	5005	2, a		
2-Hexanone						
Methylene chloride	1001	2, a	1001	2, a		
4-Methyl-2-pentanone	10000	2, a	10000	2, a		
Styrene	10010	2, a	300,000	1		
Tetrachloroethylene	401	2, a	401	2, a		
Toluene	13005	2, a	200,000	1		
1,1,1-Trichloroethane	300	3, c	300	3, c		
Trichloroethylene	6000	2, a	6000	2, a		
Vinyl chloride	300	3	300	3		
Xylenes (Total)	2505	2, a	2505	2, a		
Semivolatiles						
Acenaphthene	100	3	20,000	1		
Acenaphthylene	4100	2, a, d	4100	2, a, d		
Anthracene	4100	2, a, d	4100	2, a, d		
Benzo(a)anthracene	4100	2, a, d	4100	2, a, d		
Benzo(a)pyrene	4100	2, a, d	4100	2, a, d		
Benzo(b)fluoranthene	4100	2, a, d	4100	2, a, d		
Benzo(ghi)perylene	4100	2, a, d	4100	2, a, d		
Benzo(k)fluoranthene	4100	2, a, d	4100	2, a, d		
Bis(2-ethylhexyl)phthalate						
Butylbenzylphthalate						
Carbazole	4100	2, a, d	4100	2, a, d		
Chrysene	4100	2, a, d	4100	2, a, d		
Dibenzo(a,h)anthracene	4100	2, a, d	4100	2, a, d		
Dibenzofuran						
1,2-Dichlorobenzene	100	3	100	3		
1,4-Dichlorobenzene	20,000	1	100	3		
3,3'-Dichlorobenzidine						
Diethyl phthalate			100,000	1		
2,4-Dimethylphenol	100	3	100	3		
Dimethyl phthalate	200,000	1				
Di-N-butyl phthalate			200,000	1		
2,4-Dinitrotoluene						
2,6-Dinitrotoluene						
Di-N-octyl phthalate						
Fluoranthene	4100	2, a, d	4100	2, a, d		
Fluorene	30,000	1	100	3		
Hexachlorobenzene						
Hexachlorobutadiene						
Indeno(1,2,3-c,d)pyrene	4100	2, a, d	4100	2, a, d		
2-Methylnaphthalene						
2-Methylphenol	100	3	100	3		
4-Methylphenol	100	3	100	3		
Naphthalene	4100	2, d	4100	2, a, d		
N-nitrosodiphenylamine	20,000	1				
Pentachlorophenol	6,000	1	3,000			
Phenanthrene	4100	2, a, d	4100	2, a, d		
Phenol	30,000	1	70,000	1		
Pyrene	4100	2, a, d	4100	2, a, d		
Pesticides						
Aldrin	100	3	100	3		
Alpha-BHC	100000	3, e				
Beta-BHC	10000	3, e				
Gamma-BHC	100	3	100	3		
Alpha-Chlordane	100	3, f	100	3, f		
Gamma-Chlordane	100	3, f	100	3, f		
4,4'-DDD	100	3	100	3		
4,4'-DDE	100	3	100	3		
4,4'-DDT	100	3	100	3		
Dieldrin	100	3	100	3		
Endosulfan I						
Endosulfan II						
Endosulfan sulfate						
Endrin	100	3	100	3		
Endrin aldehyde	100	3, g	100	3, g		

TABLE 4-6B
RISK ASSESSMENT BENCHMARKS FOR TISSUES
SOIL BENCHMARKS

Compounds Detected in Soil in the Former Raritan Arsenal	Screening Benchmarks					
	Earthworms (µg/kg)		Plants (µg/kg)		PRGs^4 (µg/kg)	
Heptachlor	100	3, h	100	3, h		
Heptachlor epoxide	100	3	100	3		
Methoxychlor	100	3	100	3		
Inorganics						
Cyanide, Free	5	3	27500	2		
PCBs						
Aroclor 1248			40,000	1, j	371	4
Aroclor 1260			40,000	1, j	371	4
Metals						
Aluminum	600000	1	50,000	1		
Antimony			5,000	1		
Arsenic	60,000	1	10,000	1		
Barium	3000000	1	500,000	1		
Beryllium			10,000	1		
Cadmium	20,000	1	4,000	1		
Calcium						
Chromium	400	1	1,000	1		
Cobalt	200000	3	20,000	1		
Copper	50,000	1	100,000	1		
Iron	200000	1	3260000	3		
Lead	500,000	1	50,000	1		
Magnesium	4400000	3	4400000	3		
Manganese	330000	3	500,000	1		
Mercury	100	1	300	1	0.51	4
Nickel	200,000	1	30,000	1		
Potassium						
Selenium	70,000	1	1,000	1		
Silver	50,000	1	2,000	1		
Sodium						
Thallium			1,000	1		
Vanadium	20,000	1	2,000	1		
Zinc	100,000	1	50,000	1		
Explosives						
1,3,5-Trinitrobenzene	367.15	5	367.15	5	367.15	5
1,3-Dinitrobenzene	654.7	5	654.7	5	654.7	5
2,4-Dinitrotoluene	1280	5	1280	5	1280	5
2,4,6-Trinitrotoluene	140,000	6	30,000	6		
2,6-Dinitrotoluene	32.83	5	32.83	5	32.83	5
2-Amino-4,6-dinitrotoluene			80,000	6		
HMX						
Nitrobenzene	1310	5	1310	5	1310	5
RDX (Cyclonite)						

Footnotes

ug/kg - micrograms per kilogran

1 Lowest value from :
Efroymson et al. 1997a. *Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Terrestrial Plants: 1997 Revision.*
Efroymson et al. 1997b. *Toxicological Benchmarks for Contaminants of Potential Concern for Effects on Soil and Litter Invertebrates and Heterotrophic Process: 1997 Revision.*
Efroymson et al. 1997d. *Preliminary Remediation Goals for Ecological Endpoints.*

2 Ministry of Housing, Spatial Planning and Environment (MHSPE). 1994. Intervention values. Directorate-General for Environmental Protection, Department of Soil Protection, The Hague, Netherlands. 9 May DBO/07494013

3 U.S. Environmental Protection Agency (USEPA) Region III. 1995*Revised Region III BTAG screening levels*. Memorandum from R.S. Davis to Users. 9 August.

4 Preliminary Remediation Goals (PRGs) used only to screen the bio-accumulative compounds indicated.

5 U.S. Environmental Protection Agency (USEPA) Region V, RCRA - Ecological Screening Tables, http://www.epa.gov/Region5/rcraca/edql.htm.

6 Talmage, et.al.,1999. Nitroaromatic Munition Compounds: Environmental Effects and Screening Values. Rev. Environ. Contam. Toxicol. 161:1-156.

a Fauna/flora endpoint not specified
b Value for Dichloropropene used as surrogate benchmark.
c Value for trichlorethane used as surrogate benchmark
d Total PAHs used as surrogate benchmark.
e Value for hexachlorocyclohexane (synonym =
f Value for chlordane used as surrogate benchmark
g Values for heptachlor epoxide used as surrogate benchmark
h Value for endrin used as surrogate benchmark
j Value for Total PCBs used a surrogate benchmark.

TABLE 4-6C
RISK ASSESSMENT BENCHMARKS FOR TISSUES
SEDIMENT BENCHMARKS

Compounds Detected in Sediment in the Former Raritan Arsenal	**Screening Benchmarks**			
	FRESHWATER (µg/kg)		**MARINE (µg/kg)**	
VOCs				
Acetone	8.7	4		
2-Butanone	270	4		
Carbon disulfide	0.85	4		
Chloromethane				
1,2-Dichloroethene (total)	400	4		
Ethyl benzene	10	3,g		
2-Hexanone	22	4		
Methylene chloride	370	4		
4-Methyl-2-pentanone	33	4		
Tetrachloroethylene	57	3,g		
Toluene	50	4		
Trichloroethylene	41	2		
Xylenes (Total)	40	3,g		
Semivolatiles				
Acenaphthene	16	3	16	5
Acenaphthylene	44	3	44	5
Anthracene	220	1,b	85.3	5
Benzo(a)anthracene	320	1,b	261	5
Benzo(a)pyrene	370	1,b	430	5
Benzo(b)fluoranthene	3,200	3		
Benzo(ghi)perylene	170	1,b		
Benzo(k)fluoranthene	240	1,b		
Bis(2-ethylhexyl)phthalate	1,300	3	182	6
Butylbenzylphthalate	63	3		
Carbazole				
Chrysene	340	1,b	384	5
Dibenzo(a,h)anthracene	60	1,b	63.4	5
Dibenzofuran	540	3		
2,4-Dimethylphenol				
Dimethyl phthalate	71	3		
Di-N-octyl phthalate	6,200	3		
Fluoranthene	750	1,b	600	5
Fluorene	190	1,b	19	5
Indeno(1,2,3-c,d)pyrene	200	1,b		
2-Methylnaphthalene	70	3	70	5
2-Methylphenol	63	3		
4-Methylphenol	670	3		
Naphthalene	160	3	160	5
Pentachlorophenol	360	3		
Phenanthrene	560	1,b	240	5
Phenol	420	3		
Pyrene	490	1,b	665	5
Pesticides				
Aldrin	2	1,b		
4,4’-DDD	8	1,b		
4,4’-DDE	5	1,b	2.2	5
4,4’-DDT	7	1,b,e	1.58	5,e
Dieldrin	2	1,b		
Endosulfan I	5.5	4		
Endosulfan II	5.5	4		
Heptachlor epoxide	5	1,b,d		

TABLE 4-6C
RISK ASSESSMENT BENCHMARKS FOR TISSUES
SEDIMENT BENCHMARKS

Compounds Detected in Sediment in the Former Raritan Arsenal	Screening Benchmarks			
	FRESHWATER (µg/kg)		**MARINE** (µg/kg)	
Inorganics				
Cyanide, Free	100	1		
PCBs				
Aroclor 1260	5	1,b,d	22.7	5,f
Metals				
Aluminum	25,500,000	2		
Antimony	150,000	3		
Arsenic	6,000	1,b	8,200	5
Barium	500,000	2		
Beryllium				
Cadmium	600	1,b	1,200	5
Calcium				
Chromium	26,000	1,b	81,000	5
Cobalt	50,000	1,b		
Copper	16,000	1,b	34,000	5
Iron	20,000,000	1,b,c		
Lead	31,000	1,b	46,700	5
Magnesium				
Manganese	460,000	1,b		
Mercury	200	1,b	150	5
Nickel	16,000	1,b	20,900	5
Potassium				
Selenium	1,000	2		
Silver	500	1,b	1,000	5
Sodium				
Thallium				
Vanadium	57,000	2		
Zinc	120,000	1,b	150,000	5
Explosives				
1,3,5-Trinitrobenzene	0.121	8	0.121	8
1,3-Dinitrobenzene	0.924	8	0.924	8
2,4-Dinitrotoluene	75.1	8	75.1	8
2,4,6-Trinitrotoluene	92	7	92	7
2,6-Dinitrotoluene	20.6	8	20.6	8
2-Amino-4,6-dinitrotoluene				
HMX	4.7	7	4.7	7
Nitrobenzene	488	7	488	7
RDX (Cyclonite)	13	7	13	7

Footnotes

(µg/kg) = micrograms per kilogram

[1] Ontario Ministry of Environment and Energy (OMEE). 1993. *Guidelines for the protection and management of sediment quality in Ontario.* ISBN 0-7729-9248-7. 27 pp.

[2] Buchman, M.F. 1999. *NOAA screening quick reference tables* . NOAA HAZMAT Report 99-1, Seattle, WA. 12 pp.

[3] U.S. Environmental Protection Agency (USEPA) Region III. 1995. *Revised Region III BTAG screening levels* . Memorandum from R.S. Davis to Users. 9 August. Flora and Fauna values unless noted

[4] Jones, D.S., G.W. Suter, & R.N Hill. 1997 *Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Sediment-Associated Biota: 1997 Revision.* Oak Ridge National Laboratory. ES/ER/TM-95/R4, Oak Ridge National Laboratory, Oak Ridge, TN.

[5] Long et al. 1995. *Incidence of Adverse Biological Effects Within Ranges of chemical Concentrations in Marine and Estuarine Sediments* . (ER-L values)

[6] MacDonald, D.D. 1994. *Approach to the Assessment of Sediment Quality in Florida Coastal Waters* , Florida Department of Environmental Protection, Tallahassee, Florida. (TEL values)

[7] Talmage, et.al.,1999. Nitroaromatic Munition Compounds: Environmental Effects and Screening Values. Rev. Environ. Contam. Toxicol. 161:1-156.

[8] U.S. Environmental Protection Agency (USEPA) Region V, RCRA - Ecological Screening Tables, http://www.epa.gov/Region5/rcraca/edql.htm.

[a] Fauna only

[b] Lowest Effect Levels (LELs) are based on the 5th percentile of the Screening Level Concentration (SLC) except where noted otherwise.

[c] Value based on % effect. OMOE lists 2% iron as LEL.

[d] 10% Screening Level Concentration (SLC)

[e] Value for total DDT used as a surrogate benchmark.

[f] Value of Total PCBs used as surrogate benchmark.

[g] BTAG Values Based on AETs (aquatic effect thresholds)

TABLE 4-7
VOLATILE ORGANIC COMPOUNDS
REGULATORY GUIDANCE FOR AIR

Chemical	**USEPA REGION III Risk-Based Conc. (RBC) Ambient Air** (Updated 10/8/04)[1]	**OSHA PEL**[2]	**Agency for Toxic Substances and Disease Registry (ASTDR) Inhalation** (January 2003)[3]			**Table 2C USEPA Generic Screening Levels Target Indoor Air Conc.** (November 2002)[4]		**Table 2C USEPA Generic Screening Levels Target Shallow Soil Gas** (November 2002)[5]	
			Acute	Int.	Chr.	TR = 1E-06, THQ = 1		TR = 1E-06, THQ = 1	
	(ug/m^3)	(ug/m^3)	(ug/m^3)			(ug/m^3)		(ug/m^3)	
Acetone (2-propanone)	3300	2400000	62000	30900	30900	350	N	3500	N
Benzene	0.23	3190	160	13	ND	0.31	C	3.1	C
Bromodichloromethane	0.1	NA	ND	ND	ND	14	C	140	C
Bromoethene	0.057	NA	ND	ND	ND	NA	---	NA	---
Bromoform	1.6	5168.71	ND	ND	ND	220	C	2200	C
Bromomethane (Methyl bromide)	5.1	77800	194.5	194.5	19.45	5.0	N	50.0	N
1,3-Butadiene	0.063	2210	ND	ND	ND	0.0087	N	0.087	N
2-Butanone (Methyl ethyl ketone)	5100	590000	ND	ND	ND	1000	N	10000	N
Carbon disulfide	730	62200	ND	ND	934	700	N	7000	N
Carbon tetrachloride	0.12	62908	1258.16	314.54	ND	16	C	160	C
Chlorobenzene	62	345245	ND	ND	ND	60	N	600	N
Chloroethane	2.2	NA	39582.82	ND	ND	10000	N	100000	N
Chloroform	0.077	240000	488	244	97.6	0.11	C	1.1	C
Chloromethane (Methyl chloride)	95	207000	1030	413	103	2.4	C	24	C
3-Chloropropene (allyl chloride)	NA	NA	ND	ND	ND	NA	---	NA	---
2-Chlorotoluene (o-Chlorotoluene)	NA	NA	ND	ND	ND	NA	---	NA	---
Cyclohexane	NA	1050000	ND	ND	ND	NA	---	NA	---

TABLE 4-7 (continued)
VOLATILE ORGANIC COMPOUNDS
REGULATORY GUIDANCE FOR AIR

Chemical	**USEPA REGION III Risk-Based Conc. (RBC) Ambient Air** (Updated 10/8/04)[1]	**OSHA PEL**[2]	**Agency for Toxic Substances and Disease Registry (ASTDR) Inhalation** (January 2003)[3]			**Table 2C USEPA Generic Screening Levels Target Indoor Air Conc.** (November 2002)[4]		**Table 2C USEPA Generic Screening Levels Target Shallow Soil Gas** (November 2002)[5]	
Dibromochloromethane	0.075	NA	ND	ND	ND	NA	---	NA	---
1,2-Dibromoethane	0.0031	NA	ND	ND	ND	0.2	N	2	N
1,2-Dichlorobenzene	150	300000	ND	ND	ND	200	N	2000	N
1,3-Dichlorobenzene	11	NA	ND	ND	ND	110	N	1100	N
1,4-Dichlorobenzene	0.28	450000	4800	1200	601	800	N	8000	N
Dichlorodifluoromethane	180	4200000	ND	ND	ND	200	N	2000	N
1,1-Dichloroethane	510	400000	ND	ND	ND	500	N	5000	N
1,2-Dichloroethane	0.069	NA	ND	ND	2428.466	9.4	C	94	C
1,1-Dichloroethene	220	400000	ND	79.3	ND	200	N	2000	N
1,2-Dichloroethene (cis)	37	790000	ND	ND	ND	NA	---	NA	---
1,2-Dichloroethene (trans)	73	790000	793	793	ND	NA	---	NA	---
1,2-Dichloropropane	0.092	NA	231.06	32.35	ND	4	N	40	N
1,3-Dichloropropene (cis)	NA	NA	ND	ND	ND	NA	---	NA	---
1,3-Dichloropropene (trans)	NA	NA	ND	ND	ND	NA	---	NA	---
1,2-Dichlorotetrafluoroethane (Freon 114)	NA	7000000	ND	ND	ND	NA	---	NA	---
Ethylbenzene	1100	435000	ND	4340	ND	2.2	C	22	C
4-Ethyltoluene (p-Ethyltoluene)	NA	NA	ND	ND	ND	NA	---	NA	---
n-Heptane	NA	2000000	ND	ND	ND	NA	---	NA	---

TABLE 4-7 (continued)
VOLATILE ORGANIC COMPOUNDS
REGULATORY GUIDANCE FOR AIR

Chemical	**USEPA REGION III Risk-Based Conc. (RBC) Ambient Air** (Updated 10/8/04)[1]	**OSHA PEL**[2]	**Agency for Toxic Substances and Disease Registry (ASTDR) Inhalation** (January 2003)[3]			**Table 2C USEPA Generic Screening Levels Target Indoor Air Conc.** (November 2002)[4]		**Table 2C USEPA Generic Screening Levels Target Shallow Soil Gas** (November 2002)[5]	
Hexachlorobutadiene	0.08	NA	ND	ND	ND	NA	---	NA	---
n-Hexane	210	1800000	ND	ND	2110	200	N	2000	N
Methylene Chloride	3.8	86750	2080	1040	1040	5.2	C	52	C
4-Methyl-2-pentanone (MIBK)	3100	410000	ND	ND	ND	80	N	800	N
MTBE (Methyl tert-butyl ether)	1.6	NA	7210	2520	2520	3000	N	30000	N
Styrene	1000	426000	ND	ND	256	1000	N	10000	N
Tertiary butyl alcohol (TBA)	NA	300000	ND	ND	ND	NA	---	NA	---
1,1,2,2-Tetrachloroethane	0.24	34325	ND	2746.01	ND	33	C	330	C
Tetrachloroethene (PCE)	0.31	678000	1360	ND	271	0.81	C	8.1	C
Toluene	420	754000	3770	ND	301	400	N	4000	N
1,2,4-Trichlorobenzene	3.7	40000	ND	ND	ND	200	N	2000	N
1,1,1-Trichloroethane	2300	NA	ND	ND	ND	2200	N	22000	N
1,1,2-Trichloroethane	0.11	54564	ND	ND	ND	15	C	150	C
1,1,2-Trichloro-1,2,2-trifluoroethane (Freon TF)	31000	7600000	ND	ND	ND	30000	N	300000	N
Trichloroethene (TCE)	0.016	5370	10700	537	ND	0.02	C	0.22	C
Trichlorofluoromethane (Freon 11)	730	NA	ND	ND	ND	700	N	7000	N
1,2,4-Trimethylbenzene	6.2	NA	ND	ND	ND	6.0	N	60	N
1,3,5-Trimethylbenzene	6.2	NA	4340	3040	434	6.0	N	60	N

TABLE 4-7 (continued)
VOLATILE ORGANIC COMPOUNDS
REGULATORY GUIDANCE FOR AIR

Chemical	**USEPA REGION III Risk-Based Conc. (RBC) Ambient Air** (Updated 10/8/04)[1]	**OSHA PEL**[2]	**Agency for Toxic Substances and Disease Registry (ASTDR) Inhalation** (January 2003)[3]			**Table 2C USEPA Generic Screening Levels Target Indoor Air Conc.** (November 2002)[4]		**Table 2C USEPA Generic Screening Levels Target Shallow Soil Gas** (November 2002)[5]	
2,2,4-Trimethylpentane	NA	NA	4340	3040	434	NA	---	NA	---
Vinyl Chloride	0.072	2560	1280	76.7	ND	0.28	C	2.8	C
Xylene (m&p)	110	435000	4340	3040	434	7000	N	70000	N
Xylene (o)	110	435000	4340	3040	434	7000	N	70000	N

NOTES:

1. USEPA Region III Risk-Based Concentrations (RBC) for Ambient Air updated on 10/8/04. (Values calculated based on a risk factor of 1:1x106)
2. National Institute of Health Pocket Guide to Chemical Hazards on February 2004.
3. Agency for Toxic Substances and Disease Registry (ATSDR), Minimal Risk Levels (MRLs), Inhalation, January 2003. (The guidance values were converted by Weston from ppm to ug/m3 to 3 significant digits for the ease of review) (Confirmed ND with Dr. Chou from the CDC.)
4. USEPA Generic Screening Levels for Target Indoor Air Concentrations are as provided in the "Draft Guidance for Evaluating the Vapor Intrusion to Indoor Pathway from Ground Water and Soils" document issued by USEPA dated November 2002. (Values calculated based on a risk factor of 1:1x106)
5. USEPA Generic Screening Levels for Target Shallow Soil Gas Concentrations are as provided in the "Draft Guidance for Evaluating the Vapor Intrusion to Indoor Pathway from Ground Water and Soils" document issued by USEPA dated November 2002. (Values calculated based on a risk factor of 1:1x106)

TR: Target Risk
THQ: Target Hazard Quotient
ug/m^3: micrograms per cubic meter
C: Carcinogenic
NA: Not Applicable
N: Non carcinogenic
ND: Not Determined

TABLE 4-8
RARITAN ARSENAL PROJECT
CONTAMINANTS OF CONCERN IN SOIL/SEDIMENT AND GROUNDWATER/SURFACE WATER

VOCs of Concern	**SVOCs of Concern (Mainly in Soil/Sediment)**
Vinyl Chloride	Nitrobenzene (NB)
1,1-Dichloroethene	2,6-Dinitrotoluene
1,1-Dichloroethane	Acenaphthene
cis-1,2-Dichloroethene	2,4-Dinitrotoluene
trans-1,2-Dichloroethene	Anthracene
Chloroform	Fluoranthene
1,2-Dichloroethane	Pyrene
2-Butanone	Benzo(a)anthracene
1,1,1-Trichloroethane	Chrysene
Trichloroethene	bis(2-Ethylhexyl)phthalate
1,1,2-Trichloroethane	Benzo(b)flouranthene
Benzene	Benzo(k)flouroanthene
Tetrachloroethene	Benzo(a)pyrene
Toluene	Indeno(1,2,3-cd)pyrene
1,1,2,2-Tetrachloroethane	Dibenz(a,h)anthracene
Chlorobenzene	Benzo(g,h,i)perylene
Ethyl Benzene	
Xylenes (total)	**Pesticides/PCBs of Concern**
	Heptachlor
Inorganics/Metals of Concern	4,4’DDE
Arsenic	4,4’DDD
Beryllium	4,4’DDT
Cadmium	Toxaphene
Lead	Aroclor-1016
Explosives of Concern	Aroclor-1221
NB	Aroclor-1232
2,4,6-TNT	Aroclor-1242
2,6-DNT	Aroclor-1248
2,4-DNT	Aroclor-1254
Amino-DNTs	Aroclor-1260

TABLE 4-9
MATRIX SPIKE/MATRIX SPIKE DUPLICATE OBJECTIVES
ORGANIC COMPOUNDS

Fraction	Matrix Spike Compound[1]	Percent Recovery Limits[2]		Percent RPD Limits[2]	
		Water	Soil/ Sediment/Tissue	Water	Soil/ Sediment/Tissue
VOA	1,1-Dichloroethene	70-130	70-130	30	50
VOA	Trichloroethene	70-130	70-130	30	50
VOA	Chlorobenzene	70-130	70-130	30	50
VOA	Toluene	70-130	70-130	30	50
VOA	Benzene	70-130	70-130	30	50
BN	1,2,4-Trichlorobenzene	45-135	51-120	50	60
BN	Acenaphthene	45-135	46-135	50	60
BN	2,4-Dinitrotoluene	45-135	38-137	50	60
BN	Pyrene	45-135	24-144	50	60
BN	N-nitroso-di-N-propylamine	45-135	20-150	50	60
BN	1,4-Dichlorobenzene	45-135	25-122	50	60
ACID	Pentachlorophenol	45-135	45-135	50	60
ACID	Phenol	45-135	45-135	50	60
ACID	2-Chlorophenol	45-135	45-135	50	60
ACID	4-Chloro-3-methylphenol	45-135	45-135	50	60
ACID	4-Nitrophenol	45-135	45-135	50	60
PEST	Lindane	40-140	40-140	50	50
PEST	Heptachlor	40-140	40-140	50	50
PEST	Aldrin	40-140	40-140	50	50
PEST	Dieldrin	40-140	40-140	50	50
PEST	Endrin	40-140	40-140	50	50
PEST	4,4-DDT	40-140	40-140	50	50
PCB	Aroclor 1016	40-140	40-140	50	50
	Aroclor 1260	40-140	40-140	50	50

TABLE 4-9 (CONTINUED)
MATRIX SPIKE/MATRIX SPIKE DUPLICATE OBJECTIVESORGANIC COMPOUNDS

Fraction	Matrix Spike Compound(1)	Percent Recovery Limits(2)		Percent RPD Limits(2)	
		Water	Soil/ Sediment/Tissue	Water	Soil/ Sediment/Sediment
EXPLOSIVES	1,3,5-Trinitrobenzene	50-140	50-140	50	50
EXPLOSIVES	1,3-Dinitrobenzene	50-140	50-140	50	50
EXPLOSIVES	2,4,6-Trinitrotoluene	50-140	50-140	50	50
EXPLOSIVES	2,4-Dinitrotoluene*	50-140	50-140	50	50
EXPLOSIVES	2,6-Dinitrotoluene*	50-140	50-140	50	50
EXPLOSIVES	2-amino-4,6-Dinitrotoluene	50-140	50-140	50	50
EXPLOSIVES	4-amino-2,6-Dinitrotoluene	50-140	50-140	50	50
EXPLOSIVES	HMX	50-140	50-140	50	50
EXPLOSIVES	Nitrobenzene	50-140	50-140	50	50
EXPLOSIVES	RDX	50-140	50-140	50	50
EXPLOSIVES	Tetryl	45-140	45-140	50	50
HPLC	Thiodiglycol	50-140	50-140	50	50
	Nitroglycerine	50-140	50-140	50	50
	PETN	50-140	50-140	50	50

NOTE:

RPD – Relative Percent Difference

(1) Compound to be spiked may be project-specific. These are commonly spiked compounds.

(2) The control limits may be established by individual laboratories and may be different from limits provided in this table.

* 2,4-DNT and 2,6-DNT co-elute; control limits are for 2,4-DNT/2,6-DNT mixture.

TABLE 4-10
QC OBJECTIVES FOR ACCURACY IN LCS ORGANIC COMPOUNDS

Fraction	Spiked Compounds[(1)]	Water Limits (% Recovery)[(2)]	Solid Limits (% Recovery)[(2)]
VOA	Vinyl Chloride	80-120	75-125
	1,1-Dichloroethene	80-120	75-125
	1,1-Dichloroethane	80-120	75-125
	Chloroform	80-120	75-125
	1,2-Dichloroethane	80-120	75-125
	1,1,1-Trichloroethane	80-120	75-125
	Trichloroethene	80-120	75-125
	Benzene	80-120	75-125
	Tetrachloroethene	80-120	75-125
	chlorobenzene	80-120	75-125
	Ethylbenzene	80-120	75-125
	Xylenes (total)	80-120	75-125
	Cis-1,2-dichloroethene	80-120	75-125
	Trans-1,2-dichloroetheen	80-120	75-125
	2-butanone	80-120	75-125
	1,1,2-trichloroethane	80-120	75-125
	Toluene	80-120	75-125
	1,1,2,2-Tetrachloroethane	80-120	75-125
BNA	Nitrobenzene	60-120	60-120
	2,6-Dinitrotoluene	60-120	60-120
	Acenaphthene	60-120	60-120
	2,4-Dinitrotoluene	60-120	60-120
	Anthracene	60-120	60-120
	Fluoranthene	60-120	60-120
	Pyrene	60-120	60-120
	Benzo(a)anthracene	60-120	60-120
	Chrysene	60-120	60-120
	Bis(2-Ethylhexyl)phthalate	60-120	60-120
	Benzo(b)flouranthene	60-120	60-120
	Benzo(k)flouranthene	60-120	60-120
	Benzo(a)pyrene	60-120	60-120
	Indeno(1,2,3-cd)pyrene	60-120	60-120
	Dibenz(a,h)anthracene	60-120	60-120
	Benzo(g,h,I)perylene	60-120	60-120
PEST	Heptachlor	50-130	50-130
	4,4’-DDD	50-130	50-130
	4,4’-DDE	50-130	50-130
	4,4’-DDT	50-130	50-130
PCB	Aroclor 1016	50-130	50-130
	Aroclor 1260	50-130	50-130

TABLE 4-10 (continued)
QC OBJECTIVES FOR ACCURACY IN LCS
ORGANIC COMPOUNDS

Fraction	Spiked Compounds[1]	Water Limits (% Recovery)[2]	Solid Limits (% Recovery)[2]
EXPLOSIVES	2,4,6-Trinitrotoluene	60-120	60-120
	4-Amino-2,6-dinitrotoluene	60-120	60-120
	Nitrobenzene	60-120	60-120
	2-Amino-4,6-dinitrotoluene	60-120	60-120
	2,4-/2,6-Dinitrotoluene	60-120	60-120
HPLC	Thiodiglycol	60-120	60-120
	Nitroglycerine	60-120	60-120
	PETN	60-120	60-120

Sporadic marginal failures (SMF): The number of sporadic marginal failure allowances depends upon the number of target analytes reported from the analysis. Acceptable criteria are based on the number of failures (f) and the number of samples (n) per the table below:

n	f
10-15	1
16-45	2
46-85	3
86-130	4

n = total number of target analytes being simultaneously analyzed
f = maximum number of analytes expected to fall outside of the 3-sigma control limits with 99% confidence if the probability of a random failure is less than or equal to 1%

Notes:

(1) Compound to be spiked may be project-specific. These are commonly spiked compounds.

(2) The control limits may be established by individual laboratories and may be different from limits provided in this table.

TABLE 4-11
QC OBJECTIVES FOR ACCURACY FOR ORGANIC SURROGATE ANALYSES

Fraction	Surrogate Compound(1)	Percent Recovery(2)	
		Low/Medium Water	Low/Medium Soil/Sediment/Tissue
VOA	Toluene-d_8	70-130	70-130
VOA	4-Bromofluorobenzene	70-130	70-130
VOA	1,2-Dichloroethane-d_4	70-130	70-130
BNA	Nitrobenzene-d_5	45-130	45-130
BNA	2-Fluorobiphenyl	45-130	45-130
BNA	p-Terphenyl-d_{14}	45-130	45-130
BNA	Phenol-d_5	35-140	35-140
BNA	2-Fluorophenol	35-140	35-140
BNA	2,4,6-Tribromophenol	35-140	35-140
PEST/PCB	Tetrachloro-m-xylene	40-140	40-140
PEST/PCB	Decachlorobiphenyl	40-140	40-140
EXPLOSIVES	4-Nitroaniline	40-140	40-140

(1) Compound to be spiked may be project-specific. These are commonly spiked compounds.

(2) The control limits may be established by individual laboratories and may be different from limits provided in this table.

TABLE 4-12
INORGANIC ACCURACY AND PRECISION GOALS

SAMPLE TYPE	%RPD	RECOVERY (PERCENT)
Sample Duplicate	Water: 20 Solid: 25	Not Applicable
Laboratory Control Sample	Not Applicable	80 – 120*
MS/MSD	20	75 -125

Sporadic marginal failures (SMF): 60% - 140%. The number of sporadic marginal failure allowances depends upon the number of target analytes reported from the analysis. If between 7 to 15 metals are reported from the ICP analysis, one (1) SMF is allowed to the expanded criteria presented. If greater than 15 metals are reported from the ICP analysis, two (2) SMFs are allowed.

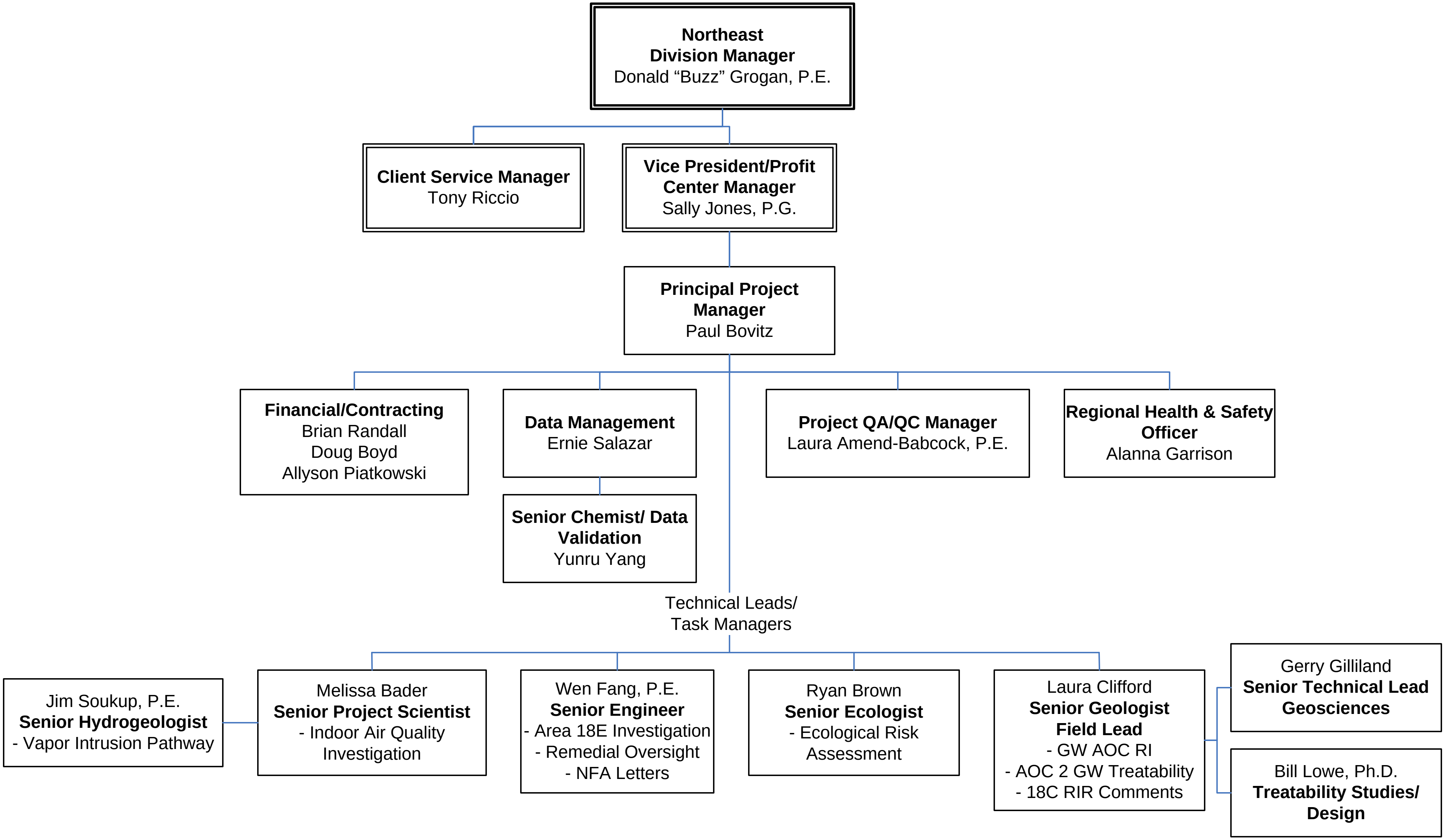
TABLE 4-13
GC/MS CALIBRATION CHECK COMPOUNDS AND SYSTEM PERFORMANCE CHECK COMPOUNDS

VOLATILES	SEMI-VOLATILES
Chloromethane*	Phenol**
Vinyl chloride**	1,4-Dichlorobenzene**
1,1-Dichloroethene**	N-Nitroso-di-n-propylamine*
1,1-Dichloroethane*	2-Nitrophenol**
Chloroform**	2,4-Dichlorophenol**
1,2-Dichloropropane**	Hexachlorbutadiene*
Bromoform*	4-Chloro-3-methylphenol**
1,1,2,2-Tetrachloroethane*	Hexachlorocyclopentadiene*
Toluene**	2,4,6-Trichlorophenol**
Chlorobenzene*	Acenaphthlene**
Ethylbenzene**	2,4-Dinitrophenol*
	4-Nitrophenol
	Diphenylamine**
	Pentachlorophenol**
	Fluoranthene**
	Di-n-octylphthalate**
	Benzo(a)pyrene**

NOTES:

* = System performance check compound
** = Calibration check compound

WESTON SOLUTIONS, INC.
RARITAN ARSENAL ORGANIZATION CHART



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- AOC 2 GW Treatability
- 18C RIR Comments

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Bill Lowe, Ph.D.
Treatability Studies/ Design

Last Updated
9 March 2005

CHAIN OF CUSTODY RECORD

Report to:

Company:
Address:

Contact:
Phone:
Fax:
Contract/ Quote:

Invoice to:

Company:
Address:

Contact:
Phone:
Fax:

ANALYSIS REQUESTED

Lab Use Only
Due Date:

Temp. of coolers when received (C°):

1	2	3	4	5

Custody Seal N / Y
Intact N / Y

Screened For Radioactivity ☐

Sampler's Name

Sampler's Signature

Proj. No.

Project Name

No/Type of Containers[2]

Matrix[1]	Date	Time	Comp	Grab	Identifying Marks of Sample(s)	VOA	A/G 1 Lt.	250 ml	P/O												Lab/Sample ID (Lab Use Only)

Relinquished by: (Signature)	Date	Time	Received by: (Signature	Date	Time	Remarks
Relinquished by: (Signature)	Date	Time	Received by: (Signature	Date	Time	
Relinquished by: (Signature)	Date	Time	Received by: (Signature	Date	Time	Client's delivery of samples constitutes acceptance of Severn Trent Laboratories terms and conditions contained in the Price Schedule.

[1]Matrix WW - Wastewater W - Water S - Soil L - Liquid A - Air bag C - Charcoal Tube SL - Sludge O - Oil

[2]Container VOA - 40 ml vial A/G - Amber / Or Glass 1 Liter 250 ml - Glass wide mouth P/O - Plastic or other

STL8234-200 (12/02)

APPENDIX A

SURFACE GEOPHYSICS SOP

ROY F. WESTON, INC.
STANDARD PRACTICES MANUAL
COMPANY CONFIDENTIAL AND
PROPRIETARY INFORMATION

OPERATING PRACTICE
Surface Geophysics

Eff. Date 04/01/93 Initiated By: R.B. Biggs Approved By: P.J. Marks Authorized By: A.M. Henry SP No. 16-11-003

SURFACE GEOPHYSICS

THE APPROVAL SIGNATURES ARE KEPT ON FILE
WITH WESTON'S POLICIES AND PRACTICES GROUP
OF THE QUALITY ASSURANCE/FINANCE DIVISION

REVISION NUMBER: 00

Initiated by:	D.L. Jones R.B. Biggs
Legal Review:	D.B. Bauer
Approved by:	P.J. Marks
Authorized by:	A.M. Henry

Important Notice

This document has been prepared to assist Roy F. Weston, Inc. (WESTON) personnel with the performance of specific tasks and procedures when other guidance or regulatory documents are not applicable or are non-existent. It is the sole responsibility of WESTON personnel performing procedures in this operating practice to determine if other guidance documents or regulatory procedures exist and are to be followed instead of or in conjunction with this operating practice. Other guidance or regulatory documents can include, but are not limited to Federal, State, and Local codes, policies, ordinances; client or WESTON proposals, work plans, field sampling plans, quality assurance project plans and any other applicable documents. This document is not a substitute for thorough understanding of the subject matter or as a substitute for applicable training.

1.0 PURPOSE

Surface geophysical methods measure the response of the earth to induced electrical or acoustical energy or measure variations in natural potential fields. Changes in the parameters that are measured can be related to variations in the local geology, the extent of contaminant plumes, or the presence of buried materials. Geophysical investigations are most effective when used in conjunction with drilling or boring programs and can be used, for example, to guide monitor well placement, or help determine the depth to bedrock.

2.0 DISCUSSION

Each geophysical method has its advantages and limitations, and the results of one method may help constrain or improve the interpretations derived from another method. Results from a single method are seldom unique and integrated interpretation reduces the ambiguity.

Each site must be evaluated separately in planning a survey and all available information should be reviewed before committing to a particular method. Site conditions and possible sources of interference should be evaluated. In the field, the geophysical team leader should be prepared to modify traverse lines, sampling intervals, or techniques due to changing or unforseen conditions. Procedural guidelines for the most commonly used geophysical methods are presented in the sections that follow.

3.0 PROCEDURES

3.1 Associated Procedures and Associated Documents

Most field efforts, work projects, and sampling events will require participants to have a thorough understanding of multiple operating practices. Field personnel performing or monitoring logging will, at a minimum, need to be familiar with the following associated procedures and documents.

- OP 16-11-001 Field Notes

3.2 Preparation

3.2.1 Office Preparation

Field Team Leaders and other key project members will meet with the Project Manager to discuss project requirements.

3.2.2 Field Preparation

Areas to be surveyed should be inspected for accessibility before scheduling the field survey. Service equipment or vehicles may be necessary if site conditions are poor. Nearby power lines or utilities are often sources of interference and can be possible safety hazards.

3.3 Field Effort

3.3.1 Ground Penetrating Radar (GPR)

3.3.1.1 Method Summary

GPR uses high frequency radio waves to map features in the shallow subsurface. Pulses of energy at radar frequencies are directed into the ground and the reflected energy is processed and either stored electronically or plotted as a subsurface profile on a graphic recorder. Variations in the intensity and strength of the signal are caused by variations in the electrical properties of the reflectors. The depth of penetration varies from site to site, but is significantly limited in clay-rich soils or soils with high conductivities. Identification of subsurface anomalies depends on both the physical size of the feature and its relative electrical contrast with its surroundings. Not every anomaly can be identified using a GPR survey.

3.3.1.2 Survey Design and Preparation

Information on site geology, soils and manmade changes will be reviewed in order to assess the effectiveness of using GPR. A choice of antennas will be made based upon soil conditions, the desired resolving power, and the probable depth of targets. Higher frequency antennas (500 or 800 mHz) have higher resolving power but less depth of penetration than lower frequency antennas (120 or 300 mHz). Grid spacings are based on the subsurface control needed and the objectives of the survey. Short grid spacings (5 to 10 feet) are used for detailed surveys while spacing on the order of tens of feet may be used for reconnaissance surveys.

The GPR survey will be performed using a Geophysical Survey Systems, Inc., GPR System 10 or GPR System 8 unit, or equivalent instrument. The GPR System 10 unit consists of a control/display unit, mainframe/data storage unit, and microcomputer. The GPR System 8 unit consists of a radar control unit, graphic recorder, microcomputer, and calibration box. Either a 100-, 120-, or 300-megahertz antenna will be used for radar data collection. A 12-volt battery will be used to power the GPR system. Selection of an appropriate GPR antenna will be based on soil conditions determined during the review of site information.

Prior to beginning the GPR survey, the system will be calibrated to soil and moisture conditions at the survey location. A detailed description of this calibration procedure is presented in Appendix A.

A reference grid of wooden stakes will be established over the study area. GPR profiling in each area will consist of a series of parallel traverse lines with appropriate spacing based on objectives. Additional traverses may be performed to confirm and/or enhance the resolution of a potentially significant subsurface feature. At least one profile must be repeated each day to check for repeatability of GPR signatures.

3.3.1.3 Field Procedures and Quality Control

When using the graphic recorder, the following tasks must be performed:

- Clean graphic recorder using alcohol, Q-tips, or a dust brush, etc., at least twice a day.
- Replace the stylus belt at least once a day.

- The GPR operator must annotate the GPR paper record as follows:
    - Client:
    - Site name:
    - Date: DD/MM/YY.
    - Time: 24-hour clock.
    - Profile number:
    - Direction of traverse:
    - Antenna frequency:
    - Time range (nanoseconds):
- After each transverse is recorded, the GPR operator will annotate the profile positions above each marker line on the GPR record.

In addition, whether using the System 8 or 10 unit, the GPR operator must document in the field logbook the time, profile number, end points for each traverse conducted, and any cultural features that may influence the GPR record.

3.3.1.4 Data Reduction and Processing

GPR System 10 Data

Following the GPR survey, all field tapes will be copied onto 8-mm tapes or a portable disk. The original field tapes will not be used for data reduction or processing but will be permanently archived. The copied files will be used for all data manipulation. If appropriate hardware is available to the field team, tape copies should be made at the end of each day of the GPR survey.

The lead geophysicists will review the GPR records to determine whether reprocessing is required to enhance data interpretation. The results of the reprocessing, if it is performed, will be reviewed by the senior geophysicists.

Black and white copies of all GPR records will be produced for the survey, and selected records interpreted to have features significant to the survey objective(s) will be plotted in color.

GPR System 8 Data

Following the GPR (System 8) survey, all original field records will be photocopied. The original field records will be permanently archived. The GPR copies will be used for annotation of anomalous signatures and cultural information.

3.3.2 Resistivity

3.3.2.1 Method Summary

Resistivity surveys measure the electrical resistivity of the subsurface by introducing a direct or low frequency current into the ground. One set of surface electrodes serves as the current electrodes and a second set of electrodes measures the resultant voltage drop. The voltage drop is converted into a resistivity value (resistance per unit volume). The depth of penetration and the measured volume of earth depends on the specific array and the electrode spacings. The resistivity values are a reflection of the underlying lithology and the interstitial fluids.

A resistivity survey may include either vertical electrical soundings or horizontal profiling, depending on the objective of the survey. Vertical soundings measure resistivity changes with depth by systematically varying the electrode spacing. Horizontal profiling measures lateral changes in resistivity with a constant electrode spacing. Both methods may be used at the same site if the survey objective is to determine resistivity variations laterally and with depth. Details of data acquisition, data reduction and analysis vary for the two procedures. In general, the Schlumberger method gives the best depth resolution and is better supported by a large body of interpretive techniques. The Wenner method has been traditionally used when working with small, light instruments because of the small current values needed to generate measurable voltage data.

3.3.2.2 Survey Design and Preparation

Site background information will be reviewed to assess the influence of geology, buried materials, disturbed soils, or waste plumes on the resistivity survey. Possible sources of electrical interference include buildings, power lines, pipelines, and railroads. Surveys should not be planned parallel to high voltage lines.

When the method type has been determined, the survey locations will be marked on a site base map. Preliminary sampling intervals and electrode spacings will be chosen. For the profiling method, two fixed sets of spacings will help assess the effects of both shallow and deep geologic features. Field conditions may alter the location of lines, relative spacings, and number of readings.

In the Schlumberger method, the spacing of the inner or voltage electrodes should be less that 1/5 the distance between the outer or current electrodes. In the Wenner method, the distance between the current electrodes is always equal to 3 times the distance between the voltage electrodes.

Resistivity equipment will be assembled and tested according to the manufacturers instructions before mobilization at the site. These procedures will vary slightly with the equipment used but should include a battery check and an internal check of the electronics. All cables and connectors will be inspected for signs of breaks or frayed insulation. Repairs should be made as necessary. A suggested equipment check list is given in Table 3.3-1.

3.3.1.3 Field Procedures and Quality Control

The location and orientation of the resistivity lines may be staked in the field prior to the survey. Otherwise, they may be staked as the survey proceeds using, as a minimum, a Brunton compass, adjusted to local magnetic deviation, mounted on a tripod. When the center of the sounding or profile is located, the electrodes are emplaced and the reading is taken. With older or basic units, the operator should record for each reading the location, electrode spacing, dial reading, scale multiplier and, if necessary, voltage and current. Appropriate data sheets are shown in Tables 3.3-2 and 3.3-3. With digital units, the resistivity may be automatically calculated, displayed, and stored. After the first sounding or first profile is completed, the spacings used should be reviewed in the field to determine if survey objectives are met. If not, spacings should be revised and the measurements repeated before proceeding with the survey.

3.3.2.4 On-Site Data Reduction

Resistivity values verses spacings will be plotted using a log-log scale on graph paper, or, with a portable computer as the measurements are made. Current electrode spacing is plotted on the X axis and apparent resistivity on the Y axis. If it is necessary to calculate resistivity values, the following formulas are used:

Schlumberger Array

$$pA = 0.3048(sR(\frac{a}{2})[(\frac{L}{a})^2 - \frac{1}{4}])$$

Where: pA = Apparent resistivity (ohm-meters)
s = Scale multiplier
R = Dial Reading
a = Potential electrode spacing (feet)
L = Current electrode spacing (feet)

Wenner Array

$$pA = saR$$

Where: The symbols are the same as for the Schlumberger array.

Resistivity Soundings

Sounding data may be interpreted using either published sets of master curves or vendor supplied computer programs. The number of resistivity layers, layer resistivity, and layer thicknesses must be initially selected. In most computer programs, a synthetic curve is then calculated and adjusted to approximate the starting conditions. New theoretical resistivities and thicknesses are then calculated and compared to the actual field curve.

The process is repeated until a fit between the field curves and the data has been obtained. It is imperative that the final model be compatible with the local geology. Data from drill holes, field observations, and other geophysical methods will help constrain interpretations.

Lateral Profiling

Profiling results are best presented as resistivity cross-sections or as contoured plots of resistivity, if enough data points are available. These plots are then interpreted from the standpoint of local geology. Geologic constraints are honored as described above.

3.3.2.5 Office Data Reduction and Interpretations

Raw data and graphs are reviewed for inconsistencies. Resistivity values are recalculated when necessary in order to check field calculations. The reviewer should question single anomalous values or a sudden shift in a portion of the resistivity curve.

3.3.3 Very Low-Frequency Electromagnetics

3.3.3.1 Method Summary

The VLF-EM method makes use of the electromagnetic field generated by military radio transmitters that use carrier frequencies ranging between 15 and 30 kHz. The direction and strength of the primary field can be locally affected by electrically conductive features on the ground surface or in the subsurface. In saturated or clay-filled fractures, a secondary electromagnetic field is generated that may be strong enough to be detected by a VLF-EM receiver. Optimum detection of the lineament occurs when its strike is roughly aligned between the transmitter station and the receiver. Therefore, the selection of the VLF station to be used is critical to the survey. For poor conductors, such as water-filled fractures, the feature must be at least 300 feet long.

3.3.3.2 Survey and Equipment Preparation

A control grid will be established perpendicular to known or assumed fracture orientation. The grid will be marked with wooden stakes. The equipment is checked and prepared for transport and an equipment checklist is presented in Table 3.3-4. All necessary calibrations have been performed at the factory and no other calibrations are required.

Technical procedures described below are for the ABEM VLF-EM instruments.

3.3.3.3 Field Procedures and Quality Control

VLF Transmitter Selection

Determine the direction of traverse using the work plan, control grid, and assumptions of known and inferred orientations of fractures. The traverse should be oriented parallel to the inferred strike of the fracture(s). Face the direction of the traverse and conduct a VLF frequency scan to determine a suitable transmitter. Check the signal strength of the selected transmitter, the signal amplitude should range between 10 and 50. Determine the signal strength perpendicular to the traverse orientation, the strength should be significantly less than along the traverse orientation. If the signal strengths and relative amplitudes are satisfactory, begin the survey measurements. If the signal strengths and relative amplitudes are not satisfactory, determine another suitable transmitter and repeat the tests.

VLF Data Collection

Begin VLF data collection by recording the program line number of the traverse, the line direction, line increment position number and position increment. Take measurements at succeeding positions or stations. Check the signal strength at each position, if the signal strength is less than 10, repeat the measurement. If a peak on the WADI indicates crossing of an anomaly, use the interpret key to determine slope and approximate depth of the fracture. Record all power lines, streams, trenches, utilities, metal fences and other cultural features in the field log book. Advance to next parallel line after completing line, increment programming if necessary. Repeat the procedures on the perpendicular traverses. Check battery level two to three times per day and document in the field notebook. Check the transmitter strength whenever data point reading is effected by low signal, high noise or high VLF signal. Repeat at least one traverse to check reproducibility of anomaly strength and location.

At the end of each day, transfer (dump) VLF data to the field computer using SECTOR software and make backup copy of data. Transfer data from WADI to the field computer by connecting the WADI to the computer using RS232 cables supplied by manufacturers. Enter SECTOR program main menu resident on computer and select "Read data from WADI" option. At prompt enter file name, then select profile to transfer on WADI using the coordinate key. Follow prompts as directed by SECTOR and make backup copies of all VLF data.

Office/Field Data Reduction

It is critical that the VLF-EM operator begin data reduction procedures in the field. Major fracture lineaments should be determined by the geophysicist before demobilization. If there is a question about anomaly (fracture) correlations between traverses, additional or in-fill lines can be conducted to enhance anomaly resolution.

Print Out Relevant Plots

Printing out relevant plots will consist of the following steps using SECTOR to select data files, plotting filtered data, vertical cross-sections, and original (unfiltered) data.

3.3.4 Seismic Refraction

3.3.4.1 Method Summary

The seismic refraction method is used to determine the depth or geologic units that refract acoustic energy along the interfaces with bounding units. The method depends on an acoustic velocity contrast between units and or distinct velocity changes that increase with depth. Refraction surveys measure the travel time of manmade acoustic energy from the source to an array of geophones. The sub-surface geology can be interpreted through an analysis of travel time/distance plots based on an application of Snell's Law. The slopes of various segments of a travel time curve are the inverse of layer velocities.

A seismic refraction system consists of a signal-enhancing seismograph, a set of geophones, a spread cable with take-outs for each phone, and a sound (seismic) source. The geophones are deployed in a linear array at predetermined spacings, and shot points are placed along this line at known distances from the geophones. The seismograph is triggered and begins recording when a sound is generated at a shot point by either an explosion or impact of a weight on the ground. The seismograph provides a record of time versus seismic signal for each geophone.

Several *stacks* may be made at the same shot point, where wave-forms from successive shots are added together. Stacking often aids in the selection of first arrival times (first breaks) by reducing random noise and increasing the amplitude of the seismic signal.

3.3.4.2 Survey Design and Office Procedure

All site specific and local geologic information will be reviewed in order to determine the applicability of using seismic refraction. Objectives and probable targets will be outlined. Spread configurations will initially be determined with the understanding that field conditions may change the original plans. Proposed survey lines will be marked on a site base map.

3.3.4.3 Field Procedures and Quality Control

Data will be collected using an EG&G Geometrics Model 2401 signal-enhancing seismograph or equivalent instrument, with 14-Hz geophones and cables with nominal 20-foot take-outs. The actual spread geometries will depend on the estimated depth to the target layer(s). A good comparison of spread geometry with various layered earth models is discussed in the USGS report, *Application of Seismic-Refraction Techniques to Hydrologic Studies*

(Haeni, 1986). It is recommended that the lead geophysicist review this comparison prior to conducting the refraction survey.

Field data will be digitally recorded for computer processing and selection of first arrivals. Geophones that are not located on paved areas must be surveyed for elevation. Elevation variations on paved areas are usually small. Geophone locations can be marked in the field with pin flags and later surveyed for elevation, or they can be surveyed before the geophone array is moved to a new location.

Energy can be provided at shot points with either a 20-lb sledge hammer striking a metal plate, weight drop, or 1,000-grain black powder charges buried at a depth of 3 feet. For paved areas, the geophones can be set in wooden blocks through which holes have been drilled. Data acquisition through pavement is usually successful, because pavement arrivals can generally be differentiated from later arrivals by their low amplitudes and early arrival times.

3.3.4.4 Spread Configurations

Each array geometry must be accurately depicted (sketched) in the field logbook. The array sketch must be annotated with the line number and spread number. Other important information that must be documented accurately includes:

- Measured distances between surveyed reference grid nodes and shot point and/or geophone locations. At least two points (geophones or shot points) along each spread should be measured/tied to the reference grid.
- Source type (e.g., sledge hammer, weight drop, and explosives). Note changes in source type, if applicable.
- Geophone and shot point identification or number.
- Intersection points for orthogonal refraction survey lines.
- Depth (below ground surface) of shot (when using explosives) and shot point (Y-) offset distance from spread, if applicable.
- File name of shot point record.
- Data acquisition/field processing settings on the seismograph.
- Cultural information (e.g., buried pipelines or utilities, and powerlines).

A typical spread configuration used in seismic refraction surveys includes a combination of short (e.g., 5-foot) and longer (e.g., 20-foot) geophone spacings and shot point offsets. The closely spaced geophones at each end of the array and in the middle provide shallow velocity information from the near offset shot records, while the wider spaced geophones provide deeper velocity information. For lines consisting of one spread (12 geophones), closely spaced geophones are placed at the beginning and end of the line.

Ambient Noise

If possible, seismic records should be acquired during relatively quiet periods. Ambient noise can be a serious problem in areas with a high density of cultural features. Sources of noise include arriving and departing aircraft, railroads, manufacturing facilities, and automobile traffic. High-pass filters can be used to minimize noise, but low-pass filtering generally should not be employed because of the low center frequency of the geophones (14 Hz). A number of stacked shots should be used with the sledge hammer source, decreasing the amplitude of random noise and increasing the signal. In some cases, black powder shots and a weight drop source can also be stacked to improve data quality.

Data Reduction and Interpretation

Digitally recorded field records will be imported into the SIPIK (Rimrock Geophysics, Inc.), or equivalent. program which selects the first breaks. Records can be optimized by digital filtering and individual trace size adjustments for each channel.

Hard copies of field records should show field acquisition and the processing information.

After selection of first arrivals, data will be formatted for the SIPT1 program using the SIPIN program by Rimrock Geophysics, Inc., or equivalent software. The SIPT 1 program provides profiles of velocity interfaces from relevant data. Input files include spread geometry, first arrival times, elevation of shot points and geophones, depth of shot burial, and Y-offsets (when necessary). Time-distance plots will be generated with effects of elevation removed for lines with topographic relief. The time-distance plots are then used to determine layer velocities, which are an input parameter for the SIPT1 interpretations.

Data are optimized after several interactive runs thorough the SIPT 1 program. The elevation profiles created for each line must be compared to the profiles of intersecting lines and to borehole data. Discrepancies will be resolved by revising profiles with additional iterations through the SIPT 1 program.

3.3.5 Terrain Conductivity

3.3.5.1 Method Summary

Terrain conductivity measures variations in the electrical conductivity of the subsurface that may be due to variations in natural conditions or the presence of buried metallic objects. A transmitter coil operating at a frequency of several thousand kilohertz (kHz) induces an electromagnetic field into the ground and a coplanar receiver coil measures the resulting secondary field. Most equipment allows measurement of both the in-phase and out-of-phase (quadrative) component of the included field.

3.3.5.2 Survey Design and Office Preparation

All preliminary site data will be reviewed and objectives identified. The objectives will determine the density of the profiles the sampling intervals and the antenna configuration and spacings. The site geology, target size, and soils information will help determine the applicability of the method. The profile lines will be plotted on a site base map. Buildings, vehicles, power lines, and metallic fences are sources of interference that should be considered in planning a survey.

3.3.5.3 Field Procedures and Quality Control

Measurements will be made with a Geonics EM-31 or EM-34, or equivalent instrument and will consist of an initial field test, the main survey, and the on-site data evaluation. Short station spacings may be established by pacing between known points on a coarser grid. The detailed procedures are presented below:

The field test will consist of the following steps:

- Geophysics team checks their pace distance carrying the EM-31 and EM-34 by counting paces between established site grid stakes.
- Survey design is tested by conducting initial surveys with all specified instrument configurations in areas of known geologic and geophysical properties. If site geology permits, a test survey will be conducted in both an area of known geologic/geoelectric complexity and an area of relatively nonvariable geology. Terrain conductivity readings, station locations, and observations of surface features and terrain are recorded in logbook by geophysics team.
- Geophysics team plots test survey data in the field and assesses whether the instrument configurations and station spacings selected will meet the objectives specified in the survey design. The design may be modified if necessary in order to meet objectives.

Terrain Conductivity Survey

The terrain conductivity survey will consist of the following steps:

- EM-31 unit is assembled, batteries are checked, and the instrument is nulled, if necessary, as per instructions in the Geonics EM-31 operating instruction handbook.

- Calibration of EM-31 unit is checked by performing equipment functional checks, and, if necessary, instrument calibration is performed, as per instructions in Geonics EM-31 operating instruction handbook.
- Results of battery check, electronic nulling, and equipment functional checks are recorded in logbook by geophysics team.
- Set up and program the data logger. Enter data called for by the prompts.
- Terrain conductivity readings are made at all stations specified in the survey design. The transmitter and receiver coils are oriented in the direction of the survey lines. The data are digitally stored in the data logger. Record keeping and end traverse number, station location, and analog readings in log book for comparison with digital data in the data logger.
- Geophysics team disassembles and secures EM-31 unit. The data from the data logger are down-loaded to a field personal computer.
- EM-34 unit is assembled with appropriate cables, batteries are checked, and electronic nulling is performed, if necessary, as per instructions in the Geonics EM-34 operating instructions handbook.
- Receiver compensation and gain are checked, and, if necessary, instrument calibration is performed, as per the instructions in Geonics EM-34 operating instruction handbook.
- Results of the battery check, electronic nulling, receiver compensation and gain check and instrument calibration are recorded in logbook by geophysics team.
- Set up and program the data logger. Enter data called for by the prompt.
- Terrain conductivity readings are made with the EM-34 unit at all stations along the survey lines using all dipole orientations and separations specified in the survey design. All readings are made with the transmitter and receiver coils oriented in the direction of the survey line. Dipole orientations and separations are recorded in the logbook by the geophysics team.
- Geophysics team disassembles and secures EM-34 unit.

3.3.5.4 On-Site Data Reduction

- The data will be downloaded to a field personal computer. An electronic file is then created using the program DAT 31, or equivalent, to develop a conductivity profile for each traverse.
- The Team Leader notes general trends or rapid excursions of conductivity at specific locations along the traverse. If appropriate, the Team Leader specifies additional fill-in station locations at areas of high or unusual terrain conductivity gradients.

3.3.5.5 Office Data Reduction

Office data reduction will consist of final data reduction and interpretation procedures, data management, and final independent review. Detailed procedures are presented in the subsections that follow.

Data Reduction

Data reduction will consist of the following steps:

- Field logbook sheets are photocopied.
- The terrain conductivity data are reviewed by the GP Team Leader, who selects appropriate scales for terrain conductivity

profiles/plots and contour intervals for contour maps.

- Terrain conductivity profile/plots are prepared by geophysics team for all instrument configurations.
- Geophysics team prepares contour maps of terrain conductivity data for all instrument configurations using GeoSoft or equivalent contour plotting software.
- The Team Leader reviews and checks contour maps.

Data Interpretation

Data interpretation will consist of the following steps:

- The Team Leader reviews terrain conductivity data and correlates terrain conductivity to existing anthropologic or geologic information.
- The Team Leader writes draft report describing data collection, results, and interpretations.
- The report is reviewed and modified, as necessary.

3.3.5.6 Data Management

Data management will consist of the following steps:

- Logbooks and data disks are managed and maintained.
- All graphs, maps, and original reports will be permanently stored.

4.0 INTERPRETATION

If there are questions regarding the interpretation or the applicability of items in this operating practice, the Project Manager or Technical Manager should be consulted. In the absence of either of those, contact your Section Manager.

APPENDIX A

GPR EQUIPMENT

The purpose of the GPR calibration is to provide depth control. Calculating the pulse rate or velocity of the transmitted radar signal traveling in the soil at a specific area is a means of obtaining depth control. The GPR pulse rate is controlled by subsurface lithology and moisture. The GPR unit will be calibrated by pulling the GPR antenna over a subsurface feature that has a known depth. Features that may be used for GPR calibration include buried utilities, underground storage tanks (USTs), or buried drainage culverts. The time required for the transmitted radar signal to travel from the GPR antenna on the surface to the buried object and back to the antenna is defined as the two-way travel time (t_2). Therefore, the one-way travel time (t_1) would be the time required for the radar pulse to go from the antenna to the buried feature or $t_2/2$. Travel time is expressed in units of nanoseconds (ns). If it takes 20 n for a radar pulse to travel down to a feature buried at 5 ft BGS and back to the surface, the radar pulses is 1/2 x 20 ns /5 ft, or 2 ns/ft.

The calculated pulse rate is then used to adjust the time range on the GPR control unit to reach a specific depth of investigation. For example, if the desired depth of investigation for the GPR survey is 10 feet and the radar pulse is 2 ns/ft, then the time range would be adjusted to at least 40 ns. It should be understood that the calculations described are estimated, and a significant degree of error may be caused by soil moisture and geologic variations.

The GPR calibration will be performed prior to the start of the GPR survey at each area. Internal electronic calibration is performed by the manufacturer and was done when the instrument was manufactured.

Table 3.3-1

Resistivity Equipment Checklist

___ Four tape measures, 300 feet or greater

___ Brunton compass and tripod

___ Resistivity meter (Bison Model 2350 or equivalent)

___ Meter operation handbook

___ Extra set of batteries

___ Electrodes (5)

___ Resistivity cables (5)

___ Tool kit

___ Pocket calculator

___ Data sheets (sounding or profiling)

___ Log-log graph paper

___ Standard graph paper

___ Field logbook (waterproof)

___ Waterproof ink pen

Checked by: ____________ Date: ______

Table 3.3-2

Vertical Resistivity Sounding Data Sheet

Site ____________ Sounding Number ________

Date ______ Weather ______________________

Geophysics Team ____________________________________

Team Leader _______________________ Page ___ of ___

Potential Electrode Spacing (ft)	Current Electrode Spacing (ft)	Reading	Dial Multiplier	Apparent Scale (ohm-ft)	Resistivity Remarks
(a)	(L)	(R)	(s)	(a)	

Table 3.3-3

Resistivity Profiling Data Sheet

Site ______________________ Line Number _______________

Date _________________ Weather _______________________

Geophysics Team _______________________________________

Team Leader _________________________________Page __ of __

Station (ft)	Electrode Spacing (ft)	Dial Reading	Scale Multiplier	Apparent Resistivity (ohm-ft)
	(a)	(R)	(s)	(a)

Table 3.3-4

VLF-EM Equipment and Supplies Checklist

___ ABEM VLF WADI

___ SECTOR software

___ Field computer

___ Line printer

___ Field logbook

___ 10 3-1/2-inch disks

___ Line printer paper

___ WADI operator's manual

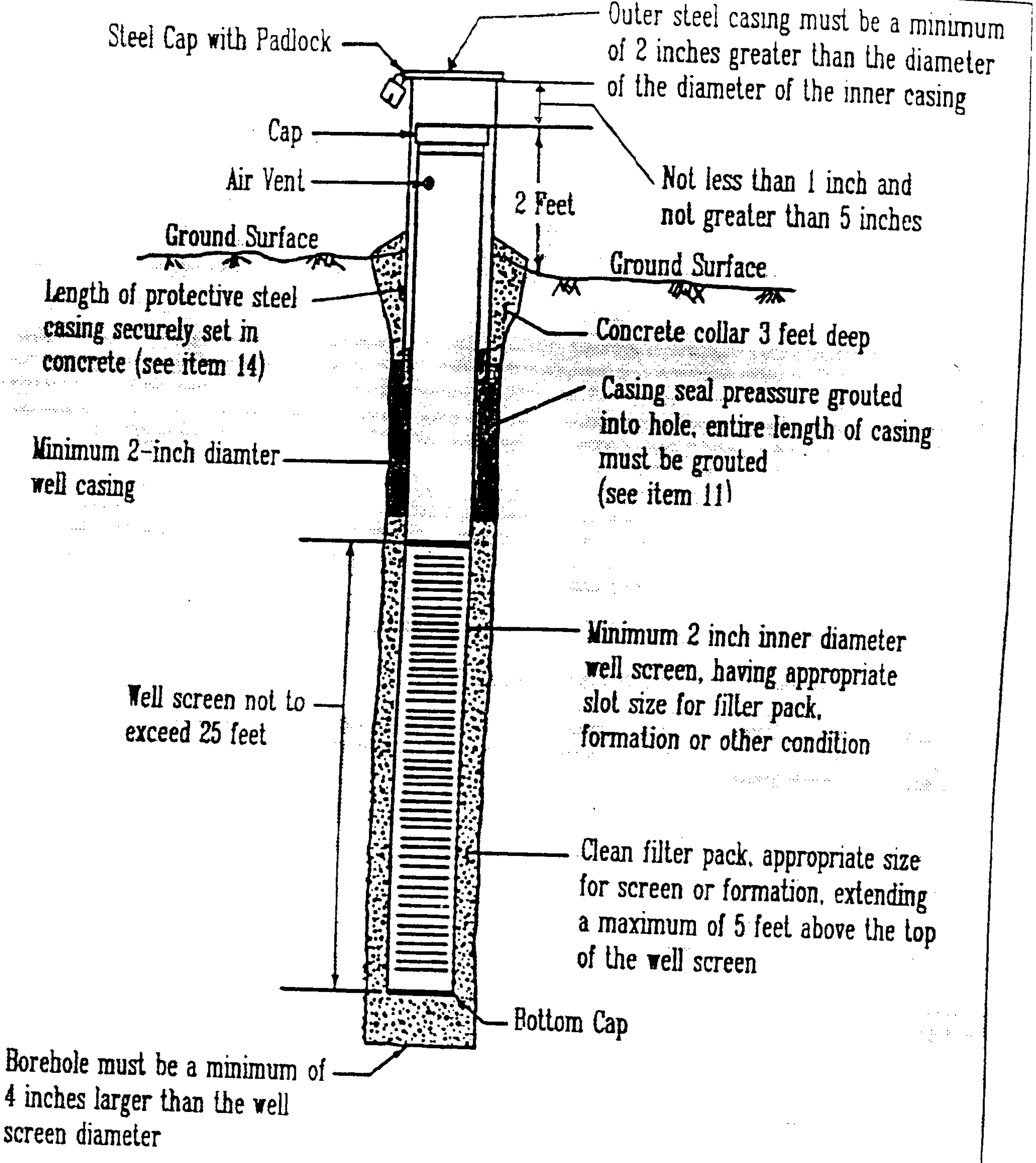
___ SECTOR software manual

___ WADI RS-232 download cable

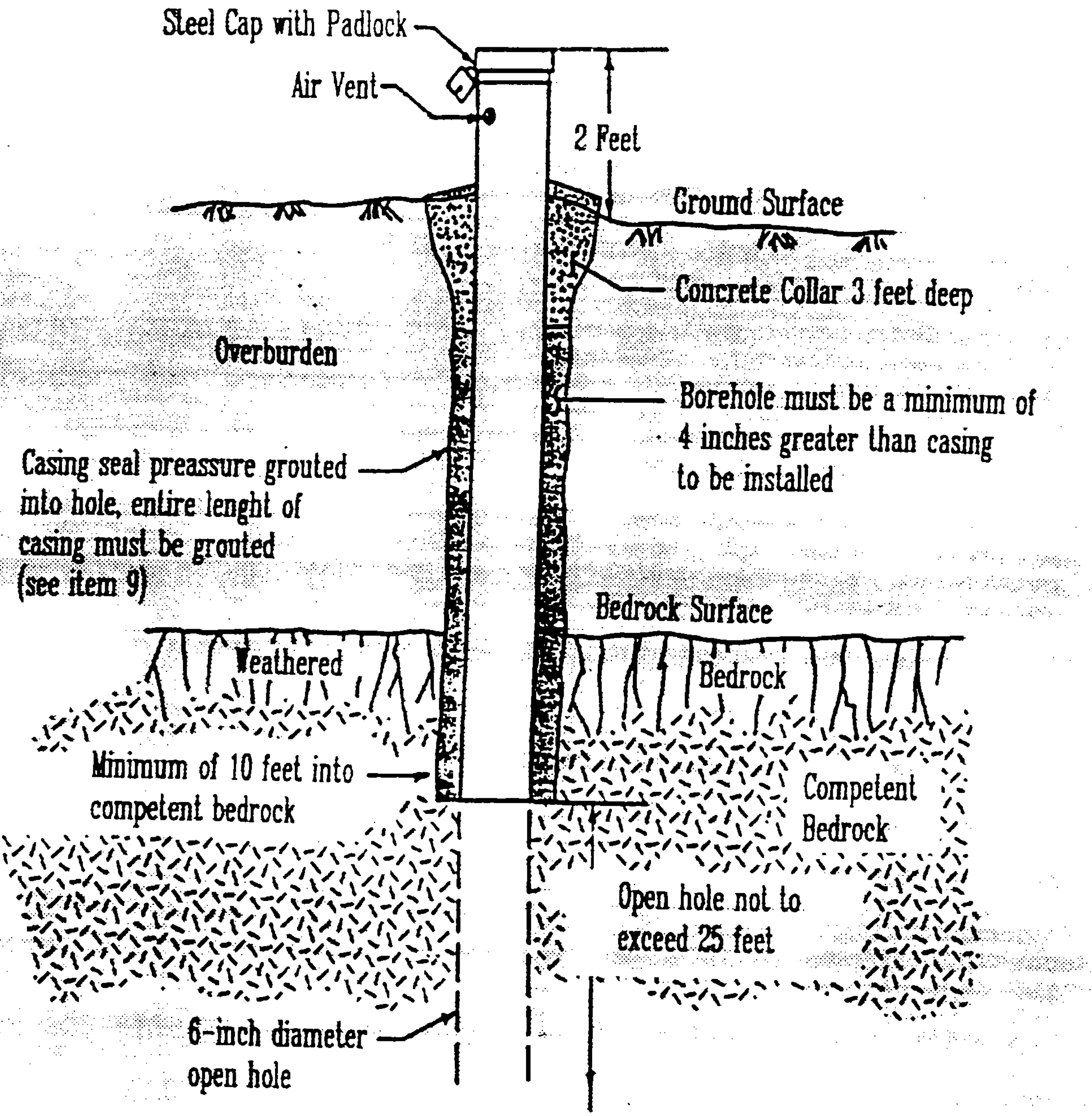
Checked by: ______________ Date: _______

APPENDIX B

NJDEP MONITORING WELL CONSTRUCTION DIAGRAMS



Unconsolidated Aquifer Well



Bedrock Formation Well

APPENDIX C

EXAMPLE FIELD DATA LOGGING FORMS

GEOPROBE Soil Boring Log

Job Name
Boring No.
Logged By
Job No.
Page ____ of ____

Date Drilled
Boring Method/ Sample Method Geoprobe / Macrocore 4-ft 5-ft
Drilling Co.
Completion Depth
Drill Foreman
Location

Depth (Feet)	Recovery (% or inches)	PID every 6"	Visual Description	Sample No.	Comments

Depth to Groundwater: ____________

Backfill Type: Cuttings Cuttings/Bentonite Bentonite
Asphalt / Concrete

Monitoring Well Installed? YES NO

Monitoring Well ID: ____________

Location surveyed? Yes No GPS Surveyor Other

Soil Logging Visual Descriptors

FORMAT: Moisture - Color - Soil Type (gradation) - Compactness/Consistency - Observations

EXAMPLE: Saturated brown medium SAND, little coarse gravel, trace silt, dense, odor.

Soil Type

clay	
silt	
sand	
fine	
medium	
coarse	
gravel	> 0.19"
fine	
coarse	
cobbles	3-12"
boulders	> 12"

Moisture

Descriptor
- dry
- moist
- wet
- saturated

Compactness (coarse-grained, non-plastic)

Descriptor	Blow Counts
loose	< 11
medium dense	11-30
dense	31-50
very dense	> 50

Consistency (fine-grained, some plasticity)

Descriptor	Blow Counts	
very soft	< 3	
soft	3-5	thumbtip indent- easy
medium	6-15	thumbtip indent- hard
stiff	16-25	thumbnail indent- easy
hard	> 25	thumbnail indent- hard

Gradation

	%
"and"	35-50
"some"	20-35
"little"	10-20
"trace"	0-10

Color

- light brown
- brown
- dark brown
- red
- red-brown
- tan
- dark grey
- light grey
- olive grey
- white
- orange
- yellow
- green
- black

Sorting (Native materials/native sands only)

Well-sorted = uniform grain size

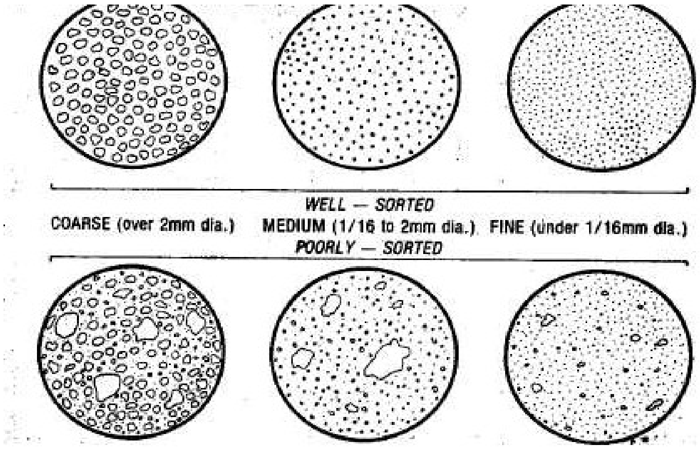
Poorly sorted = mix of grain sizes

Upward-fining = coarse grains at bottom of unit

Upward-coarsening = fine grains at bottom of unit

Observations

- staining
- sheen
- smearing
- odor
- product (residual or free)
- other



SPLIT SPOON Soil Boring Log

Job Name

Job No.

Boring No.

Page ____ of ____

Logged By

Date Drilled:

Drilling Co.:

Driller:

Boring Method Mud rotary Air rotary ODEX Hollow-stem auger

Sample Method **Spoon diameter 2" 3" other _____**

Completion Depth **Boring diameter (fill in) __________**

Depth (Feet)	Recovery	PID every 6"	Blow Counts for each 6"		Visual Description	Sample No.	Comments

Depth to Groundwater: ____________

Monitoring Well Installed? **YES** **NO**

Monitoring Well ID: ____________

Location surveyed? **Yes** **No** **GPS** **Surveyor** **Other**

Backfill Type: Cuttings Cuttings/Bentonite Bentonite Asphalt / Concrete

Soil Logging Visual Descriptors

FORMAT: Moisture - Color - Soil Type (gradation) - Compactness/Consistency - Observations

EXAMPLE: Saturated brown medium SAND, little coarse gravel, trace silt, dense, odor.

Soil Type

clay		
silt		
sand		
	fine	
	medium	
	coarse	
gravel		> 0.19"
	fine	
	coarse	
cobbles		3-12"
boulders		> 12"

Moisture

Descriptor
dry
moist
wet
saturated

Compactness (coarse-grained, non-plastic)

Descriptor	Blow Counts
loose	< 11
medium dense	11-30
dense	31-50
very dense	> 50

Consistency (fine-grained, some plasticity)

Descriptor	Blow Counts	
very soft	< 3	
soft	3-5	thumbtip indent- easy
medium	6-15	thumbtip indent- hard
stiff	16-25	thumbnail indent- easy
hard	> 25	thumbnail indent- hard

Gradation

	%
"and"	35-50
"some"	20-35
"little"	10-20
"trace"	0-10

Color

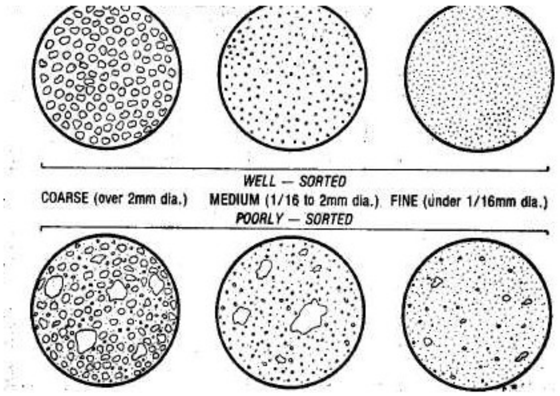
light brown
brown
dark brown
red
red-brown
tan
dark grey
light grey
olive grey
white
orange
yellow
green
black

Sorting (Native materials/native sands only)

Well-sorted	=	uniform grain size
oorly sorted	=	mix of grain sizes
ward-fining	=	coarse grains at bottom of unit
Upward-coarsening	=	fine grains at bottom of unit

Observations

staining
sheen
smearing
odor
product (residual or free)
other



GEOLIS® Well Construction Form

COMPANY: ____________________
CLIENT: ____________________
PROJECT: ____________________
SITE: ____________________

WELL NO. ____________________
DATE: ____________________
LOGGER: ____________________
SIGNATURE: ____________________

GEOLIS ®

START DATE: ____________________
COMPLETION DATE: ____________________
UNIT SYSTEM: ENGLISH - METRIC

SURVEYED ELEVATIONS (MSL)
GROUND LEVEL: __________ FT/M
MEASURING POINT: __________ FT/M
(TOP OF CASING)

DEPTH TO WATER	DATE
__________ FT/M(TOC)	__________
__________ FT/M(TOC)	__________
__________ FT/M(TOC)	__________

WELL DIAGRAM - NOT TO SCALE	DEPTH (FT. BGS)	WELL CODE
	0	GRS

WELL TYPE: SCREENED - OPEN HOLE
CASING: SINGLE - DOUBLE - TRIPLE
PROTECTIVE CASING: Y - N
FLUSH MOUNT: Y - N

WELL DESIGN CONSTRUCTION

CASING #1: (INNERMOST) DIAMETER: ________ IN/CM INTERVAL: __________ TO __________ FT/M BGS
TYPE: PVC: SCHEDULE 20 - 40 - 80 STEEL: STAINLESS - LOW CARBON

CASING #2: DIAMETER: ________ IN/CM INTERVAL: __________ TO __________ FT/M BGS
TYPE: PVC: SCHEDULE 20 - 40 - 80 STEEL: STAINLESS - LOW CARBON

CASING #3: (OUTERMOST) DIAMETER: ________ IN/CM INTERVAL: __________ TO __________ FT/M BGS
TYPE: PVC: SCHEDULE 20 - 40 - 80 STEEL: STAINLESS - LOW CARBON

STICK UP: INNER CASING: __________ FT/M OUTER CASING: __________ FT/M

CASING GROUT: TYPE: PORTLAND CEMENT - CEMT/BENT - BENTONITE - HI SOL BENT
OTHER: ____________________
INTERVAL: __________ TO __________ FT/M BGS

WELL T.D.: DEPTH: __________ FT/M BGS BACKFILL/COLLAPSE ? YES - NO

BACKFILL/ COLLAPSE: INTERVAL: __________ TO __________ FT/M BGS TYPE: __________

BEDROCK ELEVATION: TOP OF BEDROCK: __________ FT/M BGS

OPEN HOLE: DIAMETER: ________ IN/CM INTERVAL: __________ TO __________ FT/M BGS

SEAL: TYPE: __________ INTERVAL: __________ TO __________ FT/M BGS

SAND PACK: TYPE: __________ INTERVAL: __________ TO __________ FT/M BGS
GRAIN SIZE: UNIFORM - MIXED MEDIAN DIAMETER: __________ IN/MM

SCREEN: DIAMETER: ________ IN/MM INTERVAL: __________ TO __________ FT/M BGS
TYPE: PVC - STAINLESS - OTHER: __________
SLOTS: CONTINUOUS - MACHINE/BRIDGE - FIELD CUT
SLOT SIZE: 6 - 10 - 20 - 30 - 40 SLOT __________ IN/MM

SILT TRAP/SUMP: YES - NO INTERVAL: __________ TO __________ FT/M BGS

WELL DEVELOPMENT

DATE: ____________________ YIELD/RATE: __________ GPM/LPM
METHOD: ____________________ PURGE VOLUME: __________ GAL/L

WELL CONSTRUCTION CODES

GRS = GROUND SURFACE
BPC = BOTTOM OF PROTECTIVE CASING
TBS = TOP OF BENTONITE SEAL
TBR = TOP OF BEDROCK
BOC = BOTTOM OF OUTER CASING
TSP = TOP OF SAND PACK
TSC = TOP OF SCREEN
TST = TOP OF SILT TRAP
WTD = TOTAL DEPTH INSIDE WELL
BTD = BOREHOLE TOTAL DEPTH
TOC = TOP OF CASING (INNER)
BGS = BELOW GROUND SURFACE

COMMENTS: ____________________

GEOLIS® Well Development Form

COMPANY: ____________________
CLIENT: ____________________
PROJECT: ____________________
SITE: ____________________

WELL NO.: ____________________
DATE: ____________________
LOGGER: ____________________
SIGNATURE: ____________________

ONE WELL VOLUME: __________ gallons WELL TD: __________ ft TOC

Well Volume (gallons/foot) 2-inch = 0.16 4-inch = 0.65 6-inch = 1.47 8-inch = 2.61

TIME	ACTIVITY CODE	DEPTH TO WATER (ft)	PURGE RATE (gpm)	PURGE VOLUME (gal)	FIELD MEASUREMENTS				TURBIDITY	COMMENTS
	FINAL									

FINAL WELL YIELD: __________ GPM PUMP RATE - ESTIMATED CORRESPONDING DRAWDOWN: ________ FT

DEVELOPMENT ACTIVITY CODES

- DBB - Begin Bailing
- DOB - Begin Overpumping
- DRB - Begin Rawhiding
- DCB - Begin Recirculation
- DHB - Begin Hydraulic Jetting
- DAB - Begin Air Surging
- DSB - Begin Surge Blocking
- DXB - Begin Other
- DBE - End Bailing
- DOE - End Overpumping
- DRE - End Rawhiding
- DCE - End Recirculation
- DHE - End Hydraulic Jetting
- DAE - End Air Surging
- DSE - End Surge Blocking
- DXE - End Other

Specify other method: ____________________

FMT - Field Measurements (select from codes at right)

FIELD MEASUREMENT CODES

- MTP - Temperature
- MSC - Specific Conductance
- MPD - Photoionizer (e.g., HNu)
- MFD - Flame Ionizer (e.g., OVA)
- MDO - Dissolved Oxygen
- MPH - pH
- MEH - Eh
- MMC - Imhoff Cone
- MO1 - Other: __________
- MO2 - Other: __________

TURBIDITY

Enter Turbidity Meter Reading
(Final should be < 5 NTU)
OR
Enter Qualitative Observations

- H - High: Opaque/Muddy/Silty
- M - Medium: Translucent/Cloudy
- L - Low: Transparent/Some Silt
- N - None: Clear/No Visible Silt

WELL GAUGING FORM

Client:
Site Location:
Field Team Leader:

Weston Project:
Weston's Project No.:
Project Manager: Paul Bovitz

Page **1** of __

GW AOC	Monitoring Well ID:	Stick-up or Flushmount	Inside Casisng Diameter:	PID *(ppm)*	DTP *(ft bTOC)*	DTW *(ft bTOC)*	TDW *(ft bTOC)*	Comments

NOTES:

ppm - parts per million
DTP - Depth to Product
TDW - Total Depth Well
ft bTOC - feet below Top of Casing
DTW - Depth to Water

Signatures:

Field Team Leader: ______________________ **Date:** _______________________
Reviewer: ______________________________ **Date:** _______________________
Reviewer Title: _________________________ **Date:** _______________________

Weston Solutions
205 Campus Drive
Edison, NJ 08837

GROUND WATER SAMPLING LOG *(Low-Flow)*

Client: USACE
Site Location: Former Raritan Arsenal - Edison, NJ
Field Team Leader:

Weston Project:
Weston's Project No.:
Project Manager:

Page __ of __

Monitoring Well: __________

Depth to Water (feet): __________
Total Well Depth (feet): __________
Casing Diameter (inches): __________
Water Column (feet): __________
Water Column Volume (gallons): __________

Date: ______________________________
Samplers: ______________________________
Weather Conditions: ______________________________

Purging Information

Start Time: __________
End Time: __________
Purge Rate (gpm / lpm): __________
Total Volume Removed (gallons): __________

Purge Method
(circle method)
Centrifugal pump
Submersible Pump
Bailer
Other: __________

Misc. Info:

Pump Intake (ft bgs): ______________
Screened Interval (ft): ______________
Well Permit ID: ______________
Stick-up/Flushmount: ______________

Time									
Volume (gallons/liters)									
Depth to Water (DTW)									
Rate									
pH									
Temperature (deg. C)									
Conductivity (mS/cm)									
DO (mg/L)									
Turbidity (NTU)									
ORP									
Odor/Film									
Other:______________									

Sampling Information

Sample ID: _________________
Sample Time:_______________ Sampling Method/Equipment:_________________

Analyte Group	**Bottle Type**	**Number**	**Preservation**	**Method #**
VOCs	40 mL	3	HCL	624

Stabilization Order/Range

Three successive readings within:

DTW = < 0.3 feet
Rate = <500 ml/min
pH = +/- 0.1
Temp. = +/- 3%
SC = +/- 3%
DO = +/- 10%
Turb = +/- 10%, for values >1 NTU
ORP = +/- 10 mV

Metals Filtered? Y N
Sample Rate (ml/minute):_____________

QA/QC Samples? Y N If yes, Type: ______________
Sample ID: _______________ Sample Time: __________

Comments/Observations:

Signatures:

Field Team Leader: ____________________ **Date:** _____________________
Reviewer: ___________________________ **Date:** _____________________
Reviewer Title: _______________________ **Date:** _____________________

Weston Solutions
205 Campus Drive
Edison, NJ 08837

APPENDIX D

METHODOLOGY FOR THE FIELD EXTRACTION/PRESERVATION OF SOIL SAMPLES WITH METHANOL FOR VOLATILE ORGANIC COMPOUNDS

DRAFT

NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION

METHODOLOGY FOR THE FIELD EXTRACTION/PRESERVATION OF SOIL SAMPLES WITH METHANOL FOR VOLATILE ORGANIC COMPOUNDS

FEBRUARY 1997

1.0 Scope and Application

1.1 This method describes the container preparation, field sampling and field extraction/preservation procedure to be used in conjunction with the analysis of soil samples for volatile organics. The applicable analytical methods are SW-846 methods 8010B, 8015A, 8020A, 8021A, 8240B and 8260A found in the most recently promulgated edition of USEPA's Test Methods For Evaluating Solid Waste and the most current version of the Statement of Work for Organic Analysis, Multi-Media, Multi-Concentration, USEPA Contract Laboratory Program.

1.2 It is the laboratory's responsibility when analyzing samples obtained by this method to demonstrate internally that all NJDEP soil cleanup criteria for VOC's (last revised on 2/3/94, as contained in the April 1994 NJDEP Site Remediation News, Volume 6, Number 1, pages 13, 17-19) have been achieved. Should a laboratory know or suspect it has inadequate analytical sensitivity to meet any of the cleanup criteria, the laboratory shall not accept any samples unless the Department is notified in advance and the laboratory obtains approval.

2.0 Method Summary

2.1 Soil samples collected for volatile organic analysis must be handled in a manner which will minimize the loss of contaminants due to volatilization and biodegradation. Department experience and open literature indicate that, for the analysis of volatile organic compounds in soil, field extraction/preservation with methanol must be conducted to ensure that contaminants do not degrade or volatilize during sample handling and transport.

2.2 A small diameter soil core sampling device is used to collect a 10 gram (g) soil sample. The sample is extruded into a tared sample container, supplied by the laboratory performing the analysis, containing purge and trap grade methanol and surrogate compounds. The ratio of volume of methanol to weight of soil is 2.5:1. A portion of the methanol extract is combined with organic free reagent water and analyzed by purge and trap GC or GC/MS.

3.0 Sample Containers

3.1 The recommended sample containers are a 60 ml (2 oz.) wide mouth packer bottle, a 60 ml straight sided wide mouth bottle and a 40 ml or 60 ml VOA vial. All sample containers should have a open-top screw cap and a silicone rubber coated with Teflon^{R} septa or other similar sample container. Some similar containers with Teflon^{R} lined screw caps have shown to be susceptible to leakage. The type of container used should be tested to ensure leakage will not occur during shipment.

The use of larger volume containers will cause the layer of methanol over the sample to be minimized, making it difficult to extract an aliquot of methanol for analysis.

3.2 The standard 40ml or 60ml VOA vial can be used, but the small mouth may not accommodate some core samplers. The VOA vial is also unstable and susceptible to spillage.

4.0 Sample Container Preparation

4.1 Label each sample container with a unique numerical designation.

4.2 Fill the sample container with 25 mls of demonstrated analyte free purge and trap grade methanol.

4.3 An actual analysis should be traceable to the methanol used in the sample containers on the day the sample containers were prepared.

4.4 Record the lot number of the methanol used in the preparation of the sample containers. This information can be used for future reference in the event of suspected contamination of the methanol.

4.5 Employing a syringe, add the appropriate surrogate compounds to the methanol based on the analytical method. For methods 8010B, 8015A, 8020A, and 8021A, add each surrogate compound to the methanol yielding a concentration of approximately 1500 ug/l in each sample container. For methods 8240B, 8260A and the Medium Level Soil/Sediment Sample procedure of the Contract Laboratory Program Statement of Work, add each surrogate compound to the methanol yielding a concentration of approximately 2500 ug/l in each sample container.

4.6 Immediately cap the container tightly and gently swirl.

4.7 Variations of the surrogate compounds may be used depending upon expected sample matrix interferences and contaminants.

4.8 Weigh each labeled sample container with the 25 mls of methanol and surrogate compounds to the nearest one tenth (0.1g) of a gram.

4.9 Record the weight in a bound logbook and on the chain of custody record with its corresponding numerical designation.

4.10 All sample containers must be supplied by the laboratory performing the analysis.

4.11 The prepared sample containers must be stored at 4 ±2°C before shipment. The sample containers should be prepared no more than fourteen (14) days prior to shipment. It will be the responsibility of the laboratory to ensure the integrity of the sample containers remain contaminant free.

5.0 Sample Collection Methodology

5.1 Soil sample collection for volatile organic analysis must be performed with the use of a decontaminated small diameter coring device. A modified 10-30 ml disposable syringe or commercially available small diameter tube/plunger sampler is acceptable. The small diameter coring device must be capable of collecting the required amount of sample from larger diameter core samplers (split spoons, etc.) or from freshly exposed soils.

5.2 Selection of the sample location for volatile organics must be based on the methods in the <u>NJDEP Field Sampling Procedures Manual, May, 1992</u> and the site specific sampling plan.

5.3 If a modified disposable syringe is used it can be prepared in-house by cutting off the injection tip. Depending upon the construction of the syringe, small air vents must be cut into the plunger or the rubber tip and retaining post must be removed. These alterations to the plunger will prevent air from being forced through or around the soil plug during subcoring and sample extrusion.

5.4 The small diameter core sampler must be capable of delivering the sample directly into the sample container. The outer diameter of the core sampler must be smaller than the inner diameter of the sample container to avoid loss of sample and ease the soil transfer process. **The sample from the small diameter core cannot be transferred to a secondary container such as another sample bottle, zip lock bag, aluminum foil, etc. prior to placement into the sample container with the methanol preservative.**

5.5 Use a small electronic balance or manual scale for measuring the weight of the soil in the syringe. The scale must be calibrated before use, and intermittently the calibration should be checked during the sampling day to ensure accuracy of the weight measurements.

5.6 Tare weigh the small diameter core sampler.

5.7 Once the sampling interval has been selected, trim off the surface soils of the sample interval to expose a fresh soil surface. The loss of volatile organics from the surface soils will occur if the soil has been exposed for a short period of time (during screening, etc.). The removal of the surface soils can be accomplished by scraping the soil surface using a decontaminated spatula or trowel. The sampling procedure must commence immediately once a fresh soil surface has been exposed.

5.8 Using a decontaminated coring device, collect 10g ±2g (8-12grams) of sample (wet weight). Wipe the outside of the subcoring device to remove any adherent soil. The plunger of the coring device can be pulled back or completely removed allowing the open barrel of the subcore to be inserted into the soil. Depending upon the soil texture, depth or moisture content, the subcore can be inserted straight into the soil, on an angle or multiple insertions can be performed to obtain the required sample weight.

5.9 Quickly weigh the sample while contained in the small diameter core sampler. Excess soil sample can be removed from the coring device by extruding a small portion of the core and cleaning away with a decontaminated trowel or spatula. **If soil weight is below the weight limit, obtain additional sample. Reweigh after each addition or removal of sample to the subcore until the target weight is attained (8-12g). Analytical results from a sample exceeding the weight maximums and minimums may be rejected and thus require resampling.**

5.10 When sampling soils consisting of similar textures and water content, sample weight can be estimated based on volume of previously weighed samples from sampling or practice core sampling to determine sample weights.

5.11 Immediately open the sample container and slowly extrude the soil core into the preweighed and prenumbered sample container supplied by the laboratory performing the analysis. Avoid splashing methanol out of the sample container. Do not insert the small diameter coring device into the mouth of small diameter sample containers (40ml or 60ml VOA vials) or immerse the small diameter soil coring device into the methanol.

5.12 Ensure the threads on the sample container and cap are free of soil particles. Use a clean brush or paper towel to remove the particles off the threads. The presence of soil particles compromises the seal of the container resulting in loss of methanol which may invalidate the sample.

5.13 Secure the lid of the sample container. Gently swirl the sample to mix and break up the soil aggregate until soil is covered with methanol. **Do not shake.**

5.14 Do not attach any additional adhesive backed labels or tape to the sample containers. Record sample numbers on container avoiding covering laboratory identification number. Labels with wire or rubber band attachments may be used provided they can be removed easily for sample weighing. Record laboratory and field identification numbers on chain of custody and field notes.

5.15 The actual weight of soil will be determined by the laboratory performing the analysis.

5.16 Do not use or submit samples for analysis if any methanol has spilled from a sample container during shipment to the site or during sampling. Extra sample containers can be made available by the laboratory in case of accidental spillage of methanol in the field. The sample containers must be prepared in accordance with Section 4.0.

5.17 After sample collection, immediately return the containers to an iced cooler in an upright position. Sample containers can be placed in separate ziplock bags to protect other containers in case of leakage during transport. The laboratory sample number or field sample identification number may be placed on the bag and crossed referenced on the Chain of Custody. Do not place additional adhesive backed labels or tape on the sample containers. If any methanol is lost from a sample container upon arrival at the laboratory, the sample is invalid and resampling must be performed.

6.0 Moisture Determination

6.1 To report the sample results on a dry weight basis, collect one duplicate sample **not preserved with methanol** from each sample location for moisture determination. Tightly seal the container to prevent the loss of soil moisture. This sample does not require to be weighed or preserved with methanol. A small volume sample container (15 mls or less) may be used for this sample to avoid possible sample shortages.

6.2 Weigh a 5-10g portion of the sample in a tared crucible.

6.3 Dry the sample overnight at 103-105 °C. Allow to cool in a desiccator before reweighing.

6.4 Determine percent dry weight by the following formula:

$$\% \text{ dry weight} = \frac{\text{g of dry sample}}{\text{g of sample}} \times 100$$

6.5 Calculate sample concentration on a dry weight basis.

7.0 QA/QC Sample and Decontamination Requirements

7.1 Ambient Blank

7.1.1 An Ambient Blank is a QA/QC sample which will determine the potential contamination from ambient air during sampling procedures. This sample will provide a means to evaluate non-sample related contamination.

7.1.2 The Ambient Blank is prepared in the same manner as the sample containers described in Section 4.0. During sample collection, it is opened at the same time and next to the sample container and remains open during sample collection. It is closed at the same time as the sample container. It is performed at only one sample location in an area suspected of having the highest ambient contamination.

7.1.3 **The collection of an Ambient Blank is not required when sampling is performed using the methanol extraction/preservation technique**. It will be optional at the discretion of the site investigation team, or will be required on a site specific basis if previous elevated analytical results are suspected due to contamination from the sampling environment.

7.1.4 If Ambient Blanks are employed, the frequency of collection should be one (1) per day or at the discretion of the investigation team based on site conditions.

DRAFT

7.1.5 Results of the Ambient Blank must be reported as a solid sample where a sample weight of 10g and 100% dry weight is assumed.

7.2 Field Blank

7.2.1 A Field Blank is a QA/QC sample which will determine potential contamination from sampling equipment used to collect and transfer samples from the point of collection to the sample container.

7.2.2 A Field Blank is performed by pouring demonstrated analyte free **water** from one sample container, over each piece of sampling equipment required for sample collection and into a separate set of identical sample containers. Additional information on Field Blanks can be found in the NJDEP Field Sampling Procedures Manual, May 1992.

7.2.3 **A Field Blank is not required when sampling with the methanol extraction/preservation technique.** It is optional, or will be required on a site specific basis if previous elevated analytical results are suspected due to cross contamination from sampling equipment.

7.3 Trip Blanks

7.3.1 A Trip Blank is a QA/QC sample which will determine additional sources of contamination that may potentially influence the samples. The sources of the contamination may be from the lab, sample bottles or during shipment.

7.3.2 A Trip Blank is prepared at the same time and in the same manner as the sample containers as described in Section 4.0. The Trip Blank must accompany the sample containers to the field and back to the laboratory along with the collected samples for analysis. It must remain sealed at all times until it is analyzed at the laboratory.

7.3.3 **A Trip Blank is required when sampling with the methanol extraction/preservation technique.** It will be required due to potential cross contamination from sample shipment or from handling at the laboratory.

7.3.4 The frequency of collection for the Trip Blank must be at a rate of one (1) per sample shipment.

7.3.5 Results of the Trip Blank must be reported as a solid sample where a sample weight of 10g and 100% dry weight is assumed.

7.4 Duplicate Samples

7.4.1 Perform duplicate samples at a rate of five (5) percent (1 per 20 samples).

7.4.2 Duplicate samples must be obtained from the same location and soil type to minimize location as a potential source of variation in the analytical results. Separate core samples should be obtained for the sample and duplicate sample.

7.5 Sample and Sample Container Handling Time

7.5.1 Sample handling time is to control the length of time bottles are shipped to the site and held on site. The standard four (4) day handling time for sample containers and samples remains the same. Obtain additional information on handling times from Chapter 2 in the NJDEP Field Sampling Procedures Manual, May 1992.

7.5.2 As stated in N.J.A.C. 7:26E-2.1(a)15, samples must be delivered to the laboratory no later than 48 hours after sample collection.

7.6 Decontamination of Sampling Equipment

7.6.1 All equipment used for sampling must be decontaminated prior to use.

7.6.2 Decontamination of sampling equipment must follow the procedures in the NJDEP Field Sampling Procedures Manual, May 1992 for soil sampling equipment. If modified disposable syringes are utilized, they should be discarded if the three step cleaning procedure will not remove the contamination since exposure to acetone may damage the sampling tool.

7.7 General Quality Assurance

7.7.1 Quality assurance requirements have been established to maintain sample integrity. Their primary objectives are to maintain the physical form and chemical composition of the sample and to prevent contamination from other sources or cause changes in contaminant concentrations. Chapter 2 in the NJDEP Field Sampling Procedures Manual, May 1992 may be consulted for further details on other sampling QA/QC criteria and procedures.

8.0 Field Analysis

8.1 Field analytical methods may be employed during an investigation to aid in the selection or elimination of samples for laboratory analysis. When collecting samples for field analysis, collect a duplicate sample for laboratory analysis. This prevents returning to a sample location and resampling at a later time. Any methanol preserved samples not submitted for laboratory analysis are a hazardous waste and must be disposed of on-site or by the laboratory according to State and Federal regulations. To avoid this problem, the following procedure can be used:

8.1.1 Using the sampling method in section 5.0, use an EnCore® core sampler to obtain a duplicate sample for laboratory analysis. Store the soil for laboratory analysis in the core sampler by sealing the end(s) of the core with the end caps supplied with the EnCore® sampler. **Eliminate headspace in the sampler.**

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8.1.2 Label the core for lab analysis and <u>immediately</u> cool the sample. The core sample may be stored at 4°C on ice for a maximum of six (6) hours prior to preserving with methanol. This intermediate storage method can only be used if samples are field analyzed.

8.1.3 Perform the selected field analytical procedure on the duplicate sample and document the field analysis in accordance with the <u>NJDEP Field Analysis Manual, July 1994</u>.

8.1.4 If soil from a sample location is selected for laboratory analysis, preserve the iced core sample with methanol. Samples must be preserved with methanol within the six (6) hour field holding time.

8.1.5 **Use this procedure only when performing field analysis of the samples (i.e. Field GC, Immunoassay, etc.).**

9.0 Laboratory Analysis

9.1 Upon arrival of the sample at the laboratory, weigh the sample container to the nearest one tenth (0.1g) of a gram to determine the weight of soil placed in the sample container.

9.2 Subtract the weight of the container, methanol and surrogates from the total weight of the sample container with the soil sample. This gives the wet weight of the soil sample.

9.3 Proceed with the analysis of the sample using the "high concentration" methodology of the requested SW-846 analytical method or the "Medium Level Soil/Sediment Samples" procedure of the USEPA Contract Laboratory Program Statement of Work. In both instances, start the analytical procedure at the point where approximately 1ml of methanol extract is to be transferred to storage.

9.4 Using the non-methanol preserved duplicate sample, determine the dry weight of the sample.

10.0 Shipping Procedures

10.1 Methanol is considered a hazardous material therefore shipping of the sample containers is regulated by the U.S. Department of Transportation and the International Air Transport Association (IATA). The rules of shipment set in Title 49 of the Code of Federal Regulations (49 CFR parts 171 to 179) and the current edition of the IATA Dangerous Goods Regulation must be followed when shipping methanol between the laboratory and the field. Consult the above documents or the shipping company for additional information.

10.2 The shipment of the quantity of methanol used for the sample preservation falls under the exemption for small quantities. A summary of the requirements for shipping samples follows. Refer to the code for a complete review of the requirements.

10.2.1 The maximum volume of methanol in a sample container is limited to thirty (30) mls.

10.2.2 The sample container must not be full of methanol.

10.2.3 The sample container must be stored upright and have the lid held securely in place. The mechanism used to hold the cap in place must be able to be completely removed so weight is not added to the sample container.

10.2.4 Sample containers must be packed in a sorbent material capable of absorbing spills from leaks or breakage of the sample containers.

10.2.5 The maximum sample shuttle weight must not exceed 64 pounds.

10.2.6 The maximum volume of methanol per shipping container is 500mls.

10.2.7 The shipper must mark the sample shuttle in accordance with shipping dangerous goods in acceptable quantities.

10.2.8 The package must not be opened or altered until no longer in commerce.

11.0 Safety

11.1 Methanol is a toxic and flammable liquid. Therefore, methanol must be handled with all safety precautions related to toxic and flammable liquids. Inhalation of methanol vapors must be avoided. Vials should be opened and closed quickly during the sample preservation procedure. Methanol must be handled in a ventilated area. Use protective gloves when handling the methanol vials. Store methanol away from sources of ignition such as extreme heat or open flames. The vials of methanol should always be stored in a cooler with ice at all times.

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APPENDIX E

MONITORING WELL ABANDONMENT

SUBCHAPTER 7. (RESERVED)

Amended by R.1984 d.310, effective December 2, 1974.

See: 6 N.J.R. 302(d), 6 N.J.R. 470(c).

SUBCHAPTER 8. (RESERVED)

Historical Note

Rules concerning Treatment of Wastewaters Discharged into Waters of the State were adopted as the original text of this subchapter pursuant to authority delegated at N.J.S.A. 26:2E-1 et seq. and were filed and became effective prior to September 1, 1969. Amendments were filed pursuant to N.J.S.A. 13:1D-1 et seq., 58:10A-1 et seq., and 58:11A-1 et seq. as R.1977 d.477, effective December 16, 1977. See: 9 N.J.R. 461(a), 10 N.J.R. 10(c). On March 4, 1981, R.1981 d.80 repealed this subchapter but recodified sections 8.4 through 8.43 as N.J.A.C. 7:9-5.11, with amendments. See: 12 N.J.R. 108(c), 13 N.J.R. 194(b).

SUBCHAPTER 9. SEALING OF ABANDONED WELLS

Authority

Unless otherwise expressly noted, all provisions of this subchapter were adopted pursuant to authority of N.J.S.A. 58:4A-4.1 and were filed and became effective October 23, 1973, as R.1973 d.299. See: 5 N.J.R. 185(b), 5 N.J.R. 370(b).

7:9-9.1 General provisions

(a) The filling and sealing of an abandoned well in accordance with the following specifications will be accepted as in compliance with the provisions of N.J.S.A. 58:4A-4.1. A well may not be sealed by a proposed alternate method unless first approved in writing by the Bureau of Water Supply Planning and Management of the Division of Water Resources.

(b) No person, partnership or corporation may engage in the sealing of a well unless his qualifications and experience have been approved in writing by the Bureau of Water Supply Planning and Management of the division. Depending upon the qualifications of a contractor, the bureau may limit a contractor to the sealing of only certain types of wells (for example rock wells, single cased wells and the like). All sealing operations shall be under the immediate supervision of a person possessing a valid New Jersey well drillers license.

(c) The use of dynamite in well-sealing operations is expressly prohibited unless authorized in writing by the Bureau of Water Supply Planning and Management of the division.

(d) The following types of wells may not be sealed until the contractor has submitted a drawing with description of method proposed, which must be approved in writing by the Bureau of Water Supply Planning and Management of the division:

1. Wells drilled in areas where saltwater intrusion is imminent (for example beach communities);

2. Wells which have already been affected by saltwater intrusion or any other contaminants;

3. Gravel-packed wells deriving water from one or more aquifer. The aquifers of the State are those water bearing formations or beds recognized as such by the division. Some formations may contain more than one aquifer. If in doubt, contact the Bureau of Water Supply Planning and Management of the division.

(e) The contractor shall return to the well no sooner than 24 hours after sealing to allow time for settlement. The remaining space at the top of the well shall then be filled with concrete and the top formed so as to create a concrete slab at least six inches thick above the top of the casing, with a diameter at least two feet greater than the outer casing.

(f) After well has been sealed, a detailed description of the well and method used for sealing shall be submitted to the Bureau of Water Supply Planning and Management of the division.

As amended, R.1977 d.477, eff. December 16, 1977.
See: 9 N.J.R. 461(a), 10 N.J.R. 10(c).

7:9-9.2 Rock wells

(a) The regulations concerning single cased rock wells are:

1. Clear well of pump, pipe and all obstructions.

2. That portion of a well which is uncased in rock shall be filled only with sterilized coarse gravel or crushed stone to within 10 to 20 feet of the bottom of the casing and sealed off with an impermeable plug of sterilized packing materials. The open hole above the plug and the space within the casing shall then be sealed with concrete, cement grout or neat cement which shall be introduced through a pipe discharging at the bottom of the space to be filled in order to prevent dilution of the sealing material.

3. If geologic and hydrologic conditions make it unadvisable to use gravel or crushed stone in the uncased hole the entire well shall be sealed as described in paragraph 2 of this subsection.

(b) The regulations concerning double or multiple cased rock wells are:

1. Clear well of pump, pipe and all other obstructions and where possible remove all inner casings

2. Procedure then shall be as under subsection (a) of this section except that any remaining casing shall be sealed as in a single cased well.

7:9–9.3 Sand and gravel wells

(a) The regulations concerning single-cased sand and gravel wells are:

1. Clear well of pump, pipe and all obstructions:

i. Where only one aquifer has been screened the screen shall be filled with sterilized sand or gravel which shall not extend above the top of the screen;

ii. Where two or more aquifers have been screened, only the lowermost screen shall be filled with sterilized sand or gravel. The remainder of the well and all upper screens shall be sealed as described below in paragraphs 2 and 3 of this subsection.

2. The casing and screen (where not filled with sand or gravel as described in paragraph 1 of this subsection) shall be filled with a sterilized clay slurry weighing not less than 14 pounds per gallon, cement grout, or neat cement. Concrete may not be used in a screened interval but may be used within the casing. All of the above-mentioned sealing materials shall be introduced through a pipe discharging at the bottom of the space to be filled in order to prevent dilution of the sealing material.

3. If preferred in large diameter wells, casing and upper screens may be filled from the top with dry clay free of lumps larger than ¾ inch diameter, in lifts not higher than five feet, and each lift tamped with the proper drilling tool.

(b) The rules concerning double or multiple cased wells with no gravel pack, or gravel packed in the first water bearing formation only are:

1. Clear well of pump, pipe and all other obstructions and remove as much inner casing as possible.

2. The screened portion shall be filled with sterilized sand or gravel which shall not extend above the top of the screen.

3. All remaining casing and annular spaces shall be filled as described in N.J.A.C. 7:9–9.3(a)2.

(c) The rules concerning double or multiple cased wells with gravel packed, screened below the first water bearing formation but tapping only one aquifer are:

1. Clear well of pump, and all other obstructions and remove as much inner casing as possible.

2. If gravel pack within annular space(s) between casing(s) does not extend from the screened formation to the aquifer above and is at least 20 feet below the next aquifer, the contractor may fill the screen with sand or gravel and seal the well and annular space as described in N.J.A.C. 7:9–9.3(a)2.

3. If gravel within annular space(s) extends to within 20 feet of the next water bearing formation, either of the two methods described below are acceptable:

i. Place packer at the top of the screen, and inject a nontoxic chemical grout under pressure into the screen and surrounding gravel pack below the packer and at least 20 feet vertically into the gravel pack occupying the annular space(s) between casings. If preferred, this section may be filled with sterilized coarse gravel prior to grout injection in order to reduce the amount of grout needed. After the grout has set, the remaining casing and annular space(s) shall be sealed as described in N.J.A.C. 7:9–9.3(a)2.

ii. If preferred the screen and casing may be filled with sterilized sand to a point between the screen and next overlying aquifer but at least 20 feet below the next aquifer. The inner casing(s) then shall be perforated or ripped at this point, a packer inserted, and nontoxic chemical grout injected under pressure below the packer into the surrounding gravel pack so that the annular space(s) between casings is sealed for a vertical distance at least 20 feet between the screen and the next aquifer. After the grout has set the remaining casing and annular space(s) shall be sealed as described in N.J.A.C. 7:9–9.3(a)2.

7:9–9.4 Test wells

(a) An unused test well shall be considered an abandoned well and shall be sealed as described in the previous sections unless it is to be used for observation purposes in which case permission must be granted in writing by the Bureau of Water Control of the Division.

(b) If the casing of a test well is to be removed, the open hole shall be filled with a sterilized clay slurry weighing not less than 14 pounds per gallon, cement grout, neat cement or concrete, which shall be introduced from the bottom of the spaces to be filled. In unconsolidated formations, the sealing material shall be introduced into the bottom of the hole while the casing is pulled so as to prevent the uncased hole from caving. The producing zone, or uncased hole in a rock shall be filled with sterilized gravel or crushed stone. However, in rock wells where zones of poor-quality water were encountered or where geologic and hydrologic conditions make it unadvisable to use gravel or crushed stone, the entire hole shall be sealed.

SUBCHAPTER 10. (RESERVED)

Historical Note

This subchapter formerly contained rules on the "Installation of Sewerage Facilities in Critical Areas", which were adopted pursuant to authority delegated at N.J.S.A. 58:11–43 et seq. and filed on November 16, 1971 as R.1971 d.208 to become effective on January 15, 1972. See: 3 N.J.R 76(a), 3 N.J.R. 255(b). Amendments were filed and became effective on January 23, 1978 as R.1978 d.19. See: 9 N.J.R. 311(a), 10 N.J.R. 60(a). Subsequent amendments became effective on December 16, 1977 as R.1977 d.477; July 19, 1979 as R.1979 d.282; and September 7, 1982 as R.1982 d.298. See: 9 N.J.R. 46(a), 10 N.J.R. 10(c); 10 N.J.R. 476(a), 11 N.J.R. 374(c); and 14 N.J.R. 504(a), 14 N.J.R. 979(a). On October 3, 1983 R.1982 d.423 repealed the text of the subchapter as duplicative of current review procedures conducted by local boards of health and the Pinelands Commission. See 15 N.J.R 1155(a), and 15 N.J.R. 1654(b)

DWR-020
9/96

New Jersey Department of Environmental Protection
Water Supply Element — Bureau of Water Allocation

WELL ABANDONMENT REPORT

MAIL TO: **Bureau of Water Allocation**
CN 426
Trenton, NJ 08625-0426

WELL PERMIT # ____________
of well sealed

DATE WELL SEALED ____________

PROPERTY OWNER ____________

ADDRESS ____________

WELL LOCATION ____________
Street & No., Township, County

____________ Well No. ____________ Lot No. ____________ Block No.

USE OF WELL PRIOR TO ABANDONMENT: ____________

REASON FOR ABANDONMENT: ____________

WAS A NEW WELL DRILLED? ☐ YES ☐ NO PERMIT # OF NEW WELL: ____________

TOTAL DEPTH OF WELL ____________
DIAMETER ____________
CASING LENGTH ____________
SCREEN LENGTH ____________
NUMBER OF CASINGS ____________

MATERIAL USED TO DECOMMISSION WELL:

____________ Gallons of Water
____________ Lbs. of Cement
____________ Lbs. of Bentonite
____________ Lbs. of Sand/Gravel
(none if well is contaminated)

FORMATION: ______ Consolidated
______ Unconsolidated

Cross-section of sealed well	Draw a sketch showing distance and relations of well site to nearest roads, buildings, etc.
	N

To permit adequate grouting, the casing should remain in place, but ungrouted liner pipes or any other obstructions must be removed. Pressure grouting is the only accepted method.

WAS CASING LEFT IN PLACE? ☐ YES ☐ NO CASING MATERIAL: ____________

WERE OTHER OBSTRUCTIONS LEFT IN WELL? ☐ YES ☐ NO WHAT WERE THE OBSTRUCTIONS: ____________

IF "YES", AUTHORIZATION GRANTED BY ____________ ON ____________
(NJDEP Official) (Date)

Was an alternative decommissioning method used? ☐ YES ☐ NO

If "YES", aauthorization granted by ____________ ON ____________
(NJDEP Official) (Date)

I certify that this well was sealed in accordance with N.J.A.C. 7:9-9.1 et seq.

____________ Name of NJ Certified Well Sealer Performing Work (Print or Type)

____________ Address

____________ Mailing Date

____________ Signature of NJ Certified Well Sealer Performing Work

____________ License #

COPIES: White - Water Allocation Yellow - Owner Pink - Health Dept. Goldenrod - Driller

APPENDIX F

SLUG TEST SOP

U.S. EPA ENVIRONMENTAL REPONSE TEAM

RESPONSE ENGINEERING AND ANALYTICAL CONTRACT

STANDARD OPERATING PROCEDURES

U.S. EPA CONTRACT 68-C4-0022

SOP: 204

PAGE: 1 of

REV: 0.

DATE: 10/03/9

SLUG TESTS

CONTENTS

SUPERCEDES: SOP #2158; Revision 2; 08/30/90; U.S. EPA Contract 68-03-3482.

1.0 SCOPE AND APPLICABILITY

This procedure is applicable to determine the horizontal hydraulic conductivity of distinct geologic horizons under in-situ conditions. The hydraulic conductivity (K) is an important parameter for modeling the flow of groundwater in an aquifer.

These are standard (i.e. typically applicable) operating procedures which may be varied or changed as required, dependent upon site conditions, equipment limitations or limimtations imposed by the procedure. In all isntances, the ultimate procedures employed should be documented and associated with the final report.

Mention of trade names or commercial products does not constitute U.S. Environmental Protection Agency (U.S. EPA) endorsement or recommendation for use.

2.0 METHOD SUMMARY

A slug test involves the instantaneous injection or withdrawal of a volume or slug of water or solid cylinder of known volume. This is accomplished by displacing a known volume of water from a well and measuring the artificial fluctuation of the groundwater level.

The primary advantages of using slug tests to estimate hydraulic conductivities are numerous. First, estimates can be made in-situ, thereby avoiding errors incurred in laboratory testing of disturbed soil samples. Second, tests can be performed quickly at relatively low costs because pumping and observation wells are not required. And lastly, the hydraulic conductivity of small discrete portions of an aquifer can be estimated (e.g., sand layers in a clay).

3.0 SAMPLE PRESERVATION, CONTAINERS, HANDLING AND STORAGE

This section is not applicable to this standard operating procedure (SOP).

4.0 INTERFERENCES AND POTENTIAL PROBLEMS

Limitations of slug testing include: 1) only the hydraulic conductivity of the area immediately surrounding the well is estimated which may not be representative of the average hydraulic conductivity of the area, and 2) the storage coefficient, S, usually cannot be determined by this method.

5.0 EQUIPMENT/APPARATUS

The following equipment is needed to perform slug tests. All equipment which comes in contact with the well should be decontaminated and tested prior to commencing field activities.

- Tape measure (subdivided into tenths of feet)
- Water pressure transducer
- Electric water level indicator
- Weighted tapes
- Steel tape (subdivided into tenths of feet)
- Electronic data-logger (if transducer method is used)

- Stainless steel slug of a known volume
- Watch or stopwatch with second hand
- Semi-log graph paper (if required)
- Water proof ink pen and logbook
- Thermometer
- Appropriate references and calculator
- Electrical tape
- 21X micrologger
- Compact portable computer or equivalent with Grapher installed on the hard disk

6.0 REAGENTS

No chemical reagents are used in this procedure; however, decontamination solvents may be necessary. If decontamination of the slug or equipment is required, refer to ERT/REAC SOP #2006, Sampling Equipment Decontamination and the site specific work plan.

7.0 PROCEDURES

7.1 Field Procedures

The following general procedures may be used to collect and report slug test data. These procedures may be modified to reflect site specific conditions:

1. When the slug test is performed using an electronic data-logger and pressure transducer, all data will be stored internally or on computer diskettes or tape. The information will be transferred directly to the main computer and analyzed. A computer printout of the data shall be maintained in the files as documentation.

   If the slug test data is collected and recorded manually, the slug test data form (Figure 1, Appendix A) will be used to record observations. The slug test data form shall be completed as follows:

   - Site ID - Identification number assigned to the site.
   - Location ID - Identification of location being tested.
   - Date - The date when the test data was collected in this order: year, month, day (e.g., 900131 for January 31, 1990).
   - Slug volume (ft^3) - Manufacturers specification for the known volume or displacement of the slug device.
   - Logger - identifies the company or person responsible for performing the field measurements.
   - Test method - The slug device is either injected or lowered into the well or withdrawn or pulled-out from the monitor well. Check the method that is applicable to the test situation being run.
   - Comments - Appropriate observations or information for which no other blanks are provided.
   - Elapsed time (min) - Cumulative time readings from beginning of test to end of test, in minutes.
   - Depth to water (ft) - Depth to water recorded in tenths of feet.

2. Decontaminate the transducer and cable.

3. Make initial water level measurements on monitor wells in an upgradient to downgradient sequence, if possible.

4. Before beginning the slug test, information will be recorded and entered into the electronic data-logger. The type of information may vary depending on the model used. When using different models, consult the operator's manual for the proper data entry sequence to be used.

5. Test wells from least contaminated to most contaminated, if possible.

6. Determine the static water level in the well by measuring the depth to water periodically for several minutes and taking the average of the readings, (see ERT/REAC SOP #2043, Water Level Measurements).

7. Cover sharp edges of the well casing with duct tape to protect the transducer cables.

8. Install the transducer and cable in the well to a depth below the target drawdown estimated for the test but at least two feet from the bottom of the well. Be sure the depth of submergence is within the design range stamped on the transducer. Temporarily tape the transducer cable to the well to keep the transducer at a constant depth.

9. Connect the transducer cable to the electronic data-logger.

10. Enter the initial water level and transducer design range into the recording device according to manufacturers instructions (the transducer design range will be stamped on the side of the transducer). Record the initial water level on the recording device.

11. "Instantaneously" introduce or remove a known volume or slug of water to the well. Another method is to introduce a solid cylinder of known volume to displace and raise the water level, allow the water level to restabilize and remove the cylinder. It is important to remove or add the volumes as quickly as possible because the analysis assumes an "instantaneous" change in volume is created in the well.

12. At the moment of volume addition or removal assigned time zero, measure and record the depth to water and the time at each reading. Depths should be measured to the nearest 0.01 foot. The number of depth-time measurements necessary to complete the test are variable. It is critical to make as many measurements as possible in the early part of the test. The number and intervals between measurements will be determined from earlier previous aquifer tests or evaluations.

13. Continue measuring and recording depth-time measurements until the water level returns to equilibrium conditions or a sufficient number of readings have been made to clearly show a trend on a semi-log plot of time versus depth.

14. Retrieve slug (if applicable).

    Note: The time required for a slug test to be completed is a function of the volume of the slug, the hydraulic conductivity of the formation and the type of well completion. The slug volume should be large enough that a sufficient number of water level measurements can be made before the water level returns to equilibrium conditions. The length of the test may range from less than a minute to several hours.

    If the well is to be used as a monitoring well, precautions should be taken that the wells are not contaminated by material introduced into the well. If water is added to the monitoring well, it should be from an uncontaminated source and transported in a clean container. Bailers or measuring devices should be cleaned prior to the test. If tests are performed on more than one monitor well, care must be taken to avoid cross contamination of the wells.

    Slug tests shall be conducted on relatively undisturbed wells. If a test is conducted on a well that has recently been pumped for water sampling purposes, the measured water level must be within 0.1 foot of the water level prior to sampling. At least one week should elapse between the drilling of a well and the performance of a slug test.

7.2 Post Operation Procedures

When using an electronic data-logger use the following procedure:

1. Stop logging sequence.
2. Print data.
3. Send data to computer by telephone.
4. Save memory and disconnect battery at the end of the day's activities.
5. Review field forms for completeness.

8.0 CALCULATIONS

The simplest interpretation of piezometer recovery is that of Hvorslev (1951). The analysis assumes a homogenous, isotropic medium in which soil and water are incompressible. Hvorslev's expression for hydraulic conductivity (K) is:

$$K = \frac{r^2 \ln (L/R)}{2\, L\, T_0} \quad \textit{for } L/R > 8$$

where:

K = hydraulic conductivity [ft/sec]
r = casing radius [ft]
L = length of open screen (or borehole) [ft]
R = filter pack (borehole) radius [ft]
T_0 = Basic Time Lag [sec]; value of t on semi-logarithmic plot of $H\text{-}h/H\text{-}H_0$ vs. t, where $H\text{-}h/H\text{-}H_0 = 0.37$
H = initial water level prior to removal of slug
H_0 = water level at t = 0
h = recorded water level at t > 0

(Hvorslev, 1951; Freeze and Cherry, 1979)

The Bower and Rice method is also commonly used for K calculations. However, it is much more time consuming than the Hvorslev method. Refer to Freeze and Cherry or <u>Applied Hydrogeology</u> (Fetter) for a discussion of these methods

9.0 QUALITY ASSURANCE/QUALITY CONTROL

The following general quality assurance procedures apply:

1. All data must be documented on standard Chain of Custody records, field data sheets, or within personal/site logbooks

2. All instrumentation must be operated in accordance with operating instructions as supplied by the manufacturer, unless otherwise specified in the work plan. Equipment checkout and calibration activities must occur prior to sampling/operation, and they must be documented.

The following specific quality assurance activity will apply:

1. Each well should be tested at least twice in order to compare results.

10.0 DATA VALIDATION

This section is not applicable to this SOP.

11.0 HEALTH AND SAFETY

When working with potential hazardouse materials, follow U.S. EPA, OSHA and corporate health and safety procedures.

12.0 REFERENCES

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APPENDIX A
Slug Test Data Form
SOP #2046
October 1994

Page __ of __

FIGURE 1. Slug Test Data Form

DATE: ____________________

SITE ID: ____________________ SLUG VOLUME (ft^3): ____________________

LOCATION ID: ____________________ LOGGER: ____________________

TEST METHOD: __ SLUG INJECTION __ SLUG WITHDRAWAL

COMMENTS: ____

____

____

Time Beginning of Test #1 _____ Time Beginning of Test #2 ____________________

Time End of Test #1 _____ Time End of Test #2 ____________________

ELAPSED TIME (MIN)	DEPTH TO WATER (FT)	ELAPSED TIME (MIN)	DEPTH TO WATER (FT)

APPENDIX G

INDOOR AIR SAMPLING TEST SOP AND FIELD SHEET

NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION
INDOOR AIR BUILDING SURVEY AND SAMPLING FORM
AND
INDOOR AIR AND AMBIENT AIR SAMPLING
STANDARD OPERATING PROCEDURES
FORMER RARITAN ARSENAL
EDISON, NEW JERSEY

Background Information on Building Surveying

Prior to any indoor air sampling event, an inspection of each building being monitored must be performed. This prior inspection and subsequent sampling event lead to the completion of the New Jersey Department of Environmental Protection (NJDEP) Indoor Air Building Survey and Sampling Form. The purpose of this form is to identify and evaluate site conditions that could impact the sample results including any possible indoor air emission sources that could generate target volatile organic compounds (VOCs). During the site inspections, locations for indoor air and subslab soil gas sampling are determined. The sample locations, sample collection information, and potential sources of contamination are shown on each NJDEP Indoor Air Building Survey and Sampling Form. A blank copy of this NJDEP Indoor Air Building Survey and Sampling Form is included in Attachment A.

Procedure for Completing Indoor Air Building Survey

Parts I and II- Occupants and Building Characteristics

1. This information can be found during an interview with the owner/tenant of the building.

Part III – Outside Contaminant Sources

1. The NJDEP Comprehensive Site List is a list of contaminated sites within each county and municipality. The purpose of this listing is to determine nearby sources of contamination that may affect sample results. The list can be found at **http://www.state.nj.us/dep/srp/kcs-nj/**. The contaminated sites within 1000 ft of the site in question need to be listed on the Survey Form.
2. Other stationary source nearby (gas stations, emission stacks, etc.) can be found on the NJDEP Comprehensive Site List or during the site inspection.
3. Heavy vehicular traffic nearby can be determined during the site inspection, by determining whether main roads or highways exist nearby.

Part IV – Indoors Contaminant Sources

1. The purpose of Part IV is to determine all potential indoor sources of contamination found within the building. A list of potential sources is given. During, the site inspection, this list must be completed, giving locations of these potential sources along with whether the source was or was not removed 48 hours prior to sampling.
2. Additional information on Chemicals found in the building will be observed during the site inspection. The brand and type of chemical in question should be noted on the Building Survey Form. MSDSs may be requested during site inspections.

Part V – Miscellaneous Items

1. The information in Part V can be obtained through direct observation of the building as well as interviewing with the occupants.

INDOOR AIR AND AMBIENT AIR SAMPLING APPROACH

1. All indoor air and ambient air samples will be collected using 6-Liter Summa® canisters that were cleaned and certified. Summa® canisters must be cleaned and certified by a laboratory certified by the New Jersey Department on Environmental Protection to perform USEPA Method TO-15.
2. Samples should be collected in the breathing zone height approximately 3-5 feet from the floor. For a basement sample, position the Summa Canister as close as possible to the source area (i.e., sumps, major cracks in foundation).
3. The precise sample locations will be selected during the site inspection, prior to the beginning of any sampling event.
4. One ambient (outdoor) sample per sampling event must be taken concurrently with indoor samples to assist in evaluating background contaminant levels. This ambient air sample should be taken on the roof of the building being evaluated or in the breathing zone, approximately 3-5' from ground level, and as far from vehicular traffic, or other potential VOC sources as possible.
5. Indoor Air and Ambient Air samples are collected over a 24-hour period.
6. During all Indoor Air Sampling events, all windows and overhead doors should be closed to the extent possible.
7. An effort should be made to have the building windows and doors closed at least 12 hours before measurements begin.
8. An effort should also be made limiting the use of appliances that induce large pressure differences (e.g., exhaust fans) at least 12 hours before measurements begin.
9. Ventilation Systems should be operated as normal.
10. Request that tenants stop cleaning services during indoor air sampling.

SAMPLING PROCEDURE

1. Attach Regulator to 6-Liter Summa® Canister with wrench.
2. Place Summa® Canister in location pre-determined during the building inspection.
3. Open regulator.
4. Ensure that the starting pressure is approximately -30 inches of mercury (or the same as stated on certification label from the laboratory).
5. Record the canister number, regulator number and starting pressure on the field log sheet.
6. Leave the Summa® Canister for 24 hours.
7. Leave a note requesting that no people touch the canister during the 24-hours of sampling.
8. Collect the air sample after 24-hours, by closing the regulator. The regulator should read approximately between -5 inches of mercury and 0 inches of mercury.
9. Remove Regulator from the Summa® Canister.
10. Complete the Sample Tag from the Laboratory and the Field Log Sheet.

WEATHER DATA

During a sampling event weather data should be collected utilizing weather station equipment. The minimum and maximum temperature, barometric pressure, humidity, and any precipitation should be noted on the NJDEP Sampling Form.

If weather conditions cannot be obtained from weather station equipment, obtain the archived weather data from the following web site:

http://www.weatherunderground.com/history/airport/KEWR/2004/6/10/DailyHistory.html

RECORDKEEPING

1. On the sample canister tag, identify each location with a Sample ID (Round-Building ID-Matrix-Sample Number).
2. On the Field Log Sheet, record the sample ID, location, summa canister number, regulator number, starting pressure, ending pressure, and beginning and ending date and time for each sample collected.
3. In addition, complete this information on the NJDEP Sampling Form, which can be found in Attachment A.

Blank Log Sheet can be found in Attachment B

ANALYITICAL METHOD

The indoor air samples are to be collected and analyzed in accordance with the U.S. Environmental Protection Agency (EPA) "Compendium Method TO-15 Determination of Volatile Organic Compounds (VOCs) in Air Collected in Specially Prepared Canisters and Analyzing by Gas Chromatography/Mass Spectrometry (GC/MS)." Method is found in the *Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air* (January 1999).

QUALITY ASSURANCE/CONTROL

Field quality control (QC) samples consisting of field blanks and field duplicates are not required according to the guidelines outlined in the *Indoor Air VOC Sampling Analysis Requirements* by the NJDEP in April 2003 and the NJDEP Draft Vapor Intrusion Guidance Document (NJDEP, June 2005).

HOLDING TIMES

Based upon the EPA "Compendium Method TO-15 Determination of Volatile Organic Compounds (VOCs) in Air Collected in Specially Prepared Canisters and Analyzing by Gas Chromatography/Mass Spectrometry (GC/MS)," the maximum holding time for Summa Canisters is 30 days. The turn around time for the laboratory is a maximum of 21 Days.

DATA VALIDATION

The indoor air and subslab soil gas data was validated in accordance with the principles outlined in the USEPA Region II Data Validation SOP HW-18, Revision 0 (January 1994), *Validating Canisters of Volatile Organics in Ambient Air.* All quality control (QC) limits outlined in Method TO-15 were used as evaluation criteria.

ATTACHMENTS

Attachment A	NJDEP Indoor Air Building Survey and Sampling Form
Attachment B	Field Log Sheet

New Jersey Department of Environmental Protection

INDOOR AIR BUILDING SURVEY & SAMPLING FORM

Survey Completed by: ____ Date: _______________

Site Name: ____ Case #: ___________________

Part I - Occupants

Building Address: ____

Property Contact: _________________________ Owner / Renter / other: ______________________

Contact's Phone: home ( )____________ work ( )______________ cell ( )____________

Building occupants: Children under age 13 _____ Children age 13-18 ______ Adults _____

Part II – Building Characteristics

Building type: single-family residential / multi-family residential / office / strip mall / commercial / industrial

Describe building: ____

Number of floors - below grade: ______ (full basement / crawl space / slab) at or above grade: __________

Basement size: _______ ft^2 Basement floor: concrete / dirt / floating / other (specify): _____________

Foundation type: poured concrete / cinder blocks / stone / other (specify) ___________________________

Type of ground cover around outside of building: grass / concrete / asphalt / other (specify) ________________

Basement sump present? *Yes / No* Sump pump? *Yes / No*

Type of heating system (circle all that apply):

hot air circulation	hot air radiation	wood	steam radiation	hot water radiation
kerosene heater	electric baseboard	heat pump	other (specify): ____________	

Type of ventilation system (circle all that apply):

central air conditioning	mechanical fans	bathroom ventilation fans
individual air conditioning units	kitchen range hood fan	other (specify): _______________

Type of fuel utilized (circle all that apply):

Natural gas / electric / fuel oil / wood / coal / solar / kerosene / outside (fresh) air intake

Septic system? *Yes / Yes (but not used) / No* Irrigation/private well? *Yes / Yes (but not used) / No*

Existing subsurface depressurization (radon) system in place? *Yes / No* and running? *Yes / No*

Part III - Outside Contaminant Sources

NJDEP Comprehensive Site List (1000-ft. radius): ____________________________________

Other stationary sources nearby (gas stations, emission stacks, etc.): ______________________________

Heavy vehicular traffic nearby (or other mobile sources): ______________________________________

Part IV – Indoor Contaminant Sources

Identify all potential indoor sources found in the building (including attached garages), the location of the source (floor & room), and whether the item was removed from the building 48 hours prior to indoor air sampling event.

Potential Sources	Location(s)	Removed Prior to Sampling? (Yes / No / NA)
Gasoline storage cans		
Gas-powered equipment		
Kerosene storage cans		
Paints / thinners / strippers		
Cleaning solvents		
Oven cleaners		
Carpet / upholstery cleaners		
Other house cleaning products		
Moth balls		
Polishes / waxes		
Insecticides		
Furniture / floor polish		
Nail polish / polish remover		
Hairspray		
Cologne / perfume		
Air fresheners		
Fuel tank (inside building)		NA
Wood stove or fireplace		NA
New furniture / upholstery		
New carpeting / flooring		NA
Recent painting in building?		NA
Hobbies - glues, paints, etc.		

Part V – Miscellaneous Items

Do any occupants of the building smoke? *Yes / No* How often? ____________

Has anyone smoked within the building within the last 48 hours? *Yes / No*

Does the building have an attached garage? *Yes / No*

If so, is a car usually parked in the garage? *Yes / No*

Do the occupants of the building have their clothes dry-cleaned? *Yes / No*

When were dry-cleaned clothes last brought into the building? ____________

Have the occupants ever noticed any usual odors in the building? *Yes / No*

Describe (with location): ____________

Any known spills of a chemical immediately outside or inside the building? *Yes / No*

Describe (with location): ____________

Have any pesticides/herbicides been applied around the building foundation or in the yard/gardens? *Yes* / No

If so, when and which chemicals? ____________

Part VI – Sampling Information

Sample Technician: ______________________________ Phone number: ( ) ______ - __________

Sampler Type: Tedlar / Sorbent / Canister Analytical Method: TO-15 / TO-17 / other: ________

Laboratory: ____ NJ Certified Lab? Yes / No

Sample #	**Floor**	**Room**	**Canister / Tube #**	**Pump ID #** (if applicable)	**Sample Start** Date / Time	**Sample End** Date / Time

Sample location(s): Provide Drawing of Sample Location(s) in Building

Sample # _____ - ________________________

Sample # _____ - ________________________

Sample # _____ - ________________________

Did the occupants **not** follow any of the "Instructions for Residents" directions? *Yes / No*

If so, describe modifications: ________________

____

Part VII - Weather Conditions

Outside temperature at time of sampling: _____ °F

Expected high temperature: _______ °F Expected low temperature: _______ °F

Was there significant precipitation within 12 hours of (or during) the sampling event? *Yes / No*

Describe the general weather conditions: ____

Part VIII – General Observations

Provide any information that may be pertinent to the sampling event and may assist in the data interpretation process.

____

____

____

(NJDEP 1997; NHDES 1998; NYDOH 1997; VDOH 1993; MA DEP 2002)

Data Log Sheet

Sample ID#	Location of Summa	Summa Canister Serial Number	Regulator Serial #	Regulator Flow Rate	Certification Date	Beginning Gauge	Ending Gauge	Start Date and Time	End Time	Total Time

Sampler's names:

Dates Sampled:

APPENDIX H

SUBSLAB SOIL GAS SAMPLING SOP

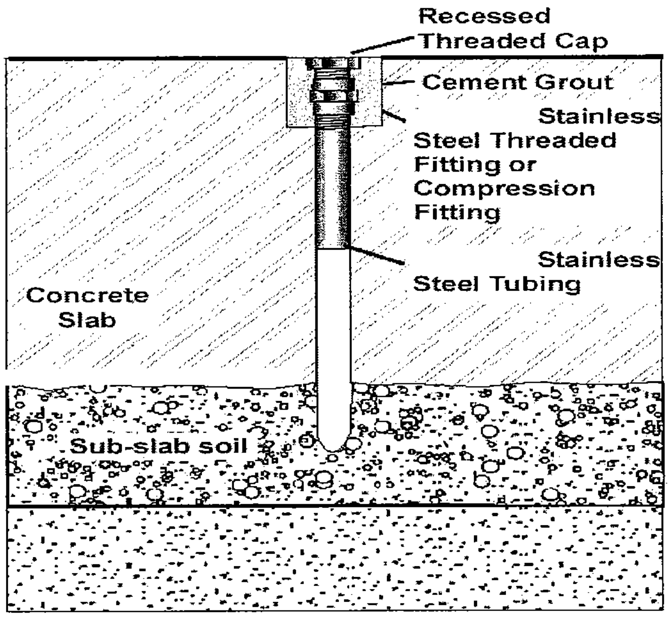
SUBSLAB SOIL GAS SAMPLING
STANDARD OPERATING PROCEDURES
FORMER RARITAN ARSENAL
EDISON, NEW JERSEY

1. INITIAL SUBSLAB SOIL GAS SAMPLING PROCEDURE

The subslab soil gas sampling point installation procedure is done in accordance with the "*Draft NJDEP Vapor Intrusion Guidance Document*" by the New Jersey Department of Environment Protection (NJDEP) in June 2005. This method is required for long-term monitoring of subslab soil gas as part of a remedial action.

1. Remove carpeting, if present (this may require cutting a small ½" square flap that can be glued back down after the sampling event is completed)
2. Put together the stainless steel vapor probe with thread seal tape [The vapor robe consists of a 3/8" x 2 ½" stainless steel Pipe Nipple with a Fip Reducing Coupling (½" x 3/8") and a Square Head Plug (½")].
3. Drill a 3/8" diameter hole through the concrete slab using an electric drill with a ¾" drill bit
4. Advance the drill bit approximately 9 inches through the concrete slab and into the subslab material to create an open cavity (most buildings in the former Raritan Arsenal have approximately a 6 inch concrete slab – the cavity need to be approximately 3" into the subslab soil).
5. Over drill the top 1" (vertical) of the probe hole to a diameter of 1".
6. Insert the vapor probe flush with the top of the concrete slab and add a quick expansive cement to seal the hole. It is imperative that the vapor probe is completed flush with the concrete surface to avoid tripping hazards for the occupants of the building.
7. Allow the test point to cure to secure the vapor probe in place.
8. Connect the vapor probe to the "T" fitting using the Fip to Mip Street Elbow ("All Tube" Nut Sleeve and Insert [3/8"]). The "T" fitting is made of stainless steel flexible line and in-line valve.
9. Connect air sampling pump to the "T" setup.
10. Connect regulator to the Summa Canister and connect both to the "T" setup.
11. Open valve to portable vacuum pump.
12. Turn on portable vacuum pump at 100 ml/per minute to purge vapor probe through the purge line. (Calculate the total time based on the calculation in Section 2).
13. Turn off vacuum pump and close valve.
14. Open the stainless steel Summa canister valve to collect a one-hour sub-slab soil gas sample.
15. Ensure that the starting pressure is approximately -30 inches of mercury (or the same as stated on certification label from the laboratory).
16. Record the canister number, regulator number, starting pressure, start date and time on the field log sheet.
17. After one (1) hour collect the sample by closing regulator on the Summa Canister. The regulator should read approximately between -5 inches of mercury and 0 inches of mercury.
18. Disconnect "T" setup
19. Remove Regulator from the Summa® Canister.
20. Complete the Sample Tag from the Laboratory and the Field Log Sheet.
21. Place cap on vapor probe.

DIAGRAM



Subsequent Soil Gas Sampling Rounds

1. Connect the vapor probe to the "T" fitting using the Fip to Mip Street Elbow.
2. Connect air sampling pump to the "T" setup.
3. Connect regulator to the Summa Canister and connect both to the "T" setup.
4. Open valve to portable vacuum pump.
5. Turn on portable vacuum pump to purge vapor probe through the purge line. (Purge volume as calculated in Section 2)
6. Turn off vacuum pump and close valve.
7. Open the stainless steel Summa canister valve to collect a one-hour subslab soil gas sample.
8. After one (1) hour close Summa Canister
9. Ensure that the starting pressure is approximately -30 inches of mercury (or the same as stated on certification label from the laboratory).
10. Record the canister number, regulator number and starting pressure on the field log sheet.
11. After one (1) hour collect the sample by closing regulator on the Summa Canister. The regulator should read approximately between -5 inches of mercury and 0 inches of mercury.
12. Disconnect "T" setup
13. Remove Regulator from the Summa® Canister.
14. Complete the Sample Tag from the Laboratory and the Field Log Sheet.
15. Place cap on vapor probe.

2. CALCULATING PURGE VOLUME

The vapor probe and connecting tubing will be purged at a volume of 100 ml/minute.

Purge Volume = $1.5*\pi*r^2*h$
r=inner radius of the vapor probe
h= length of the vapor probe and connecting tubing

3. WEATHER DATA

During a sampling event weather data should be collected utilizing weather station equipment. The minimum and maximum temperature, barometric pressure, humidity, and any precipitation should be noted on the NJDEP Sampling Form.

If weather conditions cannot be obtained from weather station equipment, obtain the archived weather data from the following web site:

http://www.weatherunderground.com/history/airport/KEWR/2004/6/10/DailyHistory.html

4. RECORDKEEPING

1. On the sample canister tag, identify each location with a Sample ID (Round-Building ID-Matrix-Sample Number).
2. On the Field Log Sheet, record the sample ID, location, summa canister number, regulator number, starting pressure, ending pressure, and beginning and ending date and time for each sample collected.
3. In addition, complete this information on the NJDEP Sampling Form, which can be found in Attachment A.

Blank Log Sheet can be found in Attachment B

5. ANALYITICAL METHOD

The indoor air samples are to be collected and analyzed in accordance with the U.S. Environmental Protection Agency (EPA) "Compendium Method TO-15 Determination of Volatile Organic Compounds (VOCs) in Air Collected in Specially Prepared Canisters and Analyzing by Gas Chromatography/Mass Spectrometry (GC/MS)." Method is found in the EPA *Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air* in January 1999.

6. QUALITY ASSURANCE/CONTROL

Field quality control (QC) samples consisting of field blanks and field duplicates are not required according to the guidelines outlined in the *Indoor Air VOC Sampling Analysis Requirements* by the NJDEP in April 2003 and the NJDEP Draft Vapor Intrusion Guidance Document (NJDEP, June 2005).

7. HOLDING TIMES

Based upon the EPA "Compendium Method TO-15 Determination of Volatile Organic Compounds (VOCs) in Air Collected in Specially Prepared Canisters and Analyzing by Gas Chromatography/Mass Spectrometry (GC/MS)," the maximum holding time for Summa Canisters is 30 days. The turn around time for the laboratory is a maximum of 21 Days.

8. DATA VALIDATION

The indoor air and subslab soil gas data was validated in accordance with the principles outlined in the USEPA Region II Data Validation SOP HW-18, Revision 0 (January 1994), *Validating Canisters of Volatile Organics in Ambient Air.* All quality control (QC) limits outlined in Method TO-15 were used as evaluation criteria.

ATTACHMENTS

Attachment A	NJDEP Indoor Air Building Survey and Sampling Form
Attachment B	Field Log Sheet

APPENDIX I

FIDDLER CRAB PROCESSING GUIDANCE

NJDEP/BEERA/ETRA January 2002

Fiddler Crab Monitoring for the Determination of Contaminant Uptake: Draft Guidelines for Field Collection and Chemical Analyses

Fiddler Crabs (*Uca* spp.) are members of brackish- water and salt marsh invertebrate communities, where they are responsible for converting detrital-based energy for use by higher trophic level animals. They feed mainly upon bacteria, algae, and decomposing plant matter gleaned from mud and sediments, and are consumed by blue crabs, rails, egrets, herons, raccoons, and other wildlife. Because they are abundant, relatively immobile natural burrowers, in constant contact with marsh sediments, fiddler crab tissue is appropriate for the evaluation of contaminant uptake. The three species common to New Jersey are *U. pugilator*, *U. pugnax*, and *U. minax*. Their preferred habitats are tidal flats and banks in the intermediate marsh zone, between low and high tide lines. *U. pugilator* is restricted to sandy substrates; *U. pugnax* and *U. minax* are found in muddier areas associated with edges of cordgrass stands.

A. Field Collection

1. Number/mass of fiddler crab tissue required

The sampler should approach the sample location on foot with as little disturbance as possible. (Note: fiddler crabs will run into burrows, but will reappear at entrance soon; collection must rely on patience. BEERA has had success with gently tapping one foot near burrow, and when crabs emerge, inserting a sand spike on an angle such that crabs cannot re-enter borrow.) For each replicate, approximately 15-20 crabs, with hard carapace, shall be hand-collected with dip net or other appropriate sampling device. The number of crabs needed may vary, but must be sufficient to ensure a minimum of a 40-gram tissue sample mass for each segregated composite sample, with the number of replicates considered, as described in A. 2 and 3 below. However, on a case-specific basis, the sample collector and laboratory must coordinate on the sample mass required, so that analytical detection limits required to support the data quality objectives of the monitoring study can be achieved.

2. Sample compositing

Crabs shall be composited according to age and sex (i.e., juvenile males, juvenile females, adult males, adult females) in order to avoid confounding the data with lipid concentrations and exposure durations that would be variable by sample group. For example, gravid females included with only some of the sample composites and at different proportions could dramatically increase contaminant residues in tissue. Mature males, on the other hand, have an oversize claw, and the muscle tissue generally has lower contaminant concentrations than the more lipid-rich digestive and reproductive organs. The inclusion of more males in a composite sample may cause contaminant concentrations to be lowered by differences in sex rather than site conditions. Since mature males have an oversized claw, if weight is used to determine the age, males may be placed different age class than similarly aged females. Thus, tissue analyses on organisms not segregated by sex and age can introduce undesirable variability and misleading results. If adequate sample mass within these groups cannot be collected, the collection effort should be extended until adequate mass is collected. If adequate mass cannot be collected after the extended effort, the data collection should be dropped for that group at that station.

The standard method for aging fiddler crabs is measuring the width of carapace. For reference, the carapace of adult male *U. pugilator* is 17 mm in length and 26 mm in width; the adult female is 14 mm in length and 19 mm in width. For *U. pugnax,* the carapace measurement of the adult male is 15 mm in length and 23 mm in width; the adult female is 13 mm in length and 18 mm in width [1]. (Note: information on carapace measurement *for U. minax* not available at time of draft guideline preparation.)

The sex of fiddler crabs should be easily discernable from examination of the chelipeds. Females have two tiny chelipeds that resemble pincers; males have one cheliped that is at least four times larger than the other (can be 50% as massive as the other male crab body parts combined).

3. Sample replicates

Between 3- 5 replicate samples per location, for each age/size and sex class, should be independently analyzed to provide for a statistically sound monitoring program; each sampling location is treated as a distinct population, and can be compared to a reference location to determine tissue burden differences.

4. Species identification

It must be confirmed through taxonomic classification that only one species of fiddler crab is being encountered in the monitoring area; if more than one species is present, it would further complicate the issue of size difference. (Note: the red-jointed fiddler crab, *U. minax,* sometimes co-occurs with the smaller mud fiddler crab, *U. pugnax*; adults of *U. pugnax* could be confused with juvenile *U. minax* where their ranges overlap.) References must be proved for the keys used for species identification.

5. Sample timing and locations

Fiddler crab should be collected in the late summer/ fall of the year.

Fiddler crabs and corresponding sediment sample should be co-located in a depositional area and collected at the same time/same tidal cycle. If the sediment sample has been obtained first, the fiddler crabs should be captured as close to the corresponding sediment sample location as possible; distance between the two sample locations must be recorded.

6. Sample collection data sheets

Fiddler crab field collection data sheets must contain records of individual weights and carapace width. A visual inspection of physical appearance, health, behavior, and reproductive success must be conducted at each sample location and recorded on field collection data sheets. For example, check for individual representatives of life stages (i.e., juvenile, adult), males jousting and posing, preening feeding, etc. Reproductive success can be assumed by large numbers of very small crabs, females carrying egg masses, etc. Inspect for missing cheliped, signs of chemical burns, stains, tumors, aberrations in appendages, etc, and record all observations.

7. Sample shipment

Prior to shipment to laboratory, rinse specimens with distilled water to remove adhering sediment, place in aluminum foil, enclose in ziploc bag and freeze. Samples must arrive at laboratory in a timely manner to ensure that analytical sample holding times can be met.

B. Laboratory analysis

1. Tissue preparation and analysis

Crabs must be allowed to depurate for 24 hours prior to analysis.

The laboratory shall submit internal SOP for tissue sample preparation (homogenization, extraction), chemical analyses, and lipid analyses to NJDEP for review and approval prior to commencement of field work.

Tissue analyses for contaminants (whole body) shall be based on USEPA SW846, 3rd Ed., Final Update III, or equivalent. (NOTE: see Reference section for other suggested references for tissue evaluation.)

Percent lipids shall be determined by AOAC, Procedure 948.15 (AOAC, 1990), or equivalent method.

2. Laboratory quality control

One matrix spike (MS) and one matrix spike duplicate sample (MSD) shall be incorporated per sample batch.

C. Data Reporting

Tissue concentrations shall be reported for each age/size and sex class as lipid normalized, in accordance with the following calculation:

Lipid Normalized concentration = Tissue concentration/(% lipid/100).

Tissue data shall be reported on a dry weight basis, to enable comparison with dry weight sediment concentrations.

D. Suggested references for further information

NOAA, 1993. Sampling and Analytical Methods of the National Status and Trends program, National Benthic Surveillance and Mussel Watch Projects, 1984-1992. Volume IV. Comprehensive Descriptions of Trace Organic Analytical Methods. NOAA Technical Memorandum NOS ORCA 71.

"USEPA, 1995. Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories, Volume 1, Fish Sampling and analysis, 2nd edition.

E. References

1. Zhong, He (undated). Common Florida Fiddler Crabs (*Uca* spp.) EntGuide, Public Health Entomology Research & Education Center, Florida A & M University.
   Available at http://www.pherec.org/entguides

Note: NJDEP instructed Weston (via telephone call to Paul Bovitz on 20 July 2005) to change procedure to require analysis of whole-body samples instead of carapace-removed samples.

APPENDIX J

IMMUNOASSAY FIELD SCREENING METHOD FOR TNT, PCBS, AND PAHS

STRATEGIC DIAGNOSTICS INC.

TNT EnSys® SOIL TEST SYSTEM

RAPID FIELD SCREEN

User's Guide

IMPORTANT NOTICE

The range of this test is between 1 and 30 ppm TNT/TNB/DNT. The relative standard deviation is 8% The least detectable concentration is 0.7 ppm (TNT).

This test system should be used only under the supervision of a technically qualified individual who is capable of understanding any potential health and environmental risks of this product as identified in the product literature. The components must only be used for the analysis of soil samples for the presence of TNT. After use, the kits must be disposed of in accordance with applicable federal and local regulations.

PHASE 1 TEST PREPARATION

READ ALL INSTRUCTIONS BEFORE PROCEEDING WITH THE TEST

ITEMS INCLUDED IN TEST KIT

☐ **2 Cuvette stopper plugs**
☐ **1 Ampule cracker**
☐ **20 Syringe filters**
☐ **20 Wooden spatulas**
☐ **20 Extraction jars**
☐ **1 Bulb pipette**
☐ **1 Developer solution**
☐ **1 - 50mL graduated conical tube**
☐ **1 TNT control ampule**
☐ **20 - 30cc syringes**
☐ **20 Weigh boats**

ITEMS NOT INCLUDED IN TEST KIT

☐ **2 matched HACH cuvettes**
☐ **Paper towels**
☐ **Disposable gloves**
☐ **Acetone**
☐ **Hach DR/2000 or DR/2010**
☐ **Calculator**
☐ **Waste container**
☐ **Balance**

READ BEFORE PROCEEDING

- For some matrices, air drying the soil samples may result in better TNT recovery or more reproducible data.
- A slightly modified protocol should be used if the primary analyte of concern is DNT. Please refer to the modification outlined on page 6.
- It is recommended that a control be run each day. See page 8 for instructions.
- SDI's EnSys® TNT Soil Test System is designed for use with either of Hach models **DR/2000** or the newer **DR/2010** spectrophotometers. Protocols for use of both instruments are provided in this User's Guide. Ensure the instrument protocol followed is appropriate for the instrument being used.
- The Hach DR/2000 is designed to turn off after a few minutes of inactivity. Press the "READ/ENTER" key every few minutes to prevent DR/2000 from turning off. If DR/2000 turns off, use Reference cuvette to rezero. Newer DR/2000 models and the DR/2010 have an overide "constant on" feature that allows the machine to run indefinitely. Refer to the Instrument Operation: Spectrophotometer Setup section of the HACH DR/2000 or DR/2010 User's manuals.

If you are using the TNT test in conjunction with the RDX test it is important to save your sample extracts. They will be used in the RDX test. Remember to cap the extracts tightly after use. An RDX kit without extraction set-ups can be purchased specifically for this purpose.

PHASE 1 TEST PREPARATION

READ ALL INSTRUCTIONS BEFORE PROCEEDING WITH THE TEST

CLEAN CUVETTES

Cuvette

Cuvette stopper

1b

1a Fill 2 Hach matched cuvettes with approximately 5 mL water.

1b Cap each with cuvette stopper plug and, holding plug in place, shake vigorously for 3 seconds.

1c Empty into waste container.

1d Fill cuvettes with approximately 5 mL acetone.

1e Cap each with cuvette stopper plug and, holding plug in place, shake vigorously for 3 seconds.

1f Empty into waste container.

1g Repeat acetone wash (steps 1d - 1f).

1h Wipe outside of cuvette with paper towels. Take care to especially clean the side labeled "25 mL" and the side opposite.

PHASE 1 TEST PREPARATION

READ ALL INSTRUCTIONS BEFORE PROCEEDING WITH THE TEST

READ BEFORE PROCEEDING

- Designate a "Reference" and "Sample" cuvette.

SPECTROPHOTOMETER PREPARATION

2a1 Turn on Hach **DR/2000**. The instrument will read "SELF-TEST" followed by "Method?". Select Method "0" and press the "READ/ENTER" key.

or

2a2 Turn on the Hach **DR/2010**. The instrument will read "Self-Test V.xx", then "Enter Program #". Press the [Shift] key (do not hold) and then the [ABS/8] key. Note: Select Program # "0" may also be used to select absorbance mode on the DR/2010.

2b Rotate the wavelength dial until the small display shows: 540 nm.

2c Fill both cuvettes with acetone to the 25 mL line.

2d Insert "Reference" cuvette into cell holder on Hach DR/2000 or DR/2010 with side marked "25 mL" on the right.

2e1 Close light shield of the **DR/2000** and press "CLEAR/ZERO" key to establish the reference. The display will read "WAIT" and then "0.000 Abs.".

or

2e2 Close the light shield of the **DR/2010** and press the [ZERO] key. The display will read "Zeroing..." then "0.000 Abs.".

2f Remove the "Reference" cuvette and place the "Sample" cuvette in the cell holder.

2g1 On the **DR/2000**, press the "READ/ENTER" key and record the absorbance on the worksheet as "Abs$_{\text{background}}$".

or

2g2 On the **DR/2010**, press the [READ] key and record the absorbance on the worksheet as "Abs$_{\text{background}}$".

2h If reading is greater than 0.002 in magnitude (+ or -), clean cuvettes and redo steps 2a - 2g.

2i Empty acetone from "Sample" cuvette into waste container.

Cuvette

PHASE 2 SAMPLE EXTRACTION & PREPARATION

READ ALL INSTRUCTIONS BEFORE PROCEEDING WITH THE TEST

READ BEFORE PROCEEDING

- Sample should be mixed to ensure a homogeneous sample.

WEIGH SAMPLE

3c

3a Place an unused weigh boat on pan balance.

3b Press ON/MEMORY button on pan balance. Balance will beep and display 0.0.

3c Weigh out 10+/- 0.1 grams of soil.

3d If balance turns off prior to completing weighing, use empty weigh boat to retare, then continue.

EXTRACT TNT

4b

4a Measure 50 mL acetone in the 50mL graduated conical tube.

4b Pour acetone into an extraction jar.

4c Using wooden spatula, transfer 10 grams of soil from weigh boat into extraction jar.

4d Recap extraction jar tightly and shake vigorously for three minutes.

4e Allow to settle for five minutes.

Repeat steps 3a - 4e for each sample to be tested.

FILTER SAMPLE

5a

5a Place tip of 30 cc syringe into liquid above the sediment layer in the extraction jar and draw up 25 mL of the sample.

5b Screw the syringe filter onto the end of the syringe.

5c Press the plunger firmly and dispense the sample into the "Sample" cuvette.

Weigh Boat

Pan balance

Wooden spatula

50mL Graduated Conical Tube

Extraction jar

Syringe filter

30 cc syringe

Cuvette

PHASE 3 SAMPLE ANALYSIS

READ ALL INSTRUCTIONS BEFORE PROCEEDING WITH THE TEST

READ SAMPLE

6a

6a Place the "Sample" cuvette in the cell holder.

6b Press the "READ/ENTER" key and record the absorbance on the worksheet as "Abs$_{initial}$".

6c Remove the "Sample" cuvette from the cell holder.

6d Add 1 drop of Developer Solution.

6e Cap the "Sample" cuvette and shake vigorously for 3 seconds.

Cuvette

DNT Analysis Note:

For analysis of samples containing DNT, and/or where DNT concentration is of concern, samples must be allowed to develop for 10 minutes before reading sample absorbance. This will not effect color development for other nitroaromatics.

6f Remove the cuvette stopper and place the "Sample" cuvette in the cell holder.

6g Press the "READ/ENTER" key and record the absorbance on the worksheet as "Abs$_{sample}$".

6h Clean cuvette between samples using procedure in steps 1a - 1h.

PHASE 4 INTERPRETATION

READ ALL INSTRUCTIONS BEFORE PROCEEDING WITH THE TEST

INTERPRETATION OF RESULTS

7a Multiply the "$\text{Abs}_{\text{initial}}$" value for each sample by 4. Enter these values on the worksheet.

7b Subtract this value from the "$\text{Abs}_{\text{sample}}$" values for each sample and record on the worksheet.

7c Divide the adjusted sample value by 0.0323 and record on the worksheet. This value is the TNT concentration of the sample in parts per million.

$$\text{TNT}_{(\text{ppm})} = \frac{\text{Abs}_{\text{sample}} - (\text{Abs}_{\text{initial}} \times 4)}{0.0323}$$

Note: For sample concentrations greater than 30ppm the sample extract should be diluted with acetone and reanalyzed. Remember to multiply the result by the dilution factor in order to determine the correct concentration.

CONTROL (QA/QC) CHECK

READ ALL INSTRUCTIONS BEFORE PROCEEDING WITH THE TEST

- **The TNT control is optional, but it is recommended that it be run daily.**

PREPARE CONTROL

1. Measure 50 mL acetone in the 50mL graduated conical tube.
2. Pour into extraction jar.
3. Open TNT control ampule by slipping ampule cracker over top, and then breaking tip at scored neck.
4. Transfer entire contents of TNT control ampule into extraction jar using bulb pipette.
5. Cap extraction jar and shake vigorously for 3 seconds.

Ampule cracker

TNT control

50mL Graduated Conical Tube

Extraction jar

Bulb pipett

ANALYZE THE CONTROL

7. Place tip of 30 cc syringe in extraction jar and draw up 25 mL.
8. Attach syringe filter and dispense into "Sample" cuvette.
9. Add 1 drop of developer solution.
10. Cap the cuvette and shake vigorously for 3 seconds.
11. Remove the cuvette stopper and place in the cell holder.
12. Press "READ/ENTER" key and record the absorbance on the worksheet as "$\text{Abs}_{\text{control}}$".

    Absorbance must be between 0.307 - 0.373 for the test to be in control.

    If test is not in control, clean "Sample" cuvette, and then redo steps 7-12 using the remaining liquid from the extraction jar.
13. If test is in control clean "Sample" cuvette before proceeding with samples.

Syringe filter

30 cc syringe

Cuvette

Cuvette stopper

Developer solution

QUALITY CONTROL

READ ALL INSTRUCTIONS BEFORE PROCEEDING WITH THE TEST

System Description

Each SDI EnSys® TNT Soil Test System contains enough material to perform twenty complete tests.

The TNT Soil Test is divided into four phases. The instructions and notes should be reviewed before proceeding with the test.

Hotline Assistance

If you need assistance or are missing necessary Test System materials, call toll free: 1-800-544-8881.

Validation Information

Product claims are based on validation studies carried out under controlled conditions. Data has been collected in accordance with valid statistical methods and the product has undergone quality control tests of each manufactured lot.

Strategic Diagnostics Inc. does not guarantee that the results with the TNT Soil Test System will always agree with instrument-based analytical laboratory methods. All analytical methods, both field and laboratory, need to be subject to the appropriate quality control procedures.

How It Works

Controls, Samples, and color-change reagents are added to cuvettes. The concentration of TNT in an unknown **Sample** is determined by evaluating how much color is developed.

Quality Control

Standard precautions for maintaining quality control:

- Do not use reagents or components from one Test System with reagents or components from another Test System.
- Do not use the Test System after its expiration date.
- The sample must be analyzed immediately after adding the Developer Solution.
- Results may not be valid if DR/2000 reading for **Control** is outside of the range of 0.307 - 0.373.

Storage and Handling Precautions

- Wear protective gloves and eye wear.
- Store kit at room temperature and out of direct sunlight (less than 80°F).
- If acetone comes into contact with eyes, wash thoroughly with cold water and seek immediate medical attention.
- Operate test at temperatures greater than 4° C/40° F and less than 39° C/100° F.
- After use, dispose of kit components in accordance with applicable federal and local regulations.

ON-SITE QUALITY CONTROL/QUALITY ASSURANCE RECOMMENDATIONS
SDI EnSys® TEST SYSTEM

Please read the following before proceeding with field testing.

SAMPLING

The result of your screening test is only as valid as the sample that was analyzed. Samples should be homogenized thoroughly to ensure that the 10 grams you remove for field testing is representative of the sample as a whole. All other applicable sample handling procedures should be followed as well.

PRIOR TO TESTING SAMPLES

Carefully follow the instructions in the User's Guide included with every test kit. This is the key element in obtaining accurate results. In addition, store your unused test kits at room temperature and do not use them past their expiration date (see label on each test kit).

INTERNAL TEST QC

One control is provided with each Kit to provide internal test system quality control. Test runs resulting in a number that falls outside of the specified range should be repeated to ensure valid conclusions.

QA/QC

The validity of field test results can be substantially enhanced by employing a modest, but effective QA/QC plan. SDI recommends that you structure your QA/QC plan with the elements detailed below. These have been developed based on the data quality principles established by the U.S. Environmental Protection Agency.

A. **Sample Documentation**
   1. Location, depth
   2. Time and date of collection and field analysis

B. **Field analysis documentation** - provide raw data, calibration, any calculations, and final results of field analysis for all samples screened (including QC samples)

C. **Method calibration** - this is an integral part of SDI tests; a TNT control analysis should be performed daily (see the instructions in the User's Guide)

D. **Method blank** - field analyze fresh acetone

E. **Site-specific matrix background field analysis** - collect and field analyze uncontaminated sample from site matrix to document matrix effect

F. **Duplicate sample field analysis** - field analyze duplicate sample to document method repeatability; at least one of every 20 samples should be analyzed in duplicate

G. **Confirmation of field analysis** - provide confirmation of the quantitation of the analyte via an EPA-approved method different from the field method on at least 10% of the samples; provide chain of custody and documentation such as gas chromatograms, mass spectra, etc.

H. **Performance evaluation sample field analysis (optional, but strongly recommended)** - field analyze performance evaluation sample daily to document method/operator performance

I. **Matrix spike field analysis (optional)** - field analyze matrix spike to document matrix effect on analyte measurement

FURTHER QUESTIONS?

SDI's Technical Support personnel are always prepared to discuss your quality needs to help you meet your data quality objectives. Call 1-(800) 544-8881.

TNT SOIL TEST - ABBREVIATED PROCEDURE

STEP	PROCEDURE
1	• Clean cuvettes • Zero the spectrophotometer at 540 nm
2	• Add 10 g soil and 50 ml acetone to extraction jar • Shake 3 minutes, let settle • Draw up 25 mL extract, filter into cuvette
3	• Read $\text{Abs}_{\text{initial}}$, record • Add 1 drop developer solution, shake • Read $\text{Abs}_{\text{sample}}$,record
4	• Multiply $\text{Abs}_{\text{initial}}$ by 4 • Subtract from $\text{Abs}_{\text{sample}}$ • Divide by 0.0323 • $\text{TNT}_{(\text{ppm})} = \dfrac{\text{Abs}_{\text{sample}} - (\text{Abs}_{\text{initial}} \times 4)}{0.0323}$

TNT SOIL TEST KIT WORKSHEET

$\text{Abs}_{\text{background}}$ ____________ $\text{Abs}_{\text{control}}$ ________________

1	2	3	4	5	6
SAMPLE #	$\text{Abs}_{\text{initial}}$	$\text{Abs}_{\text{sample}}$	$\text{Abs}_{\text{initial}}$ x4	$\text{Abs}_{\text{final}}$ (Column 3 - Column 4)	TNT CONC ppm (Column 5/0.0323)

METHOD 4050

TNT EXPLOSIVES IN SOIL BY IMMUNOASSAY

1.0 SCOPE AND APPLICATION

1.1 Method 4050 is a procedure for screening soil samples to determine when trinitrotoluene (TNT, CAS No. 118-96-7) is present at concentrations above 0.5 mg/kg. Method 4050 provides an estimate for the concentration of TNT by comparison with a reference.

1.2 Using the test kit from which this method was developed, 93% of soil samples containing 0.25 ppm or less of TNT will produce a negative result, and 99+% of soil samples containing 1.0 ppm or greater of TNT will produce a positive result.

1.3 In cases where the exact concentrations of TNT are required, quantitative techniques (i.e., Method 8330) should be used.

1.4 This method is restricted to use by or under the supervision of trained analysts. Each analyst must demonstrate the ability to generate acceptable results with this method.

2.0 SUMMARY OF METHOD

2.1 Test kits are commercially available for this method. The manufacturer's directions should be followed.

2.2 In general, the method is performed using an extract of a soil sample. Samples and an enzyme-TNT conjugate reagent are added to a immobilized TNT antibody. The enzyme-TNT conjugate "competes" with TNT present in the sample for binding to the immobilized TNT antibody. The enzyme-TNT conjugate bound to the TNT antibody then catalyzes a colorless substrate to a colored product. The test is interpreted by comparing the color produced by a sample to the response produced by a reference reaction.

3.0 INTERFERENCES

Chemically similar compounds and compounds that might be expected to be found in conjunction with TNT contamination were tested to determine the concentration required to produce a positive test result. Table 1 provides the concentrations of compounds tested with the D TECH™ test kit that are required to elicit a positive response at the MDL, as well as the concentration required to yield 50% inhibition compared to the standard curve.

4.0 APPARATUS AND MATERIALS

Immunoassay test kit: D TECH™ TNT (Strategic Diagnostics Inc.), or equivalent. Each commercially available test kit will supply or specify the apparatus and materials necessary for successful completion of the test.

5.0 REAGENTS

Each commercially available test kit will supply or specify the reagents necessary for successful completion of the test.

6.0 SAMPLE COLLECTION, PRESERVATION, AND TRANSPORTATION

6.1 See the introductory material to this chapter, Organic Analytes, Sec. 4.1.

6.2 Soil samples may be contaminated, and should therefore be considered hazardous and handled accordingly.

7.0 PROCEDURE

Follow the manufacturer's instructions for the test kit being used. Those test kits used must meet or exceed the performance specifications indicated in Tables 3-6.

8.0 QUALITY CONTROL

8.1 Follow the manufacturer's instructions for the test kit being used for quality control procedures specific to the test kit used. Additionally, guidance provided in Chapter One should be followed.

8.2 Use of replicate analyses, particularly when results indicate concentrations near the action level, is recommended to refine information gathered with the kit.

8.3 Do not use test kits past their expiration date.

8.4 Do not use tubes or reagents designated for use with other test kits. Do not mix reagents from one kit lot with a different kit lot.

8.5 Use the test kits within their specified storage temperature and operating temperature limits.

8.6 Method 4050 is intended for field or laboratory use. The appropriate level of quality assurance should accompany the application of this method to document data quality.

9.0 METHOD PERFORMANCE

9.1 Table 1 provides data on the minimum concentrations of possible interferants and co-contaminants required to elicit a positive response in the test kits evaluated.

9.2 Twenty five soil samples, known to not be contaminated with TNT, were extracted and analyzed using the D TECH™ TNT kit to determine the extent of soil matrix effects on the performance of the test kit. The results are provided in Table 2, and show that false positive results are not attributable to soil components.

9.3 Thirty soil samples, known to not be contaminated with TNT, were each spiked with TNT at one-half and two times the MDL (0.25 and 1.0 ppm respectively). These samples were analyzed with the D TECH™ TNT test kit to determine the error rate of the assay. The results are presented in Table 3 .

9.4 Ten different soil types, all known to not be contaminated with TNT, were spiked with an acetone solution containing approximately 1.0 ppm TNT. This spiking solution was later quantitated by Method 8330 and found to contain 0.77 ppm TNT. The spiked soil samples were analyzed three (3) times with the D TECH™ kit to determine the extraction efficiency of the method. The data are presented in Table 4.

9.5 Table 5 presents the results of analysis of three soils spiked at approximately 1 and 3 ppm TNT. Each sample was analyzed once using Method 8330 and ten times using the D TECH™ kit.

9.6 Tables 6A and 6B present the results of two field trials. In each trial, soil samples were obtained at a West Coast site from borings, using a split spoon technique. The samples were homogenized by placing approximately six cubic inches of soil into a stainless steel vessel and mixing for five minutes with a stainless steel trowel. The soil was aliquotted into two (2) six ounce glass bottles, tested on-site using the D TECH™ method and transported to commercial laboratories (one laboratory per field trial) for analysis by Method 8330. Table 6C presents the results of a third party field trial, conducted by the California Department of Health Services.

10.0 REFERENCES

1. D TECH™ TNT Users Guide , SDI/EM Sciences 1994

2. Hutter,L., G. Teaney, and J.W.Stave, "A Novel Field Screening System for TNT Using EIA", in Field Screening Methods for Hazardous Wastes and Toxic Chemicals, Vol 1, Proceedings of the 1993 U.S. EPA/A&WMA International Symposium, p.472, 1993.

3. Teaney, G., J.Melby, L.Hutter and J.Stave, "A Novel Field Analytical Method for TNT", Proceedings of the American Association of Analytical Chemists, 1993.

4. Haas, R.J., and B.P. Simmons, "Measurement of Trinitrotoluene (TNT) and Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX) in Soil by Enzyme Immunoassay and High Performance Liquid Chromatography (EPA Method 8330)", California Environmental Protection Agency, Department of Toxic Substances Control, Hazardous Materials Laboratory, March, 1995.

TABLE 1

CROSS REACTANTS
D TECH™ TNT TEST KIT

COMPOUND	MDL[a] (ppm)	IC 50[b] (ppm)	% CROSS REACTIVITY[c]
TNT (2,4,6-trinitrotoluene)	0.5	17	100
Tetryl[d]	3	48	35
1,3,5-trinitrobenzene	4	75	23
2-amino-4,6-dinitrotoluene	13	150	11
4-amino-2,6-dinitrotoluene	>500	>500	<1
2,4-dinitrotoluene	90	390	4
2,6-diaminonitrotoluene	>500	>500	<1
2-nitrophenol	>500	>500	<1
4-nitrophenol	>500	>500	<1
2,4-dinitrophenol	>500	>500	<1
RDX[d]	>500	>500	<1
HMX[d]	>500	>500	<1

The following compounds were not detected at or above 100 ppm:

Benzene
Ethylbenzene
Xylenes
Toluene
PCB 1254
PCP
Triazine

PAHs - an equal concentration mixture of:

Acenaphthene
1,2-Benzanthracene
Benzo(b)fluoranthene
Benzo(ghi)perylene
Benzo(k)fluoranthene
Dibenz(ah)anthracene
Acenaphthalene
Benzo(a)pyrene
Chrysene
Fluoranthene
Indeno(123-cd)pyrene
Anthracene
Pyrene
Phenanthrene
Fluorene
Naphthalene

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[a] The Method Detection Limit (MDL) is defined as the lowest concentration of compound that yields a positive test result.

[b] The IC$_{50}$ is defined as the concentration of compound required to produce a test response equivalent to 50% of the maximum response.

[c] % Cross reactivity is determined by dividing the equivalent TNT concentration by the actual compound concentration at IC$_{50}$

[d] Tetryl = methyl-2,4,6-trinitrophenylnitramine
RDX = hexahydro-1,3,5-trinitro-1,3,5-triazine
HMX = octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine

TABLE 2

SOIL MATRIX EFFECTS

Soil	Soil type		D TECH™ RANGE (ppm)
133	Avonburg Fine Sine Silt	N/A	<0.5
101	Matapeake Silt Loam	DE	<0.5
100	Clay Loam	DE	<0.5
102	Sassafras Sand Loam	DE	<0.5
106	Evesboro Low Organic Sand	DE	<0.5
107	Pokomoke High OM Sand	DE	<0.5
109	Davidson Clay Loam	GA	<0.5
111	Shontic Casa Grande Sand	AZ	<0.5
112	Casa Grande Clay Loam	AZ	<0.5
113	Trix Sand Clay Loam	AZ	<0.5
114	Trix Casa Grande Clay Loam	AZ	<0.5
115	Yolo Loam	CA	<0.5
116	Capay Silt Clay	CA	<0.5
117	Sycamore Silt Loam	CA	<0.5
118	Dennis Silt Loam	KS	<0.5
119	Grundy Silt Clay Loam	KS	<0.5
120	Luray Silt Clay Loam	OH	<0.5
121	Wooster Silt Loam	OH	<0.5
122	Vienna Loam	SD	<0.5
123	Opal Clay	SD	<0.5
124	Raub Silt Loam	IN	<0.5
125	Rockfield Silt Loam	IN	<0.5
127	Cisne	IL	<0.5
128	Muscatine Loam	IL	<0.5
130	Sandy Brae	DE	<0.5

TABLE 3

FALSE NEGATIVE AND FALSE POSITIVE RATES, SOIL MATRIX[a]

Spike Concentration	False Positive Rate	False Negative Rate
0.25 ppm	7%	-
1.0 ppm	-	0%

[a] Thirty negative soils were spiked with TNT at one-half and two times the MDL (0.25 and 1.0 ppm respectively). These samples were analyzed with the D TECH™ TNT test kit to determine the error rate of the assay.

TABLE 4

DETERMINATION OF EXTRACTION EFFICIENCY FROM SOIL SAMPLES[a]

SOIL ID	MEAN TNT CONC. (ppm)	SD	%CV	%RECOVERY
101	0.54	0.04	7	70
106	0.64	0.06	9	84
108	0.87	0.18	20	113
109	0.63	0.08	13	82
110	0.88	0.15	17	115
116	1.02	0.15	17	115
117	0.82	0.15	15	132
123	0.87	0.23	26	113
126	0.95	0.26	28	123
128	0.65	0.11	16	84
SPIKING SOLUTION	0.77	N/A	N/A	100

[a] Ten different TNT negative soils were spiked with an acetone solution containing 0.77 TNT. The spiked soil samples were analyzed three times with the D TECH™ kit to determine the extraction efficiency of the method.

TABLE 5
RECOVERY OF TNT SPIKED INTO REAL SOILS

Three (3) soils were spiked at approximately 1 and 3 ppm TNT. Each sample was analyzed once by Method 8330 and ten (10) times by the D TECH™ TNT immunoassay test product.

SAMPLE ID	AMOUNT SPIKED	D TECH™ (ppm)	HPLC METHOD 8330	AGREEMENT Y, FN, FP
106-1	1.0	0.5 - 1.5	0.69	Y
		0.5 - 1.5		Y
		0.5 - 1.5		Y
		0.5 - 1.5		Y
		0.5 - 1.5		Y
		0.5 - 1.5		Y
		0.5 - 1.5		Y
		0.5 - 1.5		Y
		0.5 - 1.5		Y
		1.5 - 3.0		FP
116-1	1.0	0.5 - 1.5	0.73	Y
		0.5 - 1.5		Y
		1.5 - 3.0		FP
		0.5 - 1.5		Y
		0.5 - 1.5		
		0.5 - 1.5		Y
		0.5 - 1.5		Y
		0.5 - 1.5		Y
		0.5 - 1.5		Y
		1.5 - 3.0		FP
128-1	1.0	0.5 - 1.5	0.75	Y
		0.5 - 1.5		Y
		0.5 - 1.5		Y
		0.5 - 1.5		Y
		0.5 - 1.5		Y
		1.5 - 3.0		FP
		0.5 - 1.5		Y
		0.5 - 1.5		Y
		0.5 - 1.5		Y
		0.5 - 1.5		Y

TABLE 5 (cont.)

RECOVERY OF TNT SPIKED INTO REAL SOILS

SAMPLE ID	AMOUNT SPIKED	D TECH™ (ppm)	HPLC METHOD 8330	AGREEMENT[a] Y, FN, FP
106-3	3.0	1.5 - 3.0	1.53	Y
		1.5 - 3.0		Y
		1.5 - 3.0		Y
		0.5 - 1.5		Y
		1.5 - 3.0		Y
		1.5 - 3.0		Y
		1.5 - 3.0		Y
		1.5 - 3.0		Y
		1.5 - 3.0		Y
		0.5 - 1.5		Y
116-3	3.0	1.5 - 3.0	2.12	Y
		1.5 - 3.0		Y
		1.5 - 3.0		Y
		1.5 - 3.0		Y
		1.5 - 3.0		Y
		1.5 - 3.0		Y
		1.5 - 3.0		Y
		1.5 - 3.0		Y
		0.5 - 1.5		N
		1.5 - 3.0		Y
128-3	3.0	0.5 - 1.5	2.07	FN
		1.5 - 3.0		Y
		1.5 - 3.0		Y
		1.5 - 3.0		Y
		1.5 - 3.0		Y
		1.5 - 3.0		Y
		1.5 - 3.0		Y
		1.5 - 3.0		Y
		1.5 - 3.0		Y
		1.5 - 3.0		Y

TABLE 6A

COMPARISON OF D TECH™ SOIL RESULTS WITH METHOD 8330

SAMPLE ID	D TECH™ RANGE (ppm)	METHOD 8330 TNT (ppm)	AGREEMENT[a] Y, FN, FP
61-1	< 0.2	< 0.09	Y
61-10	< 0.2	< 0.09	Y
61-11	< 0.2	< 0.09	Y
61-12	< 0.2	< 0.09	Y
61-13	< 0.2	< 0.09	Y
61-14	< 0.2	< 0.09	Y
61-15	< 0.2	< 0.09	Y
61-16	< 0.2	< 0.09	Y
61-17	< 0.2	< 0.09	Y
61-18	< 0.2	< 0.09	Y
61-19	< 0.2	< 0.09	Y
61-2	> 1.5	> 3.0	Y
61-20	< 0.2	< 0.09	Y
61-21	0.5-1.0	2.44	FN
61-22	< 0.2	< 0.09	Y
61-23	< 0.2	< 0.09	Y
61-24	1.0-1.5	1.4	Y
61-25	< 0.2	< 0.09	Y
61-26	< 0.2	< 0.09	Y
61-27	0.2-0.5	0.27	Y
61-28	< 0.2	< 0.09	Y
61-29	< 0.2	< 0.09	Y
61-3	1.0-1.5	1.3	Y
61-30	< 0.2	< 0.09	Y
61-4	> 1.5	1.1	FP
61-5	0.5 - 1.0	1.0	Y
61-6	> 1.5	> 3.0	Y
61-7	< 0.2	< 0.09	Y
61-8	0.5-1.0	1.0	Y
61-9	0.2-0.5	0.56	Y
TET-1	0.5-1.0	< 0.09	FP
TET-2	< 0.2	< 0.09	Y

TABLE 6A (cont.)

SAMPLE ID	D TECH™ RANGE (ppm)	METHOD 8330 TNT (ppm)	AGREEMENT[a] Y, FN, FP
TET-3	< 0.2	< 0.09	Y
TL-1	0.2-0.5	0.99	FN
TL-2	> 1.5	1.2	FP
TL-3	> 1.5	> 3.0	Y
TL-4	0.2-0.5	0.66	FN
TL-5	> 1.5	> 3.0	Y
TL-6	0.2-0.5	0.66	FN
TL-7	0.2-0.5	0.71	FN
TL-8	0.5-1.0	1.46	FN
TL-9	0.2-0.5	0.92	FN

Y = Yes, FN = False Negative, FP = False Positive

TABLE 6B

COMPARISON OF D TECH™ SOIL RESULTS WITH METHOD 8330

Sample Number	D TECH™ Range (ppm)	8330 TNT (ppm)	8330 TNB (ppm)	TNT Equivalent (ppm)	AGREEMENT Y, FN, FP
1	> 1.5	5.75	< 1.0	5.75-6.0	Y
2	> 1.5	3.32	< 1.0	3.32-3.57	Y
3	> 1.5	166	< 1.0	166	Y
4	> 1.5	2500	18.50	2504	Y
5	> 1.5	2.72	< 1.0	2.72-2.97	Y
6	> 1.5	<2.0	7.02	1.76-3.76	Y
7	> 1.5	<2.0	5.12	1.28-3.28	Y
8	> 1.5	140	12.2	143	Y
9	> 1.5	230	20.2	235	Y
10	> 1.5	1100	16.9	1104	Y
11	> 1.5	23.5	11.5	26.0	Y
12	0.5 - 1.0	<2.0	2.95	0.74-2.74	Y
13	0.5 - 1.0	<2.0	1.30	0.33-2.33	Y
14	0.5 - 1.0	<2.0	1.89	0.47-2.47	Y
15	> 1.5	<2.0	3.94	0.99-2.99	Y
16	0.5 - 1.0	<2.0	4.54	1.14-3.14	FN
17	> 1.5	<2.0	4.57	1.14-3.14	Y
18	> 1.5	<2.0	10.5	2.63-4.63	Y
19	> 1.5	3.23	24.3	9.3	Y
20	> 1.5	<2.0	81	20.3	Y
21	> 1.5	<2.0	1.61	0.40-2.40	Y
22	> 1.5	4.75	2.60	5.40	Y
23	> 1.5	<2.0	2.97	0.74-2.74	Y
24	> 1.5	<2.0	6.29	1.57-3.57	Y
25	> 1.5	<2.0	< 1.0	<2.25	Y
26	> 1.5	3.64	5.05	4.90	Y
27	> 1.5	<2.0	6.62	1.66-3.66	Y
28	> 1.5	<2.0	1.94	0.49-2.49	Y
29	> 1.5	<2.0	8.53	2.13-4.13	Y
30	> 1.5	<2.0	6.77	1.69-3.69	Y
31	> 1.5	<2.0	6.75	1.69-3.69	Y
32	> 1.5	<2.0	17.6	4.40-6.41	Y

TABLE 6B (cont.)

Sample Number	D TECH™ Range (ppm)	8330 TNT (ppm)	8330 TNB (ppm)	TNT Equivalent (ppm)	AGREEMENT Y, FN, FP
33	> 1.5	6.39	39.2	16.2	Y
34	> 1.5	4.20	1.39	4.55	Y
35	> 1.5	5.14	< 1.0	5.14-5.39	Y
36	> 1.5	<2.0	2.68	0.67-2.67	Y
37	> 1.5	<2.0	7.65	1.91-3.91	Y
38	> 1.5	<2.0	27.70	6.9-8.9	Y
39	> 1.5	<2.0	9.01	2.25-4.25	Y
40	> 1.5	<2.0	30.90	7.7-9.7	Y
41	> 1.5	<2.0	35.70	8.9-10.9	Y
42	> 1.5	820	5.69	821	Y
43	> 1.5	1200	24.0	1206	Y
44	> 1.5	27.6	11.9	31	Y
45	> 1.5	7.43	9.01	9.70	Y
46	> 1.5	4.98	9.46	7.40	Y
47	> 1.5	3.32	10.4	5.90	Y
48	> 1.5	3.42	16.5	7.60	Y
49	> 1.5	4.32	28.2	11.4	Y
50	> 1.5	7.57	44.8	18.8	Y
50	> 1.5	5.12	81.2	25.4	Y
51	> 1.5	<2.0	1.64	0.41-2.41	Y
52	0.5 - 1.0	<2.0	2.27	0.57-2.57	Y
53	> 1.5	33.5	23.4	39.4	Y
54	> 1.5	2.19	8.43	4.30	Y
55	> 1.5	7.00	11.0	9.75	Y
56	> 1.5	2.84	4.69	4.01	Y
57	> 1.5	<2.0	5.67	1.42-3.42	Y
58	> 1.5	2.23	12.8	5.43	Y
59	> 1.5	5.38	31.4	13.23	Y
60	> 1.5	2.60	13.0	5.85	Y
61	> 1.5	4.43	31.1	12.2	Y
62	> 1.5	4.79	25.9	11.3	Y
63	> 1.5	2.29	18.2	6.8	Y
64	1.0 - 1.5	8.84	148	45.8	FN
65	> 1.5	9.01	< 1.0	9.01	Y
66	> 1.5	29.00	6.02	30.50	Y

TABLE 6B (cont.)

Sample Number	D TECH™ Range (ppm)	8330 TNT (ppm)	8330 TNB (ppm)	TNT Equivalent (ppm)	AGREEMENT Y, FN, FP
67	> 1.5	<2.0	1.30	0.33-2.33	Y
78	> 1.5	<2.0	7.50	1.88-3.88	Y
69	> 1.5	<2.0	4.70	1.18-3.18	Y
70	> 1.5	2.49	30.0	9.99	Y
71	> 1.5	<2.0	29.1	7.28-9.28	Y
72	> 1.5	<2.0	8.86	2.22-4.22	Y
73	> 1.5	<2.0	30.7	7.68-9.68	Y
74	> 1.5	<2.0	38.1	9.59-11.6	Y
75	> 1.5	3.98	183	49.7	Y
76	> 1.5	5.67	122	36.2	Y
77	> 1.5	7.05	< 1.0	7.05-7.3	Y
78	> 1.5	8.04	< 1.0	8.04-8.29	Y
79	> 1.5	1000	7.49	1001	Y
80	0.5 - 1.0	2.12	2.99	2.87	FN
81	0.5 - 1.0	8.83	5.56	10.20	FN
82	1.0 - 1.5	3.64	3.20	4.44	FN
83	> 1.5	3.22	10.6	5.87	Y
84	> 1.5	<2.0	18.3	4.58-6.58	Y
85	> 1.5	<2.0	17.4	4.43-6.43	Y
86	> 1.5	<2.0	20.4	5.10-7.10	Y
87	> 1.5	<2.0	117	29.2-31.2	Y
88	1.0 - 1.5	<2.0	1.96	0.49-2.49	Y
89	> 1.5	351	5.77	352	Y
90	> 1.5	116	39.2	126	Y
91	> 1.5	4.29	3.92	5.27	Y
92	> 1.5	<2.0	11.6	2.9-4.9	Y
93	> 1.5	2.34	9.26	4.66	Y
94	> 1.5	<2.0	48.7	12.2-14.2	Y
95	0.5 - 1.0	<2.0	5.05	1.26-3.26	FN
95	> 1.5	<2.0	12.6	3.15-5.15	Y
96	> 1.5	<2.0	10.7	2.68-4.68	Y
97	> 1.5	<2.0	11.1	2.78-4.78	Y
98	> 1.5	<2.0	3.74	0.94-2.94	Y
99	< 0.2	<2.0	1.88	0.47-2.47	FN
100	> 1.5	4.24	< 1.0	4.24-4.49	Y

TABLE 6B (cont.)

Sample Number	D TECH™ Range (ppm)	8330 TNT (ppm)	8330 TNB (ppm)	TNT Equivalent (ppm)	AGREEMENT Y, FN, FP
101	> 1.5	<2.0	1.10	0.28-2.28	Y
102	0.5 - 1.0	<2.0	1.28	0.32-2.32	Y
103	1.0 - 1.5	<2.0	2.70	0.68-2.68	Y
104	> 1.5	<2.0	10.5	2.63-4.63	Y
105	> 1.5	<2.0	14.1	3.53-5.53	Y
106	> 1.5	<2.0	18.4	4.6-6.6	Y
107	0.5 - 1.0	<2.0	6.35	1.59-3.59	FN
108	1.0 - 1.5	<2.0	6.66	1.67-3.67	FN
109	0.5 - 1.0	<2.0	21.8	5.45-7.45	FN
110	0.5 - 1.0	<2.0	5.29	1.32-3.32	FN
111	0.5 - 1.0	<2.0	4.49	1.12-3.12	FN
112	1.0 - 1.5	<2.0	16.3	4.08-6.08	FN
113	> 1.5	<2.0	28.7	7.18-9.18	Y
114	> 1.5	<2.0	17.7	4.43-6.43	Y
115	> 1.5	<2.0	24.1	6.03-8.03	Y
116	0.2 - 0.5	6.35	< 1.0	6.35-6.6	FN
117	0.5 - 1.0	<2.0	2.40	0.60-2.6	Y
118	0.2 - 0.5	<2.0	4.70	1.18-3.18	FN
119	0.5 - 1.0	<2.0	11.6	2.9-4.9	FN
120	> 1.5	<2.0	56.9	14.2-16.2	Y
121	> 1.5	<2.0	45.6	11.4-13.4	Y
122	> 1.5	<2.0	67.7	16.9-18.9	Y
123	0.2 - 0.5	<2.0	2.78	0.7-2.7	FN
124	< 0.2	<2.0	1.61	0.4-2.4	FN
125	< 0.2	<2.0	4.07	1.02-3.02	FN
126	0.2 - 0.5	<2.0	3.12	0.78-2.78	FN
127 through 279	< 0.2	<2.0	<1.0	<2.25	Y
280 through 365	0.2 - 0.5	<2.0	< 1.0	<2.25	Y
366 through 381	0.5 - 1.0	<2.0	< 1.0	<2.25	Y

TABLE 6B (cont.)

Sample Number	D TECH™ Range (ppm)	8330 TNT (ppm)	8330 TNB (ppm)	TNT Equivalent (ppm)	AGREEMENT Y, FN, FP
382 through 391	1.0 - 1.5	<2.0	< 1.0	<2.25	Y
392 through 399	> 1.5	<2.0	< 1.0	<2.25	Y

Y = Yes, FN = False Negative, FP = False Positive

TABLE 6C

COMPARISON OF D TECH™ SOIL RESULTS WITH METHOD 8330
Third Party Field Trial

Sample	Dilution Factor	D TECH™ Results	8330 TNT Results	8330 TNT+TNB Results	AGREEMENT Y, FN, FP
1	1	<0.5	<0.15	<0.25	Y
2	1	<0.5	<0.15	<0.25	Y
3	1	<0.5	<0.15	<0.25	Y
4	1	0.5-1.5	<0.15	<0.25	FP
5	1	<0.5	<0.15	<0.25	Y
6	1	0.5-1.5	<0.15	<0.25	FP
7	1	<0.5	<0.15	<0.25	Y
8	1	<0.5	<0.15	<0.25	Y
9	1	<0.5	<0.15	<0.25	Y
10	1	<0.5	<0.15	<0.25	Y
11	1	<0.5	<0.15	<0.25	Y
12	1	<0.5	<0.15	<0.25	Y
13	1	<0.5	<0.15	<0.25	Y
14	1	<0.5	<0.15	<0.25	Y
15	1	<0.5	<0.15	<0.25	Y
16	1	0.5-1.5	<0.15	<0.25	FP
17	1	<0.5	<0.15	<0.25	Y
18	1	<0.5	<0.15	<0.25	Y
19	1	0.5-1.5	<0.15	<0.25	FP
20	1	<0.5	<0.15	<0.25	Y
21	1	<0.5	<0.15	<0.25	Y
22	1	<0.5	<0.15	<0.25	Y
23	1	<0.5	<0.15	<0.25	Y
24	1	0.5-1.5	<0.15	<0.25	FP

TABLE 6C (cont.)

Sample	Dilution Factor	D TECH™ Results	8330 TNT Results	8330 TNT+TNB Results	AGREEMENT Y, FN, FP
25	1	<0.5	<0.15	<0.25	Y
26	1	<0.5	<0.15	<0.25	Y
27	1	<0.5	<0.15	<0.25	Y
28	1	0.5-1.5	<0.15	<0.25	FP
29	1	<0.5	<0.15	<0.25	Y
30	1	0.5-1.5	0.15-0.99	0.15-0.99	Y
31	1	<0.5	<0.15	<0.25	Y
32	1	0.5-1.5	<0.15	<0.25	FP
33	1	0.5-1.5	<0.15	<0.25	FP
34	1	0.5-1.5	0.15-0.99	0.15-0.99	Y
35	1	<0.5	<0.15	<0.25	Y
36	1	<0.5	<0.15	<0.25	Y
37	1	3.0-4.0	0.15-0.99	0.25-2.0	FP
38	1	<0.5	<0.15	<0.25	Y
39	1	<0.5	<0.15	<0.25	Y
40	1	<0.5	<0.15	<0.25	Y
41	1	0.5-1.5	<0.15	<0.25	FP
42	1	1.5-3.0	0.15-0.99	0.15-0.99	FP
43	1	<0.5	<0.15	<0.25	Y
44	1	0.5-1.5	<0.15	0.15-0.99	Y
45	1	0.5-1.5	<0.15	<0.25	FP
46	1	0.5-1.5	<0.15	<0.25	FP
47	1	0.5-1.5	<0.15	1.3	Y
48	1	<0.5	<0.15	<0.25	Y
49	1	0.5-1.5	<0.15	<0.25	FP
50	1	<0.5	<0.15	<0.25	Y
51	1	0.5-1.5	<0.15	<0.25	FP
52	10	5-15	1.4	3.2	Y

TABLE 6C (cont.)

Sample	Dilution Factor	D TECH™ Results	8330 TNT Results	8330 TNT+TNB Results	AGREEMENT Y, FN, FP
53	10	40-50	35	41.67	Y
54	1	0.5-1.5	<0.15	<0.15	FP
55	1	0.5-1.5	0.15-0.99	0.15-0.99	Y
56	1	1.5	0.15-0.99	0.15-0.99	Y
57	1	0.5-1.5	<0.15	<0.15	FP
58	1	3.0-4.0	0.15-0.99	0.15-0.99	FP
59	1	0.5-1.5	<0.15	<0.15	FP
60	10	15-30	22	22.48	Y
61	1	0.5-1.5	-	<0.15	FP
62	10	4-40	2.1	32	Y
63	10	5-15	2	3.1	Y
64	100	400-500	360	364	Y
65	1000	4000-5000	6300	6327	Y
66	10000	15000	4000	4027	FP
67	1000	15000	530	547	FP
68	10	5-15	2.8	3.375	Y
69	100	400-500	460	477	Y
70	10	15-30	4.2	6.73	FP
71	10	5-15	1.0	1.57	FP
72	10	40	5.1	34.5	Y
73	10	5-15	1.9	4	Y
74	10	5	1.6	2.7	Y
75	10	4-30	2.2	4.3	Y
76	10	5-15	1.7	2	FP
77	10	5-15	2.2	3.95	Y
78	100	300-400	180	192.19	Y
79	10	5-15	3.1	4.61	Y
80	10	5-15	2.8	5.26	Y

TABLE 6C (cont.)

Sample	Dilution Factor	D TECH™ Results	8330 TNT Results	8330 TNT+TNB Results	AGREEMENT Y, FN, FP
81	10	5-15	2.5	5.26	Y
82	10	15-30	3.2	4.5	FP
83	10	40-50	1	23	Y
84	10	15-30	3.8	18.5	Y
85	10	15-30	36	52.5	FN
86	10	15-30	3.6	8.66	Y
87	10	5-15	2.6	19.16	Y
88	10	5-15	3.2	3.84	Y
89	100	150-300	78	82	Y
90	1	4-5	18000	18050	FN
91	10000	15000	11000	11052.9	Y
92	10	40-50	36	42.4	Y
93	10000	15000-30000	11000	11052.9	Y
94	1000	500-1500	88	107	FP
95	1	3.0	9.6	10.17	FN
96	10000	40000-50000	15000	15050	FP
97	10000	4000-5000	2200	2220	Y
98	10	15-30	3.6	3.9	FP
99	10	15-30	6.4	6.7	FP
100	100	50-150	26	28.76	Y

Y = Yes, FN = False Negative, FP = False Positive

STRATEGIC DIAGNOSTICS INC.

PCB EnSys®
12T SOIL
TEST SYSTEM

70203

RAPID IMMUNOASSAY SCREEN

User's Guide

IMPORTANT NOTICE

This method correctly identifies 95% of samples that are PCB-free and those containing 1 ppm or greater of PCBs. A sample that develops less color than the standard is interpreted as positive. It contains PCBs. A sample that develops more color than the standard is interpreted as negative. It contains less than 1 ppm PCBs.

This test system should be used only under the supervision of a technically qualified individual who is capable of understanding any potential health and environmental risks of this product as identified in the product literature. The components must only be used for the analysis of soil samples for the presence of polychlorinated biphenyls. After use, the kits must be disposed of in accordance with applicable federal and local regulations.

TROUBLESHOOTING GUIDE

READ ALL INSTRUCTIONS BEFORE PROCEEDING WITH THE TEST

WASH STEP

Lack of vigorous washing may result in false positives or negatives depending on whether the wash error was committed on standard or sample tubes. Solution: Make sure to wash four times vigorously, washing the whole set of 12 tubes at once.

PIPET CALIBRATION

An out-of-calibration pipet may result in false positives or negatives depending on whether the amount is greater or less than the specified transfer volume. *Solution*:Check the calibration at least daily and after any extreme mechanical shock (such as dropping). An indication that the pipet is out of calibration is if the golc barrel is loose and will turn. (When set on 30 µl there should be about a 1/4 of an inch between the white plunger and the end of the clear pipet tip.)

AIR BUBBLES IN THE PIPET

The presence of air bubbles in the pipet tip when transferring extracts may result in false positives or negatives depending on whether the error was committed on standard or sample tubes. *Solution*:Quickly examine the pipet tip each time an aliquot is withdrawn and go back to the source and take another aliquot to displace the bubble if necessary.

MIXING

Lack of thorough mixing, when instructed, can cause inconsistent results. *Solution*:Observe the times in the instructions and mix with sufficient force to ensure that the liquid is homogenous.

TIMING

It is important to follow the timing steps in the instructions carefully. The incubation step in the antibody tubes can vary a bit without harm to the tests. The color development step timing is critical and should be no less than 2 minutes and no greater than 3 minutes.

WIPING THE TUBES

Wiping of the tubes should be done before they are read in the spectrophotometer because smudges and fingerprints on the tubes can give potentially false negative readings.

MIXING LOT #'S

Never mix lots! Each kit's components are matched for optimal performance and may give inaccurate results with the components from other kits with different lot #'s. Also, NEVER mix components from different types of kits (ex: Petro kit buffer can not be used with a PAH kit).

STORAGE AND OPERATING TEMPERATURES

Temperature requirements are very important and should be strictly adhered to. This test kit should be stored at less than 80°F/27°C and operated between 40°F/4°C and 90°F/32°C.

SHELF-LIFE

Each kit label contains the kit expiration date. To achieve accurate results, kits must be used prior to expiration.

WORKSTATION SET-UP

READ ALL INSTRUCTIONS BEFORE PROCEEDING WITH THE TEST

WORKSTATION SET-UP

- **Mechanical pipet tips**
- **Filter barrels & plungers**
- **Ampule cracker**
- **Glass PCB buffer tubes**
- **Substrate A**
- **Eppendorf pipet tips**
- **Bulb pipets**
- **PCB standard**
- **Antibody coated tubes**
- **Substrate B**
- **Extraction jars**
- **1 & 10 ppm dilution ampules**
- **Stop Solution**

Workstation shows components for 3 samples tested at 2 levels

TEST PREPARATION

READ ALL INSTRUCTIONS BEFORE PROCEEDING WITH THE TEST

READ BEFORE PROCEEDING

- Do not attempt to run more than 12 tubes, two of which must be standards.
- Items that you will need that are not provided in the test kit include: a permanent marking pen, laboratory tissue (or paper towels), a liquid waste container, and disposable gloves.
- This User's Guide was written for analyzing soil samples for PCBs at 1 and 10 ppm. See table on page 10 for sensitivity to various Aroclors.

TEST PREPARATION

- Label all Eppendorf repeater tips. Tips can be reused for future analyses. Label the first 5mL tip "A", the second 5mL tip "B" and the third 5mL tip "Stop".
- Label the 12.5 mL tip "Buffer".

Eppendorf Tip

STANDARD PREPARATION

- Open PCB Standard ampule by slipping ampule cracker over top, and then breaking tip at scored neck. Transfer solution to empty vial with Bulb Pipets.
- Label vial with current date. Standard is usable for 2 weeks. Always cap tightly when finished using standard.

PCB Standard **Ampule cracker** **Bulb pipet** **Amber vial**

PHASE 1 EXTRACTION & PREPARATION OF THE SAMPLE

READ ALL INSTRUCTIONS BEFORE PROCEEDING WITH THE TEST

WEIGH SAMPLE

1a. Place unused weigh boat on pan balance.

1b. Press ON/MEMORY button on pan balance. Balance will beep and display 0.0.

1c. Weigh out 10 ± 0.1 grams of soil.

1d. If balance turns off prior to completing weighing, use empty weigh boat to retare, then continue.

Weigh Boat

Pan balance

Wooden spatula

EXTRACT PCBS

2a. Uncap extraction jar and place on a flat surface. Without contacting solvent puncture foil seal with ampule cracker or sharp object. Peel the remainder of the seal off extraction jar.

2b. Using wooden spatula, transfer 10 grams of soil from weigh boat into extraction jar.

2c. Recap extraction jar tightly and shake **vigorously** for one minute.

2d. Allow to settle for one minute.

Repeat steps 1a - 2c for each sample to be tested.

Extraction Jar

FILTER SAMPLE

3c

3a. Disassemble filtration plunger from filtration barrel.

3b. Insert bulb pipet into top (liquid) layer in extraction jar and draw up sample. Transfer **at least ½** bulb capacity into filtration barrel. **Do not use more than one full bulb.**

3c. Press plunger firmly into barrel until adequate filtered sample is available (place on table and press if necessary).

Repeat steps **3a - 3c** for each sample to be tested.

Filtration plunger

Bulb pipet

Filtration barrel

READ TO AVOID COSTLY MISTAKES

READ ALL INSTRUCTIONS BEFORE PROCEEDING WITH THE TEST

SAMPLE DILUTION PROGRAM

1. The sample dilution procedure on the next page is for standard detection levels. The following diagram represents the sample dilution procedure for all other detection levels.
2. Your kit may include extra dilution ampules to reach high detection levels.
3. **EVERY AMPULE PROVIDED MUST BE USED!**

If there are any questions concerning the dilution procedure please call SDI Technical Services before running the samples to help avoid costly mistakes. (1-800-544-8881)

EXAMPLE:

Lowest ppm **Intermediate ppm** **Highest ppm**

Dilution Ampules

NOTE: **Your Kit may include additional ampules in order to achieve your test levels. Always transfer filtered sample to the dilution ampule labeled with the lowest PPM level and then transfer from this ampule to the next higher level dilution tube.**

PHASE 2 SAMPLE & STANDARD PREPARATION

READ ALL INSTRUCTIONS BEFORE PROCEEDING WITH THE TEST

READ BEFORE PROCEEDING

- Label the plastic antibody coated tubes with a permament marking pen.
- When using the mechanical pipet always withdraw and dispense below the liquid level.
- "Shake tubes" means to thoroughly mix the contents with special care not to spill or splash.

DILUTE SAMPLES AND STANDARDS

4a. Set the Eppendorf Repeater on 4, assemble the "Buffer" tip and fill with Buffer.

4b. Dispense 1 mL of Buffer into each glass buffer tube.

4c. Open 1 and 10 ppm dilution ampules by slipping ampule cracker over top, and then breaking top at scored neck.

4d. Withdraw 60 µL of filtered sample using mechanical pipet and dispense below the liquid level in "1 ppm" dilution ampule. Gently shake ampule from side to side for 5 seconds to mix thoroughly.

4e. Withdraw 60 µL from the "1 ppm" dilution ampule using mechanical pipet and dispense below the liquid level in "10 ppm" dilution ampule. Gently shake ampule from side to side for 5 seconds to mix thoroughly.

4f. Transfer 60 µL from each dilution ampule into glass buffer tubes. Always wipe tip after dispensing into buffer tube.

4g. Change pipet tip and repeat **4d - 4f** for each sample.

4h. Assemble new pipet tip on mechanical pipet and transfer 60 µL from Standard vial into two glass buffer tubes. Immediately replace cap on PCB Standard vial.

4i. Shake all glass buffer tubes for 5 seconds.

Dilution ampules

Ampule cracker

Mechanical pipet

Mechanic pipet tip

Glass buffer tubes

PCB Standard vial

PHASE 3 THE IMMUNOASSAY

READ ALL INSTRUCTIONS BEFORE PROCEEDING WITH THE TEST

TRANSFER FROM DILUTION TUBE TO ANTIBODY COATED TUBE

5b.1

5b.2

5c

5a. Set timer for 10 minutes

5b. Working left to right in the workstation:
1. Fit all antibody coated tubes firmly on top of all corresponding glass buffer tubes.
2. Start timer and immediately invert all connected tube pairs so that the liquid is poured into the antibody coated tubes. Return the tube pairs to the appropriate workstation row making sure the larger (antibody coated) tube is on the bottom.

5c. Invert all tube pairs several more times making sure the pair is returned to the workstation with the larger (antibody coated) tube on the bottom.

5d. Disconnect and discard the smaller (dilution) tubes. It is not important to worry about drops of liquid adhering to lips of tubes.

5e. Place conjugate tubes behind antibody tubes in workstation. Remove grey caps and discard.

TRANSFER OF CONJUGATE TO ANTIBODY COATED TUBES

6b

6c

6d

AFTER 10 MINUTES, IMMEDIATELY:

6a. Set timer for 5 minutes.

6b. Working left to right in the workstation:
Start timer and immediately:
Dissolve the conjugate pellets by horizontally connecting the antibody coated tubes and conjugate tubes and **tilt the liquid up to pour it onto the conjugate.**

6c. Return the connected tubes to the appropriate workstation row making sure **the larger (antibody coated) tube is on the bottom. It is important that this step is completed within one minute for all tubes.**

6d. In order to adequately mix solution, **invert** all connected tube pairs **several more times** making sure that the pair is returned to the workstation with the larger (antibody coated) tube on the bottom.

6e. Disconnect and discard the conjugate tubes. It is not important to worry about the loss of liquid adhering to lip of tubes.

PHASE 3 THE IMMUNOASSAY

READ ALL INSTRUCTIONS BEFORE PROCEEDING WITH THE TEST

READ BEFORE PROCEEDING WASH PROCEDURE

- An accurate test requires a vigorous wash accomplished by directing a strong stream into the antibody coated tubes.
- The wash solution is a harmless, dilute solution of detergent.

WASH

7a After the 5 minute incubation, empty antibody coated tubes into liquid waste container.

7b Wash antibody coated tubes by vigorously filling and emptying a total of 4 times.

7c Tap antibody coated tubes upside down on paper towels to remove excess liquid. Residual foam in the tubes will not interfere with test results.

Note: When running up to 12 antibody coated tubes, tubes can be washed in two groups - one group immediately following the other group.

Wash bottle

PHASE 3 THE IMMUNOASSAY

READ ALL INSTRUCTIONS BEFORE PROCEEDING WITH THE TEST

COLOR DEVELOPMENT

8a. Set the Eppendorf Repeater on 2, assemble the "A" tip and fill with Substrate A (TMB, yellow label).

8b. Dispense once (200 μL) into each antibody coated tube.

8c. Set timer for exactly 2 1/2 minutes.

8d. Assemble "B" tip, fill with Substrate B, start timer, and dispense once (200 μL H_2O_2, green label) into each antibody coated tube.

8e. Shake all tubes for 5 seconds. Solution will turn blue in some or all antibody coated tubes.

8f. Assemble "Stop" tip, fill with Stop Solution (red label), and stop reaction at end of 2 1/2 minutes by dispensing once (200 μL) into each antibody coated tube.

Substrate A **Substrate B** **Stop**

AROCLOR SENSITIVITY

Aroclor	Lowest Detection Level
1248	1.0 ppm
1254	0.5 ppm
1260	0.5 ppm
1242	2.0 ppm
1232	4.0 ppm
1016	4.0 ppm

PHASE 4 ANALYSIS OF RESULTS

READ ALL INSTRUCTIONS BEFORE PROCEEDING WITH THE TEST

SELECT STANDARD

9a. Wipe outside of all antibody coated tubes.

9b. Place both Standard tubes in photometer.

9c. Switch tubes until the photometer reading is negative or zero. Record reading.

If reading is greater than - 0.3 in magnitude (reading is less than or lower than - 0.3), results are outside QC limits. Retest the sample(s). (See QC Example)

9d. Remove and discard tube in right well. The tube in the left well is the conservative standard.

QC Check Example:

If the photometer reading (with both Standard tubes) is **-0.34 or 0.34**, results are <u>outside</u> the QC limits, and the samples should be retested.

If the photometer reading (with both Standard tubes) is **-0.27 or 0.27**, results are <u>within</u> the QClimits, and testing may proceed.

MEASURE SAMPLE

10a. Place 1 ppm tube in right well of photometer and record reading.

If photometer reading is negative or zero, PCBs are present.

If photometer reading is positive, concentration of PCBs is less than 1 ppm.

10b. Place 10 ppm tube in right well of photometer and record reading.

If photometer reading is negative or zero, PCBs are present.

If photometer reading is positive, concentration of PCBs is less than 10 ppm.

QUALITY CONTROL

READ ALL INSTRUCTIONS BEFORE PROCEEDING WITH THE TEST

System Description

Each SDI PCB Ensys® Soil 12 Test Case contains enough material to perform 12 test samples, each at two detection levels.

The SDI PCB EnSys Soil Test is divided into four phases. The instructions and notes should be reviewed before proceeding with each phase.

Hotline Assistance

If you need assistance or are missing necessary Test System materials, call toll free: 1-800-544-8881.

Validation and Warranty Information

Product claims are based on validation studies carried out under controlled conditions. Data has been collected in accordance with valid statistical methods and the product has undergone quality control tests of each manufactured lot.

PCB-free soil and soil containing 1 ppm or greater of PCBs were tested with the SDI EnSys PCB analytical method. The method correctly identified 95% of these samples. A sample that has developed less color than the standard is interpreted as positive. It contains PCBs. A sample that has developed more color than the standard is interpreted as negative. It contains less than 1 ppm PCBs.

SDI does not guarantee that the results with the PCB EnSys Soil 12 Test System will always agree with instrument-based analytical laboratory methods. All analytical methods, both field and laboratory, need to be subject to the appropriate quality control procedures.

How It Works

Standards, Samples, and color-change reagents are added to test tubes, coated with a chemical specific to PCBs. The concentration of PCBs in an unknown **Sample** is determined by comparing its color intensity with that of a **Standard**.

Note: PCB concentration is inversely proportional to color intensity; the lighter the color development of the sample, the higher the concentration of PCBs.

Quality Control

Standard precautions for maintaining quality control:

- Do not use reagents or test tubes from one Test System with reagents or test tubes from another Test System.
- Do not use the Test System after any portion has passed its expiration date.
- Do not attempt the test using more than 12 antibody coated tubes (two of which are Standards) at the same time.
- Do not exceed incubation periods prescribed by the specific steps.
- Always follow the procedure in this user's guide.
- Use EPA Method 8080 or Code of Federal Regulations Title 40, Part 136, Appendix A, Method 680 to confirm results.

Storage and Handling Precautions

- Wear protective gloves and eyewear.
- Store kit at room temperature and out of direct sunlight (less than 80°F).
- Keep aluminized pouch (containing unused antibody coated tubes) sealed when not in use.
- If Stop Solution or liquid from the extraction jar comes into contact with eyes, wash thoroughly with cold water and seek immediate medical attention.
- Standard Solution contains PCBs. Test samples may contain PCBs. Handle with care.

REPEATER PIPET & MECHANICAL PIPET

READ ALL INSTRUCTIONS BEFORE PROCEEDING WITH THE TEST

HOW TO OPERATE THE REPEATER PIPET

To Set Or Adjust Volume

To determine the pipetting volume, the dial setting (1-5) is multiplied by the minimum pipetting volume of the tip.

To Assemble Pipet Tip

Slide filling lever down until it stops. Then raise the locking clamp and insert the tip until it clicks into position. Be sure the tip plunger is fully inserted into the barrel before lowering the locking clamp to affix the tip in place.

To Fill Tip

With tip mounted in position on pipet, immerse end of tip into solution. Slide filling lever upward slowly.

To Dispense Sample

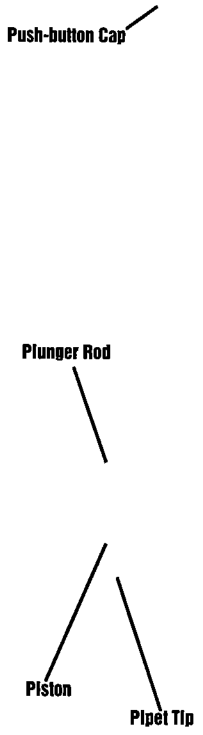
Check the volume selection dial to ensure pipetting volume. Place tip inside test tube so that tip touches the inner wall of tube. Completely depress the pipetting lever.

To Eject Tip

Empty tip of any remaining solution into appropriate container. Raise locking clamp upward, and remove the tip.

For additional information regarding operation and use of repeater, please refer to your Repeater pipet manual.

Mechanical Pipet



Repeater Pipet

HOW TO OPERATE THE MECHANICAL PIPET

To Set Or Adjust Volume

Remove push-button cap and use it to loosen volume lock screw. Turn lower part of push-button to adjust volume up or down. Meter should read "060". Tighten volume lock screw and replace push-button cap.

To Assemble Pipet Tip

Slide larger mounting end of pipet tip onto end of pipet. Holding tip in place, press push-button until plunger rod enters pipet tip. **Ensure no gap exists between piston and plunger rod.**

To Withdraw Sample

With tip mounted in position on pipet, press push-button to first stop and hold it.

Place tip at bottom of liquid sample and slowly release push-button to withdraw measured sample. Ensure that no bubbles exist in liquid portion of sample. If bubbles exist, dispense sample and re-withdraw sample.

To Dispense Sample

Place tip into dispensing vessel (immersing end of the tip if vessel contains liquid) and slowly press push-button to first stop. (Do not push to second stop or tip will eject).

Remove tip from vessel and release push-button.

To Eject Tip

Press push-button to second stop. Tip is ejected.

For additional information regarding operation and use of pipet, please refer to your pipet manual.

ON-SITE QUALITY CONTROL/QUALITY ASSURANCE RECOMMENDATIONS
SDI EnSys® 12 TEST SYSTEM

Please read the following before proceeding with field testing.

PRIOR TO TESTING SAMPLES

Carefully follow the instructions in the User's Guide included with every test kit. This is the key element in obtaining accurate results. In addition, store your unused test kits at room temperature and do not use them past their expiration date (see label on each test kit).

INTERNAL TEST QC

Two standards are analyzed with each sample to provide internal test system quality control. With both standards inserted in the photometer, a valid test is indicated when the magnitude of the displayed number (irrespective of the sign, + or -) is less than the value given in the User's Guide. Test runs resulting in a greater number should be repeated to ensure valid conclusions.

QA/QC

The validity of field test results can be substantially enhanced by employing a modest, but effective QA/QC plan. SDI recommends that you structure your QA/QC plan with the elements detailed below. These have been developed based on the data quality principles established by the U.S. Environmental Protection Agency.

A. **Sample Documentation**
   1. Location, depth
   2. Time and date of collection and field analysis

B. **Field analysis documentation** - provide raw data, calibration, any calculations, and final results of fieldanalysis for all samples screened (including QC samples)

C. **Method calibration** - this is an integral part of SDI's EnSys immunoassay tests; a duplicate calibration is performed for each set of samples tested (see the instructions in the User's Guide)

D. **Method blank** - analyze methanol from the extraction jar.

E. **Site-specific matrix background field analysis** - collect and field analyze uncontaminated sample from site matrix to document matrix effect

F. **Duplicate sample field analysis** - field analyze duplicate sample to document method repeatability; at least one of every 20 samples should be analyzed in duplicate

G. **Confirmation of field analysis** - provide confirmation of the quantitation of the analyte via an EPA-approved method different from the field method on at least 10% of the samples; choose at least two representative samples testing above the action level; provide chain of custody and documentation such as gas chromatograms, mass spectra, etc.

H. **Performance evaluation sample field analysis (optional, but strongly recommended)** - field analyze performance evaluation sample daily to document method/operator performance

I. **Matrix spike field analysis (optional)** - field analyze matrix spike to document matrix effect on analyte measurement

FURTHER QUESTIONS?

SDI's technical support personnel are always prepared to discuss your quality needs to help you meet your data quality objectives. (1-800-544-8881)

Data for SDI PCB EnSys® 12T Soil Test

Operator: ----------------------------------- Date: ------------- Location: --

Sample ID	ΔOD	OD sample	Interpretation	OD sample	Interpretation	Comments
	Standards	______ ppm		______ ppm		

STRATEGIC DIAGNOSTICS INC.

RaPID Assay® PCB Test Kit
A00133/A00134

Intended Use

The RaPID Assay® PCB Test Kit can be used as a quantitative, semi-quantitative or qualitative enzyme immunoassay (EIA) for the analysis of PCB (polychlorinated biphenyl) in water (groundwater, surface water, well water). For applications in other matrices please contact our Technical Service department or refer to the soil application procedure provided. The RaPID Assay® PCB Test Kit allows reliable and rapid screening for PCB (measured and reported as Aroclor 1254), with quantitation between 0.5 and 10 ppb (as Aroclor 1254), in water. The minimum detection level of the kit is 0.2 ppb (as Aroclor 1254.)

Test Principles

The PCB RaPID Assay® kit applies the principles of enzyme linked immunosorbent assay (ELISA) to the determination of PCB and related compounds. The sample to be tested is added, along with an enzyme conjugate, to a disposable test tube, followed by paramagnetic particles with antibodies specific to PCB attached. Both PCB (which may be in the sample) and the enzyme labeled PCB (the enzyme conjugate) compete for antibody binding sites on the magnetic particles. At the end of an incubation period, a magnetic field is applied to hold the paramagnetic particles (with PCB and labeled PCB analog bound to the antibodies on the particles, in proportion to their original concentration) in the tube and allow the unbound reagents to be decanted. After decanting, the particles are washed with Washing Solution.

The presence of PCB is detected by adding the enzyme substrate (hydrogen peroxide) and the chromogen (3,3',5,5' – tetramethylbenzidine). The enzyme labeled PCB analog bound to the PCB antibody catalyzes the conversion of the substrate/chromogen mixture to a colored product. After an incubation period, the reaction is stopped and stabilized by the addition of acid. Since the labeled PCB (conjugate) was in competition with the unlabeled PCB (sample) for the antibody sites, the color developed is inversely proportional to the concentration of PCB in the sample.

NOTE: Color development is inversely proportional to the PCB concentration.

Darker color = lower concentration
Lighter color = higher concentration

The determination of the PCB level in an unknown sample is interpreted relative to the standard curve generated from kit standards after reading with a spectrophotometer.

Performance Characteristics

The PCB RaPID Assay® will detect different PCB Aroclors to different degrees. Refer to the table below for data on several of these. The PCB RaPID Assay® kit provides screening results. As with any analytical technique (GC, HPLC, etc.) positive results requiring some action should be confirmed by an alternative method.

The PCB RaPID Assay® immunoassay test does not differentiate between PCB and other related compounds. The table below shows compounds at the method detection limit (MDL) which is the lowest concentration of the compound, in water, that can be picked up in the assay. The limit of quantitation (LOQ) is an approximate concentration, in water, required to yield a positive result at the lowest standard. **This is the lowest concentration of the compound that can be quantified in the assay.** The IC50 is the concentration required to, inhibit one half of the color produced by the negative control. It is also used to calculate cross-reactivity values to similar compounds.

Compound	MDL (ppb)	LOQ (ppb)	IC50 (ppb)
Aroclor 1254	0.20	0.50	3.6
Aroclor 1260	0.20	0.32	2.3
Aroclor 1248	0.22	0.59	4.22

Aroclor 1242	0.34	1.22	8.8
Aroclor 1262	0.36	0.66	4.74
Aroclor 1232	0.84	2.61	18.76
Aroclor 1268	0.92	3.03	21.80
Aroclor 1016	0.94	3.56	25.60
Aroclor 1221	13.54	22.58	162.60

*The following compounds demonstrated no reactivity in the PCB RaPID Assay® test kit at concentrations up to 10,000 ppb: Biphenyl, 2,5-Dichlorophenol, 2,3,5-Trichlorophenol, Di-n-octyl-phthalate.

The presence of the following substances up to 250 ppm were found to have no significant effect on PCB RaPID Assay® results: copper, nickel, zinc, mercury, manganese, phosphate, sulfate, sulfite, magnesium, calcium, nitrate and thiosulfate. Humic acid up to 25 ppm and iron to 100 ppm were found to have no significant effect. In addition, sodium chloride concentrations up to 1.0 M showed no effect on results.

Precautions

- Training is strongly recommended prior to using the RaPID Assay® test system. Contact Strategic Diagnostics for additional information.
- Treat PCB, solutions that contain PCB, and potentially contaminated samples as hazardous materials.
- Use gloves, proper protective clothing, and methods to contain and handle hazardous material where appropriate.
- Reagents must be added in a consistent manner to the entire rack. A consistent technique is the key to optimal performance. Be sure to treat each tube in an identical manner.
- Water samples should be at a neutral pH prior to analysis. Samples containing gross particulate should be filtered (e.g. 0.2 um Anotop™ 25 Plus, Whatman, Inc.) to remove particles.
- Store all test kit components at 2°C to 8°C (36°F to 46°F). Storage at ambient temperature (18°C to 27°C or 64°F to 81°F) on the day of use is acceptable. *Test tubes require no special storage and may be stored separately to conserve refrigerator space.*
- Allow all reagents to reach ambient temperature (18°C to 27°C or 64°F to 81°F) before beginning the test. This typically requires at <u>least</u> 1 hour to warm from recommended storage conditions.
- Do not freeze test kit components or expose them to temperatures above 100°F (39°C).
- Do not use test kit components after the expiration date.
- Do not use reagents or test tubes from one test kit with reagents or test tubes from a different test kit.
- Do not mix reagents from kits of different lot numbers.
- Use approved methodologies to confirm any positive results.
- Do not under any circumstances attempt to disassemble the base of the magnetic rack. Magnets will be violently attracted to each other.
- Adequate sample number and distribution are the responsibility of the analyst.
- The photometer provided in the accessory kit requires electricity and comes with a 110V adapter. Adapters for 220V are available. Do not attempt to operate with a car adaptor.
- Do not expose color solution to direct sunlight.
- Do not dilute or adulterate test reagents or use samples not called for in the test procedure; this may give inaccurate results.
- Tightly recap the standard vials when not in use to prevent evaporative loss.

Materials Provided

- Antibody Coupled Paramagnetic Particles in buffered saline containing preservative and stabilizers.

  30 test kit: one 20 mL vial
  100 test kit: one 65 mL vial

- Enzyme Conjugate.

  30 test kit: one 10 mL vial
  100 test kit: one 35 mL vial

- Standards

Three concentrations (0.25, 1.0 and 5.0 ppb) of PCB standards (as Aroclor 1254) in buffered saline containing preservative and stabilizers are supplied. Each vial contains 4 mL.

- Control

  A concentration (approximately 3 ppb) of PCB (as Aroclor 1254) in buffered saline containing preservative and stabilizers. A 4 mL volume is supplied in one vial.

- Diluent/Zero Standard

  Buffered saline containing preservative and stabilizers without any detectable PCB.

  30 test kit: one 10 mL vial
  100 test kit: one 35 mL vial

- Color Solution containing hydrogen peroxide and 3,3',5,5'-tetramethylbenzidine in an organic base.

  30 test kit: one 20 mL vial
  100 test kit: one 65 mL vial

- Stop Solution containing a solution of 2M sulfuric acid.

  30 test kit: one 20 mL vial
  100 test kit: one 60 mL vial

- Washing Solution containing preserved deionized water.

  30 test kit: one 70 mL vial
  100 test kit: one 250 mL vial

- Polystyrene test tubes

  30 test kit: one 36 tube box
  100 test kit: three 36 tube boxes

- User's Guide

Materials Required and Ordered Separately

See "Ordering Information" for the appropriate catalogue numbers.

Rapid Assay® Accessory Kit

Accessory equipment may be rented or purchased from Strategic Diagnostics. See "Ordering Information" for the appropriate catalogue numbers.

The accessory kit contains the following items:

- Adjustable Volume Pipet
- Eppendorf™ Repeater® Pipettor
- Electronic timer
- Portable balance capable of weighing 10 g (for soil samples)
- Vortex mixer
- Magnetic separation rack
- RPA-I RaPID Analyzer (or equivalent spectrophotometer capable of reading 450 nm in a 1 mL sample size).

Other Items

- 12.5 mL Combitips® for the Repeater pipettor - for 0.25 mL to 1.25 mL dispensing volumes (5)
- Pipet tips for adjustable volume pipet (100-1000 uL)

NOTE: Order replacement Combitips® and pipet tips separately. See the "Ordering Information" section.

Materials Required but Not Provided

- Methanol (HPLC grade or equivalent) – for water analysis
- Protective clothing (e.g., latex gloves)
- Absorbent paper for blotting test tubes
- Liquid and solid waste containers
- Marking pen
- Instructional video (optional)

Suggestions for Pipettor Use

- Practice using both pipettes (adjustable volume and Repeater pipettor) with water and extra tips before you analyze your samples.
- Use a new tip each time you use the Repeater pipettor to pipette a different reagent to avoid reagent cross-contamination. Tips can be rinsed thoroughly, dried completely and reused. By using the same tip to dispense the same reagent each time you can avoid cross contamination.

NOTE: **Repeator tips should be changed periodically (after ~10 uses) since precision deteriorates with use.**

- Draw the desired reagent volume into the Repeater pipettor and dispense one portion of the reagent back into the container to properly engage the ratchet mechanism. If you do not do this, the first volume delivered may be inaccurate.
- To add reagents using the Repeater pipettor, pipette down the side of the test tube just below the rim.
- When adding samples and standard using the positive displacement pipettor, always pipette into the bottom of the tube without touching the sides or bottom of the tube.
- Use a new adjustable volume pipet tip each time you pipette a new unknown.

Assay Procedure

Prior to performing your first Rapid Assay®, please take time to read the package inserts in their entirety and review the videotape if available. **On site training is strongly recommended for new users of this test system.** Please contact your account manager for further information. This procedure is designed for quantitative analysis. For running the kit semi-quantitatively or qualitatively, please contact Technical Support.

Collect/Store the Sample

The following steps explain how to properly collect and store your samples.

1. Water samples should be collected in glass vessels with teflon cap liners). **Immediately upon collection, water samples should be diluted with an equal volume (1:1) of methanol (HPLC grade) to prevent adsorptive losses to the glass containers.** This is a 2x dilution, which must be accounted for when interpreting results. See "Results Interpretation", Section 3a for further details. Use this diluted sample as "sample" in "Perform the Test".

NOTE: This 2x dilution is <u>not</u> required for soil samples.

2. Samples should be collected in appropriately sized and labeled containers.
3. If testing soil samples, follow the SDI Sample Extraction Kit User's Guide or the appropriate technical bulletin to properly collect and store your sample.
4. Samples should be tested as soon as possible after collection. If this is not possible, storage at 4°C (39°F) is recommended to minimize evaporative losses.

Set Up

1. Remove kits from refrigerator. All reagents must be allowed to come to room temperature prior to analysis. Remove reagents from packaging and place at room temperature <u>at least</u> 1 hour prior to testing.
2. Turn on the RPA-1 or other spectrophotometer. The RPA-1 should be warmed up for at least 30 minutes prior to the run.
3. Label five 12.5 mL Combitips "Conjugate", "Particles", "Wash", "Color" and "Stop". In addition, add the name of the compound you are testing for to each Combitip.

4. Remove nine clean blank test tubes for standards and control and one test tube for each sample (if testing in singlicate). Label the test tubes according to contents as follows.

Tube #	Contents
1	Negative control (replicate 1)
2	Negative control (replicate 2)
3	Standard 1 (replicate 1)
4	Standard 1 (replicate 2)
5	Standard 2 (replicate 1)
6	Standard 2 (replicate 2)
7	Standard 3 (replicate 1)
8	Standard 3 (replicate 2)
9	Control
10	Sample 1
11	Etc.

***Label at top of tubes to avoid interference with reading of tubes in photometer**

Sample Extraction, Filtration and Dilution

Filtration may be necessary to remove gross particulate from the water sample. If testing samples at levels higher than standard kit level is desired, contact SDI for special instructions. Water samples should be diluted 1:1 in methanol as described in "Collect/Store the Sample".

Please follow the instructions from the SDI Sample Extraction Kit to prepare and dilute the soil extract prior to running the assay.

Perform the Test

1. Separate the upper rack from the magnetic base. Place labeled test tubes into the rack.

2. Add **200 uL** of standards, control or samples to the appropriate tubes using the adjustable volume pipet with the dial set on **0200**. The negative control, standards and control must be run with each batch of samples.

NOTE: Sample should be added to the bottom of the tube by inserting the pipet tip into the tube without touching the sides or the bottom of the tube. Take care not to contact sample with pipette tip once dispensed into bottom of the tube.

3. Using the Repeater Pipettor with the "Conjugate" tip attached and the dial set on **"1"**, add **250 uL** of Enzyme conjugate down the **inside wall** of each tube. (Aim the pipet tip ¼" to ½" below the tube rim or tube wall; deliver liquid gently to avoid splashback.)

4. Thoroughly mix the magnetic particles by swirling (avoid vigorous shaking) and attach the "Particles" tip to the Repeater Pipettor. With the dial set on **"2"** add **500 uL** of magnetic particles to each tube, aiming down the side of the tube as described above. Vortex, mixing each tube 1 to 2 seconds at low speed to minimize foaming. Pipetting of magnetic particles should be kept to 2 minutes or less.

5. Incubate 15 minutes at room temperature.

6. After the incubation, combine the upper rack with the magnetic base and press all tubes into the base; allow 2 minutes for the particles to separate.

7. With the upper rack and magnetic base combined, use a smooth motion to invert the combined rack assembly over a sink and pour out the tube contents.

NOTE: If the rack assembly inadvertently comes apart when lifting to pour out tube contents, re-combine and wait an additional 2 minutes to allow particles to separate.

8. **Keep the rack inverted** and gently blot the test tube rims on several layers of paper towels. It is important to remove as much liquid as possible but **do not bang** the rack or you may dislodge the magnetic particles and affect the results.

9. Set the Repeater Pipettor dial to **"4"** and put on the tip labeled "Wash". Add **1 mL** of Washing Solution down the inside wall of each tube by using the technique described earlier. Vortex tubes for 1-2 seconds. **Wait 2 minutes** and pour out the tube contents as described previously. **Repeat this step one more time.**

NOTE: The number of washes and wash volume are important in ensuring accurate results.

10. Remove the upper rack (with its tubes) from the magnetic base. With the "Color" tip attached to the Repeater Pipet and the dial set to **"2"** add **500 uL** of Color Reagent down the inside wall of each tube as described previously. Vortex 1 to 2 seconds (at low speed).

11. Incubate 20 minutes at room temperature. During this period, add approximately 1 mL of Washing solution to a clean tube for use as an instrument blank for "Results Interpretation".

12. After the incubation, position the Repeater pipettor at Setting **"2"** and use the "Stop" tip to add **500 uL** of Stop solution to all test tubes.

13. Proceed with results interpretation.

WARNING: Stop solution contains 2M sulfuric acid. Handle carefully.

Results Interpretation

1. After addition of Stop Solution to the test tubes, results should be read within 15 minutes.

2. Wipe the outside of all antibody coated tubes prior to photometric analysis to remove fingerprints and smudges.

Photometric Interpretation Using the RPA-I

1. The RPA-I photometer (provided in the Rapid Assay® Accessory kit) can be used to calculate and store calibration curves. It is preprogrammed with

various RaPID Assay® protocols. For the PCB RaPID Assay® test kit, parameter settings are as follows:

Data Reduct: Lin. Regression
Xformation : Ln/LogitB
Read Mode : Absorbance
Wavelength : 450 nm
Units : PPB
Rgt Blk : 0

Calibrators:
# of Cals : 4
# of Reps : 2

Concentrations:
#1: 0.00 ppb
#2: 0.25 ppb
#3: 1.00 ppb
#4: 5.00 ppb
Range : 0.10 – 5.00
Correlation : 0.990
Rep. %CV : 10%

NOTE: Prior to analysis the RPA-I User's Manual should be thoroughly reviewed for more detailed operation instructions.

2. Follow the instrument prompts to read the absorbance of all tubes:

Instrument Display	Operator Response
SELECT COMMAND	Press RUN
RUN PROTOCOL	Scroll using the YES [] or NO [] keys until the desired protocol appears. Then press ENTER
SPL. REPLICATES (1-5)	Press 1 (for analysis of samples in singlicate.) Press ENTER
BLANK TUBE, INSERT TUBE, EVALUATING TUBE,	Insert blank tube containing 1mL wash solution.
REMOVE TUBE (Beep)	Remove tube
CAL #1, REP. #1, INSERT TUBE, EVALUATING TUBE,	Insert Tube #1
REMOVE TUBE (Beep)	Remove tube

Follow prompts to read tubes.

NOTE: Tube order is important. The RPA-I expects to see the standards in ascending order, in duplicate, starting with the negative control.

Following evaluation of all standards, the instrument will display:

PRINTING DATA,	Data will print
PRINTING CURVE	Curve will print only if programmed to print (See RPA1 User's Manual).
CTRL #1 REP #1, INSERT TUBE, EVALUATING TUBE,	Insert Control Tube
REMOVE TUBE (Beep)	Remove Tube
EDIT CALIBRATORS YES/NO	Press NO (if editing is necessary press YES and refer to the RPA1 User's Manual).
SPL #1 REP#1 INSERT TUBE EVALUATING TUBE	Insert first sample tube
REMOVE TUBE (Beep)	Remove tube

Continue to follow prompts. After all samples have been read, press STOP.

Expected Results:

- **%CV (coefficient of variation) between standard duplicates of 10% or less.**
- **Absorbance reading for the 0 ppb standard should be between 0.8 and 2.0 for all assays.**
- **Correlation (r) of 0.990 or greater for all assays.**
- **Kit control within range specified on vial.**

- **Absorbance of negative control and standards should be as follows:**

  Negative Control>Std. 1>Std. 2>Std. 3.

3. Concentrations will be indicated for all samples on the RPA-I printout.

   a) The concentration, as indicated on the printout, is multiplied by the appropriate dilution factor (if applicable) introduced in the procedure. The quantitation range of the kit is also multiplied by this factor.

EXAMPLE: Water samples were diluted 2-fold with methanol upon collection (see "Collect/Store the Sample" in this User's Guide). As a result, the concentrations listed on the printout should be multiplied by 2 to determine the sample concentration. The standard concentrations are also multiplied by 2 to give a quantitation range in water for this test kit of 0.5 to 10 ppb.

   b) Samples with an "nd" and no concentration listed have an absorbance greater than the negative control; therefore, no concentration can be computed for these samples. Results must be reported as < 0.5 ppb (or Standard 1 multiplied by the dilution factor.)

   c) Samples with an "nd" next to a listed concentration have an estimated concentration below the minimum detection level of the test kit. Results must be reported as <0.5 ppb (or Standard 1 multiplied by the dilution factor.)

   NOTE: Any samples with concentrations determined to be lower than Standard 1 (the limit of quantitation) must be reported as < 0.5 (or Standard 1 multiplied by the dilution factor.) Quantitation is not possible below this standard as this is outside the linear range of the assay.

   d) Similarly, samples with a "hi" next to a listed concentration have an estimated concentration higher than Standard 3 and must be reported as >10 ppb (or Standard 3 multiplied by the dilution factor.)

NOTE: In order to determine the concentration of samples with concentrations greater than Standard 3, they must be subjected to repeat testing using a diluted sample. A ten-fold or greater dilution of the sample is recommended with an appropriate amount of PCB diluent. This additional dilution must then be taken into account when calculating the concentration. Please contact technical support for assistance in performing dilutions.

Photometric Interpretation Using Other Photometers

Other photometers may also be used to interpret results obtained from the RPA-I photometer. It is important that the photometer be able to read absorbance at 450nm and that the instrument can read at a 1 mL fill volume. Absorbances obtained from other spectrophotometers (reading at 450 nm) may be used to manually calculate sample concentrations as outlined below.

1. Calculate the mean absorbance for each of the three standards and the negative control.

2. Determine the standard deviation and %CV (coefficient of variation) of each standard and ensure %CV is less than 10% for each.

3. Calculate the %B/Bo for each standard by dividing the mean absorbance value for the standard by the mean absorbance value for the negative control and multiplying the results by 100.

4. Construct a standard curve by plotting the %B/Bo for each standard on the vertical logit (y) axis versus the corresponding analyte concentration on the horizontal logarithmic (x) axis on the graph paper provided in the test kit. **Graph papers are specific for each method. Use only the graph paper supplied with each kit.**

5. Draw the best straight line through all points. Using the %B/Bo of the sample, the concentration can be interpolated from the standard curve.

6. Multiply results by the appropriate dilution factor (if applicable) introduced in the procedure. For example, if the sample was diluted 10-fold to increase the detection levels of the kit then the results must be multiplied by 10. This dilution also changes the range of the assay (standards) by the same factor.

NOTE: Do not forget to account for the 2x dilution introduced in the "Collect/Store the Sample" procedure for water samples.

Limitations of the Procedure

The Rapid Assay® PCB Test Kit is a screening test **only**. Sampling error may significantly affect testing reliability. Adequate sample number and distribution are the responsibility of the analyst.

Ordering Information

Description	**Catalogue Number**
Rapid Assay® PCB Kit	A00133/A00134
Rapid Assay® Accessory Kit**	6050100
Adjustable Volume Pipet Tips (100-1000 uL)	A00013
12.5 mL Combitip for Repeating Pipette (1 each)	A00009
PCB Diluent	A00136
PCB Soil Proficiency Sample	A00175
Rapid Assay® Accessory Kit Rental	6997010
**** To obtain part numbers and pricing for individual items in the Accessory Kit contact SDI at the number below.**	

Ordering/Technical Assistance

Should you have any questions regarding this procedure prior to analysis contact Technical Service to avoid costly mistakes.

To Place an Order or Receive Technical Assistance, please call Strategic Diagnostics Inc. at:

Call toll-free **800-544-8881`**

Or 302-456-6789 Phone
302-456-6782 Fax
Web site: www.sdix.com
E-mail: techservice@sdix.com

General Limited Warranty

SDI's products are manufactured under strict quality control guidelines and are warranted to be free from defects in materials and workmanship. New instruments and related non-expendable items are warranted for one year from date of shipment against defective materials or workmanship under normal use and service.
Warranty obligation is limited to repair or replacement of the defective product or to refund of the purchase price, at the discretion of SDI. Other warranties, express or implied, are disclaimed. SDI's liability under any warranty claim shall not exceed the refund of the purchase price paid by the customer. Under no circumstances shall SDI be liable for special, indirect or consequential damages.

Safety

To receive an MSDS for this product, visit our web site at www.sdix.com.

Z00245.1, Rev 4/4/00

Operation of the Repeater Pipet

To Set or Adjust Volume

To determine the pipetting volume, the dial setting (1-5) is multiplied by the minimum pipetting volume of the tip (indicated on the side of the Combitip, e.g. 1≃100 uL.)

To Assemble Pipet Tip

Slide filling lever down until it stops. Then raise the locking clamp and insert the tip until it clicks into position. Be sure the tip plunger is fully inserted into the barrel before lowering the locking clamp to affix the tip in place.

To Fill Tip

With tip mounted in position on pipet, immerse end of tip into solution. Slide filling lever upward slowly. Combitip will fill with liquid.

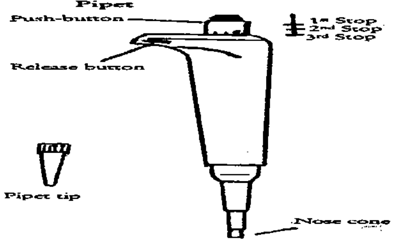
To Dispense Sample

Check the volume selection dial to ensure pipetting volume. Place tip inside test tube so that tip touches the inner wall of tube. Completely depress the pipetting lever to deliver sample. NOTE: Dispense one portion of reagent back into the container to engage the ratchet mechanism and ensure accuracy.

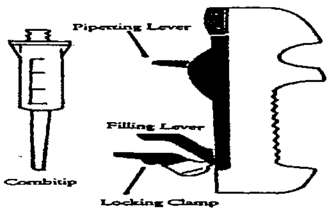
To Eject Tip

Empty tip of any remaining solution into appropriate container by pushing filling lever down. Raise locking clamp upward, and remove the Combitip.

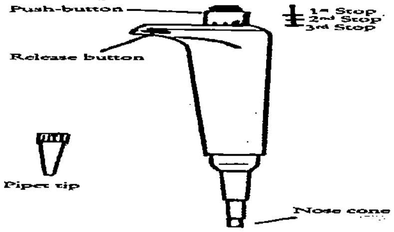
Adjustable Volume Pipet



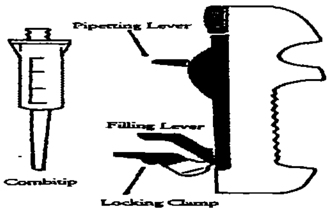
Repeater Pipet



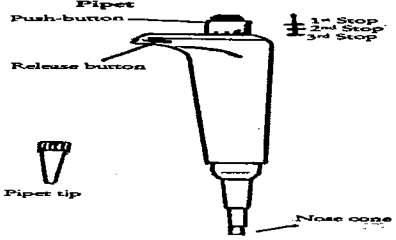
Adjustable Volume Pipet



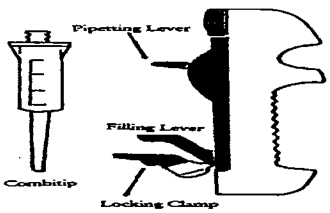
Repeater Pipet



Adjustable Volume Pipet



Repeater Pipet



Operation of the Adjustable Volume Pipet

To Set or Adjust Volume

Press release button on side of pipette and turn the push-button to adjust volume up or down. Volume setting is displayed on top of pipet. See kit instructions for appropriate setting. Pipet will accurately dispense volumes between 100 and 1000 uL.

To Assemble Pipet Tip

Gently push nose cone of pipet firmly into a pipet tip contained in the pipet tip rack.

To Withdraw Sample

Keep pipet almost vertical. With tip mounted in position on pipet, press push-button to 1st stop and hold it. Place tip at bottom of liquid sample and slowly release push-button to withdraw measured sample. Ensure that no air bubbles exist in the pipette tip. If bubbles exist, dispense sample and re-withdraw. Slide tip out along the inside of the vessel.

To Dispense Sample

Wipe any liquid from outside of tip taking care not to touch orifice. Place tip into tube, almost to the bottom, and slowly press push-button to 2nd stop. Hold push-button at 2nd stop when removing tip from tube.

To Eject Tip

Press push-button to 3rd stop. Tip is ejected.

METHOD 4020

SCREENING FOR POLYCHLORINATED BIPHENYLS BY IMMUNOASSAY

1.0 SCOPE AND APPLICATION

1.1 Method 4020 is a procedure for screening soils and non-aqueous waste liquids to determine when total polychlorinated biphenyls (PCBs) are present at concentrations above 5, 10 or 50 mg/kg. Method 4020 provides an estimate for the concentration of PCBs by comparison with a standard.

1.2 Using the test kit from which this method was developed, 95% of soil samples containing 0.625 ppm or less of PCBs will produce a negative result in the 5 ppm test configuration. Using another commercially available test kit, 97% of soil samples containing 0.25 ppm or less of PCBs will produce a negative result in the assay and greater than 99% of the samples containing 1.0 ppm or more will produce a positive result. Tables 2-5, 7, 10, and 11 present false positive and false negative data generated from commercially available test kits. Using a test kit commercially available for screening non-aqueous waste liquids, >95% of samples containing 0.2-0.5 ppm or less of PCB will produce a negative result.

1.3 In cases where the exact concentrations of PCBs are required, quantitative techniques (i.e., Method 8082) should be used.

1.4 This method is restricted to use by or under the supervision of trained analysts. Each analyst must demonstrate the ability to generate acceptable results with this method.

2.0 SUMMARY OF METHOD

2.1 Test kits are commercially available for this method. The manufacturer's directions should be followed.

2.2 In general, the method is performed using a sample extract. Sample and an enzyme conjugate reagent are added to immobilized antibody. The enzyme conjugate "competes" with PCB present in the sample for binding to immobilized anti-PCB antibody.

2.3 The test is interpreted by comparing the response produced by testing a sample to the response produced by testing standard(s) simultaneously.

3.0 INTERFERENCES

Chemically similar compounds and compounds which might be expected to be found in conjunction with PCB contamination were tested to determine the concentration required to produce a positive test result. These data are shown in Tables 1A, 1B, 1C, and 1D.

4.0 APPARATUS AND MATERIALS

4.1 Immunoassay test kit: PCB RISc™ (EnSys, Inc.), EnviroGard™ PCB in Soil (Millipore, Inc.), D TECH ™ PCB test (Strategic Diagnostics Inc.), PCB RISc™ Liquid Waste Test System (EnSys, Inc.), or equivalent.

4.2 Each commercially available test kit will supply or specify the apparatus and materials necessary for successful completion of the test.

5.0 REAGENTS

Each commercially available test kit will supply or specify the reagents necessary for successful completion of the test.

6.0 SAMPLE COLLECTION, PRESERVATION, AND HANDLING

6.1 See the introductory material to this chapter, Organic Analytes, Section 4.1. Also refer to Reference 9 for the collection and handling of non-aqueous waste liquids.

6.2 Samples may be contaminated, and should therefore be considered hazardous and handled accordingly.

7.0 PROCEDURE

7.1 Follow the manufacturer's instructions for the test kit being used.

7.2 Those test kits used must meet or exceed the performance specifications indicated in Tables 2-11.

8.0 QUALITY CONTROL

8.1 Follow the manufacturer's instructions for the test kit being used for quality control procedures specific to the test kit used. Additionally, guidance provided in Method 4000 and Chapter One should be followed.

8.2 Use of replicate analyses, particularly when results indicate concentrations near the action level, is recommended to refine information gathered with the kit.

8.3 Do not use test kits past their expiration date.

8.4 Do not use tubes or reagents designated for use with other test kits.

8.5 Use the test kits within their specified storage temperature and operating temperature limits.

8.6 Method 4020 is intended for field or laboratory use. The appropriate level of quality assurance should accompany the application of this method to document data quality.

9.0 METHOD PERFORMANCE

9.1 A study was conducted with the PCB RISc^{TM} test kit using fourteen standard soils and three soil samples whose PCB concentration had been established by Method 8082. Replicates were performed on seven of the standard soils and on one of the soil samples for a total of 25 separate analyses. Each of two different analysts ran the 25 analyses. Results indicated that "<" assignments are accurate with almost 99% certainty at the 50 ppm level while ">" assignments can be up to about 96% inaccurate as the sample concentration approaches that of the testing level. Corresponding certainties at the 5 ppm level are 92% and 82% respectively. Tables 2 and 3 summarize these results.

9.2 Table 4 presents method precision data generated using the PCB RISc^{TM} test kit, comparing immunoassay test results with results obtained using Method 8082.

9.3 Method precision was determined with the EnviroGard PCB in Soil test kit by assaying 4 different soils (previously determined to contain 5.04, 9.78, 11.8, and 25.1 mg/kg by Method 8082), at three different sites, using three different lots of assay kits, three times a day for 9 days. A total of 81 analyses were performed for each soil. Error attributable to site, lot, date, and operator were determined. Separately, the relative reactivity of Aroclors 1242, 1248, 1254, and 1260 were determined. Based on Aroclor heterogeneity, and method imprecision, concentrations of Aroclor 1248 were selected that would result in greater than 99% confidence for negative interpretation. A study was conducted (Superfund SITE demonstration) on 114 field samples whose PCB concentration were also determined by Method 8082. 32 of the field samples were collected in duplicate (as coded field duplicates) and assayed by standard and immunoassay methods. The results for all 146 samples are summarized in Tables 5 and 6.

9.4 Grab samples were obtained from sites in Pennsylvania, Iowa and Illinois using a stainless steel trowel. Each sample was homogenized by placing approximately six cubic inches in a stainless steel bucket and mixing with the trowel for approximately two minutes. The soils was aliquotted into 2 six ounce glass bottles. The samples were tested on site using the D TECH PCB test kit, and sent to an analytical laboratory for analysis by Method 8082. These data are compared in Table 7.

9.5 Tables 8 and 9 present data on the inter- and intra-assay precision of the PCB RISc^{TM} Liquid Waste Test System. The data were generated using 11 samples, each spiked at 0, 0.2 and 5 ppm, and assayed 4 times.

9.6 Tables 10 and 11 provide data from application of the PCB RISc^{TM} Liquid Waste Test System to a series of liquid waste samples whose PCB concentration had been established by Method 8082.

10.0 REFERENCES

1. J.P. Mapes, T.N. Stewart, K.D. McKenzie, L.R. McClelland, R.L. Mudd, W.B. Manning, W.B. Studabaker, and S.B. Friedman, "PCB-RISc^{TM} - An On-Site Immunoassay for Detecting PCB in Soil", Bull. Environ. Contam. Toxicol. (1993) 50:219-225.

2. PCB RISc^{TM} Users Guide, Ensys Inc.

3. R.W. Counts, R.R. Smith, J.H. Stewart, and R.A. Jenkins, "Evaluation of PCB Rapid Immunoassay Screen Test System", Oak Ridge National Laboratory, Oak Ridge, TN 37831, April 1992, unpublished

4. EnviroGard PCB in Soil Package Insert, Millipore Corp. 2/93.

5. Technical Evaluation Report on the Demonstration of PCB Field Screening Technologies, SITE Program. EPA Contract Number 68-CO-0047. 2/93.

6. D TECH^{TM} PCB Users Guide , SDI/Em Sciences

7. Melby, J.M., B.S. Finlin, A.B. McQuillin, H.G. Rovira, J.W. Stave, "PCB Analysis by Enzyme Immunoassay", Strategic Diagnostics Incorporated, Newark, Delaware, 1993

8. Melby, J.M., B.S. Finlin, A.B. McQuillin, H.G. Rovira, "Competitive Enzyme Immunoassay (EIA) Field Screening System for the Detection of PCB", 1993 PCB Seminar, EPRI, September 1993

9. T.A. Bellar and J.J Lichtenberg. The Analysis of Polychloringated Biphenyls in Transformer Fluid and Waste Oils. U.S. EPA Research and Development, EPA/EMSL-ORD, Cincinnati, Ohio (June 24, 1980). Revised June 1981, EPA 600/4-81-045.

10. PCB RISc^{TM} Liquid Waste Test System, User's Guide, EnSys Environmental Products, Inc.

TABLE 1A

CROSS REACTIVITY OF DIFFERENT COMPOUNDS[a]

Compound	Soil Equivalent Concentration (ppm) Required to Yield a Positive Result
1-Chloronaphthalene	10,000
1,2,4-Trichlorobenzene	10,000
2,4-Dichlorophenyl-benzenesulfonate	1,000
2,4-Dichloro-1-naphthol	>10,000
Bifenox	500
Diesel fuel	>10,000
Pentachlorobenzene	>10,000
2,5-Dichloroaniline	>10,000
Hexachlorobenzene	>10,000
Gasoline	>10,000
Dichlorofenthion	10,000
Tetradifon	125

(a) PCB RISc™ test kit, Ensys, Inc. publication

TABLE 1B

CROSS REACTIVITY OF DIFFERENT COMPOUNDS[a]

Compound	% Cross Reactivity
Aroclor 1248	100
Aroclor 1242	50
Aroclor 1254	90
Aroclor 1260	50
1,2-, 1,3-, & 1,4-Dichlorobenzene	<0.5
1,2,4-Trichlorobenzene	<0.5
biphenyl	<0.5
2,4-dichlorophenol	<0.5
2,5-dichlorophenol	<0.5
2,4,5-trichlorophenol	<0.5
2,4,6-trichlorophenol	<0.5
Pentachlorophenol	<0.5

[a] EnviroGard PCB Test Kits (Millipore Corporation)

TABLE 1C

CROSS REACTIVITY OF DIFFERENT COMPOUNDS[a]

Compound	MDL[b] (ppm)	IC 50[c] (ppm)	% Cross Reactivity[d]
Aroclor 1016	5.7	83	12
Aroclor 1221	25.5	300	3
Aroclor 1232	9.0	105	10
Aroclor 1242	1.5	31	32
Aroclor 1248	0.8	24	42
Aroclor 1254	0.5	10	100
Aroclor 1260	0.75	10	100
Aroclor 1262	0.5	10	100
Aroclor 1268	3.8	40	25

METHOD: The compounds listed were assayed at various concentrations and compared against an inhibition curve generated using Aroclor 1254. The concentration of the compound required to elicit a positive response at the MDL as well as the concentration required to yield 50% inhibition compared to the standard curve were determined.

[a] D TECH™ PCB test kit

[b] The Minimum Detection Limit (MDL) is defined as the lowest concentration of compound that yields a positive test result.

[c] The IC_{50} is defined as the concentration of compound required to produce a test response equivalent to 50% of the maximum response.

[d] % Cross reactivity is determined by dividing the equivalent Aroclor 1254 concentration by the actual compound concentration at IC_{50}

TABLE 1D

CROSS REACTIVITY OF DIFFERENT COMPOUNDS[a]

Compound	% Cross-Reactivity	Soil Equivalent Concentration (ppm) Required to Yield a Positive Result
1-Chloronaphthalene	0.05%	10,000
1,2,4-Trichlorobenzene	0.05%	10,000
2,4-Dichloro-1-naphthol	<0.20%	>10,000
Bifenox	<0.10%	500
Pentachlorobenzene	<0.05%	>10,000
2,5-Dichloroaniline	<0.05%	>10,000
Hexachlorobenzene	<0.05%	>10,000
Dichlorofenthion	0.05%	10,000
Tetradifon	<0.10%	125

(a) PCB RISc™ Liquid Waste Test System, Ensys, Inc.

TABLE 2

ESTIMATED ERROR RATES FOR 5 PPM DILUTION[a]

True Value (ppm)	0	1	2	3	4	5	6	7	8	9	10	20
Estimated Rate of False Positives (%)	1.3	13.2	39.2	65.2	82.3	.	.	.	.	.	.	.
Estimated Rate of False Negatives (%)	.	.	.	.	.	8.5	4.1	2.0	1.0	0.5	0.3	<0.1

TABLE 3

ESTIMATED ERROR RATES FOR 50 PPM DILUTION[a]

True Value (ppm)	0	5	10	15	20	30	40	50	60	70	80	100
Estimated Rate of False Positives (%)	1.0	7.9	24.5	46.0	65.0	87.3	95.6	.	.	.	.	.
Estimated Rate of False Negatives (%)	.	.	.	.	.	.	.	1.7	0.7	0.3	0.2	<0.1

(a) PCB RISc™ test kit

TABLE 4

Comparison of PCB RIS<u>c</u>™ Test Kit with GC

Sample ID	Screening Test Results	GC Results (Method 8082)	Agreement[a] Y, FP, FN
101	<5 ppm	<0.5 ppm	Y
284	<5 ppm	<0.5 ppm	Y
292	<5 ppm	<0.5 ppm	Y
199	<5 ppm	0.5 ppm	Y
264	<5 ppm	1 ppm	Y
257	<5 ppm	1.8 ppm	Y
259	<5 ppm	4 ppm	Y
265	<5 ppm	4.5 ppm	Y
200	<5 ppm	5 ppm	Y
170	5-50	5.8 ppm	Y
198	<5 ppm	2.2-5.8 ppm	Y
172	5-50	6.2 ppm	Y
169	5-50	7.2 ppm	Y
171	5-50	7.2 ppm	Y
202	<5 ppm, 5-50	1.3-7.2 ppm	Y
163	5-50	8.7 ppm	Y
165	5-50	9 ppm	Y
168	5-50	9 ppm	Y
166	5-50	9.3 ppm	Y
164	5-50	11.9 ppm	Y
204	5-50	12.8 ppm	Y
253	5-50	13 ppm	Y
203	5-50	13.5 ppm	Y
258	5-50	15 ppm	Y
106	5-50	15-19 ppm	Y
161	5-50	15.3 ppm	Y
167	5-50	16.2 ppm	Y

TABLE 4 (cont.)

Sample ID	Screening Test Results	GC Results (Method 8082)	Agreement[a] Y, FP, FN
247	5-50	18 ppm	Y
148	>50	18-34 ppm	FP
205	5-50	20 ppm	Y
162	5-50	20.4 ppm	Y
175	5-50	21.2 ppm	Y
176	5-50	21.6 ppm	Y
197	5-50	32 ppm	Y
243	5-50	32 ppm	Y
252	5-50	32 ppm	Y
178	5-50	43.7 ppm	Y
201	5-50	43 ppm	Y
254	5-50, >50	56 ppm	Y
238	>50	46-60 ppm	Y
248	5-50	44-60 ppm	Y
250	>50	68 ppm	Y
242	5-50	30-69 ppm	Y
256	>50	73 ppm	Y
249	>50	96 ppm	Y
245	>50	102 ppm	Y
241	5-50	154 ppm	FN
246	>50	154 ppm	Y
261	>50	204 ppm	Y
240	>50	251 ppm	Y
267	>50	339 ppm	Y
239	>50	460 ppm	Y
104	>50	200-3772 ppm	Y
108	>50	531-1450 ppm	Y

[a] Y=Yes, FN=False Negative, FP=False Positive

TABLE 5

Comparison of EnviroGard™ PCB Kit with GC

Sample Number	Screening Result[c,d]	GC Result[c] [8082]	Agreement[e] Y, FN, FP
001	>10	5.98	FP[g]
002	>10	1.27	FP
003	<10	0.11	Y
004	>10	6.71	FP[g]
005	>10	1.37	FP
006	>10	0.68	FP
007	>10	0.55	FP
008	>10	2.00	FP
009	>10	1.30	FP
010	>10	0.17	FP
011	>10	1.15	FP
012	<10	ND[f]	Y
013	<10	1.13	Y
014	<10	0.18	Y
015	>10	9.13	FP[g]
015	>10	9.84	FP[g]
016	>10	2110	Y
017	>10	2.55	FP
018	>10	45.4	Y
019	>10	6.70	FP[g]
020	<10	0.07	Y
021	<10	0.06	Y
022	<10	0.54	Y
022	<10	0.72	Y
023	>10	20.8	Y
024	<10	0.06	Y

TABLE 5 (cont.)

Sample Number	Screening Result[c,d]	GC Result[c] [8082]	Agreement[e] Y, FN, FP
024D	<10	0.05	Y
025	>10	11.7	Y
026	<10	1.96	Y
027	<10	0.06	Y
028	<10	0.22	Y
028D	<10	0.22	Y
029	<10	0.23	Y
030	<10	1.15	Y
031	<10	0.26	Y
032	>10	47.6	Y
033	>10	6.00	FP [g]
034	>10	34.0	Y
035	<10	ND[f]	Y
035D	<10	ND[f]	Y
036	>10	816	Y
037	<10	0.06	Y
037D	<10	0.04	Y
038	>10	1030	Y
039	<10	0.68	Y
040	>10	4.25	FP
041	<10	ND[f]	Y
042	>10	0.52	FP
042D	>10	0.47	FP
043	>10	1.69	FP
043D	>10	1.74	FP

TABLE 5 (cont.)

Sample Number	Screening Result[c,d]	GC Result[c] [8082]	Agreement[e] Y, FN, FP
044	<10	0.59	Y
045	<10	ND[f]	Y
046	<10	ND[f]	Y
046D	<10	ND[f]	Y
047	<10	0.09	Y
047D	<10	0.10	Y
048	<10	ND[d]	Y
049	<10	ND[d]	Y
050	>10	3.60	FP
050D	>10	4.41	FP
051	<10	ND[f]	Y
052	>10	4.21	FP
053	<10	0.96	Y
054	<10	0.52	Y
055	<10	2.40	Y
056	<10	0.51	Y
057	<10	ND[f]	Y
058	<10	0.69	Y
059	>10	7.86	FP[g]
060	>10	0.62	FP
060D	<10	0.58	Y
061	>10	580	Y
062	>10	2.35	FP
063	<10	0.09	Y
063D	<10	0.15	Y

TABLE 5 (cont.)

Sample Number	Screening Result[c,d]	GC Result[c] [8082]	Agreement[e] Y, FN, FP
064	>10	19.0	Y
065	>10	3.08	FP
066	<10	1.98	Y
067	<10	0.08	Y
068	<10	0.50	Y
069	<10	ND[f]	Y
069D	<10	ND[f]	Y
070	<10	ND[f]	Y
071	<10	0.05	Y
071D	<10	ND[f]	Y
072	<10	0.04	Y
073	>10	15.8	Y
074	>10	13.3	Y
075	>10	23.0	Y
076	>10	46.7	Y
077	<10	ND[f]	Y
078	>10	2.27	FP
079	>10	42.8	Y
080	<10	3.77	Y
081	<10	0.69	Y
081D	<10	0.45	Y
082	<10	ND[f]	Y
082D	<10	0.24	Y
083	<10	0.48	Y
083D	<10	0.41	Y
084	>10	1.16	FP

TABLE 5 (cont.)

Sample Number	Screening Result[c,d]	GC Result[c] [8082]	Agreement[e] Y, FN, FP
084D	>10	1.08	FP
085	>10	428	Y
085D	>10	465	Y
086	<10	1.42	Y
086D	<10	1.25	Y
087	<10	0.08	Y
087D	<10	ND[f]	Y
088	>10	2.70	FP
088D	>10	1.77	FP
089	>10	45.0	Y
090	<10	1.01	Y
090D	<10	1.40	Y
091	>10	1630	Y
091D	>10	1704	Y
092	<10	1.21	Y
092D	<10	ND[f]	Y
093	<10	0.30	Y
094	<10	0.36	Y
095	>10	17.5	Y
095D	>10	31.2	Y
096	<10	0.06	Y
097	<10	1.23	Y
097D	<10	0.29	Y
098	>10	1.17	FP
098D	>10	0.83	FP
099	<10	ND[f]	Y

TABLE 5 (cont.)

Sample Number	Screening Result[c,d]	GC Result[c] [8082]	Agreement[e] Y, FN, FP
100	>10	177	Y
100D	>10	167	Y
101	>10	1.21	FP
102	>10	293	Y
102D	>10	177	Y
103	>10	40.3	Y
104	>10	7.66	FP[g]
105	<10	0.21	Y
106	<10	2.50	Y
107	>10	14.1	Y
108	>10	3.84	FP
109	<10	ND[f]	Y
109D	<10	ND[f]	Y
110	<10	ND[f]	Y
111	<10	ND[f]	Y
112	>10	315	Y
113	>10	14.9	Y
114	>10	66.3	Y

[c] mg/kg (ppm)

[d] Screening Calibrator is 5 mg/kg Aroclor 1248

[e] Y=Yes, FN=False Negative, FP=False Positive

[f] ND = Not Detectable

[g] Expected Result Based on Calibrator Concentration

TABLE 6

EnviroGard™ PCB Kit Field Performance Summary

Specificity: [1-(Reported Positives/True Negatives)] = [1-(37/109)] = 66%

Note 1: 8 of the 37 reported positive samples had PCB contamination levels between 5 and 10 mg/kg. Soils in this range should test "positive" because the assay calibrator is 5 mg/kg Aroclor 1248. A positive assay bias is necessary to prevent false negative results.

Eliminating these samples from the calculations produces a Specificity of:

[1-(Reported Positives/True Negatives)] = [1-(29/101)] = 71%

Note 2: The distribution of false positives is not random ($p < 0.05$), with a clustering at the beginning of the sample set. This observation was included in *Developers Comments* which were added to the final draft of the Technical Evaluation Report. One explanation for the higher frequency of false positive results at the beginning is inexperience of the operator with the method. If the first 20 samples are eliminated from the Specificity analysis, the following result is obtained:

[1-(Reported Positives/True Negatives)] = [1-(20/86)] = 77%

In the SITE demonstration, the PCB Immunoassay had a 77% positive predictive value.

Sensitivity: [1-(Reported Negatives/True Positives)] = [1-(0/31)] = 100%

In the SITE demonstration, the PCB Immunoassay had a 100% negative predictive value.

TABLE 7

Comparison of D TECH™ PCB Test Kit with GC

Sample	D TECH™ (ppm)	GC (8082) (ppm)	Agreement[a] Y, FN, FP
J1	4.0-15	5.0	Y
J2	>50	147	Y
J3	15-50	54	Y
J5	15-50	160	FN
J6	>50	1200	Y
J7	4.0-15	12	Y
J8	4.0-15	28	FN
J9	>50	463	Y
J10	>50	1760	Y
J11	>50	28	FP
J12	15-50	17	Y
J13	>50	1300	Y
J14	>50	186	Y
J15	15-50	31	Y
J16	15-50	36	Y
J17	>50	31	FP
J18	>50	130	Y
J19	>50	1310	Y
J20	>50	2620	Y
J21	>50	111000	Y
J22	1.0-4.0	0.01	FP
J23	1.0-4.0	0.60	Y
J24	<0.5	0.10	Y

[a] Y=Yes, FN=False Negative, FP=False Positive

TABLE 7 (cont.)

Sample	D TECH™ (ppm)	GC (8082) (ppm)	Agreement[a] Y, FN, FP
J25	0.5-1.0	0.12	FP
J26	<0.5	0.01	Y
J27	1.0-4.0	1.8	Y
J28	<0.5	0.18	Y
J29	0.5-1.0	0.54	Y
J30	>50	21	FP
J31	4.0-15	13	Y
J32	0.5-1.0	0.72	Y
J33	0.5-1.0	0.32	Y
J34	1.0-4.0	0.36	FP
J35	1.0-4.0	0.26	FP
J36	>50	70	Y
J37	<0.5	0.12	Y
J38	0.5-1.0	0.81	Y
J39	0.5-1.0	0.33	Y
J40	<0.5	0.19	Y
J41	<0.5	0.01	Y
J42	1.0-4.0	0.43	FP
J43	1.0-4.0	0.31	FP
J44	15-50	503.4	FN
J45	15-50	5.6	FP
J46	<0.5	0.02	Y
J47	<0.5	0.22	Y

[a] Y=Yes, FN=False Negative, FP=False Positive

TABLE 7(cont.)

Sample	D TECH™ (ppm)	GC (8082) (ppm)	Agreement[a] Y, FN, FP
G1	15-50	18	Y
G2	4.0-15	11	Y
G3	1.0-4.0	3.4	Y
G4	15-50	6.5	FP
G5	<0.5	0.01	Y
G6	1.0-4.0	1.4	Y
G7	1.0-4.0	0.30	FP
G8	15-50	7.5	FP
G9	4.0-15	33	FN
G10	15-50	8	FP
G11	4.0-15	11	Y
G12	4.0-15	24	FN
G13	4.0-15	4.3	Y
G14	0.5-1.0	1.3	Y
G15	<0.5	0.01	Y
G16	1.0-4.0	3.2	Y
G17	4.0-15	18	Y
G18	4.0-15	4.6	Y
G19	1.0-4.0	2.3	Y
G20	>50	37	FP

[a] Y=Yes, FN=False Negative, FP=False Positive

TABLE 7(cont.)

Sample	D TECH™ (ppm)	GC (8082) (ppm)	Agreement[a] Y, FN, FP
W1A	4.0-15	9.1	Y
W2A	4.0-15	11	Y
W3A	1.0-4.0	2.8	Y
W4A	4.0-15	13	Y
W5A	>50	29	FP
W6A	>50	1200	Y
W7A	>50	57	Y
W8A	4.0-15	18	Y
W9A	1.0-4.0	1.3	Y
W10A	0.5-1.0	0.44	Y
W11A	15-50	120	FN
W12A	15-50	48	Y
W13A	15-50	19	Y
W14A	4.0-15	2.7	Y
W15A	1.0-4.0	1.3	Y
W16A	1.0-4.0	0.3	FP
W17A	4.0-15	1.4	FP
W18A	1.0-4.0	2.2	Y
W19A	4.0-15	8.2	Y
W20A	>50	9.3	FP
W21A	>50	110	Y
W22A	1.0-4.0	0.6	Y
W23A	>50	46	Y

[a] Y=Yes, FN=False Negative, FP=False Positive

TABLE 8

Intraassay Precision of the PCB RISc™ Liquid Waste Test System

PCB 1248 Spike Concentration (ppm)	Signal %RSD (OD_{450nm}) N=44 (11 data sets)	Statistical Percentage of False Results Compared to Standards
0	6.4%	<0.02%
0.2	5.9%	4.1%
5	7.9%	1.4%

TABLE 9

Interassay Precision of the PCB RISc™ Liquid Waste Test System

PCB 1248 Spike Concentration (ppm)	Signal %RSD (OD_{450nm}) N=44 (11 data sets)
0	6.4%
0.2	8.3%
5	8.5%

TABLE 10

Comparison of PCB RISc™ Liquid Waste Test with Method 8082

Sample ID	Sample Matrix	GC Results		IA Results	
		Aroclor	Conc. ppm	Test Results	Corr. with GC Results
302	Condensate	ND[b]	ND	<5	yes
303	Condensate	ND	ND	<5	yes
304	Condensate	1242	25	≥5	yes
306	Condensate	1242	5	≥5	yes
307	Condensate	1242	<10	<5	yes
308	Condensate	1242	58	≥5	yes
310	Condensate	1254	25	≥5	yes
311	Condensate	1242	200	≥5	yes
331	Transformer Oil	1260	183	≥5	yes
380	Transformer Oil	PCB[c]	20	≥5	yes
381	Transformer Oil	PCB	38	≥5	yes
382	Transformer Oil	PCB	163	≥5	yes
383	Transformer Oil	PCB	176	≥5	yes
384	Transformer Oil	PCB	336	≥5	yes
385	Transformer Oil	PCB	6400	≥5	yes
387	Coolant	PCB	10	≥5	yes
388	2,4-D Rinse Water	1254	<10	<5	yes
389	Waste Solvent	1242	29	≥5	yes
390	Herbicide	ND	<2	<5	yes
391	Paint/Solvent	1254	9	≥5	yes
394	Waste Solvent	1242/1260	11/17	≥5	yes
395	Waste Solvent	1242/1260	2/2	<5	yes
396	Waste Oil	1260	323	≥5	yes
398	Chlor. Solvent	ND	<5	<5	yes
399	Paint	ND	<50	<5	yes
400	Pump Oil	ND	<50	<5	yes
401	Waste Solvent	ND	<35	<5	yes
402	Herbicide	ND	<50	<5	yes
403	Paint/Solvent	ND	<5	<5	yes
404	Printing Solvent	ND	<5	<5	yes
405	Waste Solvent	ND	<50	<5	yes

TABLE 10 (cont.)

Sample ID	Sample Matrix	GC Results		IA Results	
		Aroclor	Conc. ppm	Test Results	Corr. with GC Results
407	Waste Oil	ND	ND	≥5	FP[d]
408	Waste Oil	ND	ND	<5	yes
409	Waste Oil	ND	ND	<5	yes
410	Waste Oil	ND	ND	<5	yes
411	Waste Oil	ND	ND	<5	yes
412	Waste Oil	ND	ND	<5	yes
413	Waste Oil	ND	ND	<5	yes
414	Waste Oil	ND	ND	<5	yes
415	Waste Oil	ND	ND	<5	yes
416	Waste Oil	PCB	50	>5	yes
417	Waste Oil	ND	ND	<5	yes
418	Waste Oil	ND	ND	<5	yes
419	Waste Oil	ND	ND	<5	yes
420	Waste Oil	ND	ND	<5	yes
421	Waste Oil	ND	ND	<5	yes
422	Waste Oil	ND	ND	<5	yes
423	Waste Oil	ND	ND	<5	yes
424	Waste Oil	ND	ND	<5	yes
425	Waste Oil	ND	ND	<5	yes
Number of False Positive Results				1/32	
Rate				3.1%	
Number of False Negative Results				0/18	
Rate				0.0%	

[a] Trial 1 data

[b] ND = Not Detectable

[c] PCB = Aroclor was not determined

[d] FP = False positive

TABLE 11

Correlation of PCB RISc™ Liquid Waste Test and Method 8082 Results
Using Spiked and Unspiked Liquid Waste Field Samples

ID	Matrix	GC Results Unspiked ppm	Immunoassay Result		Interp.
			Unspiked ppm	Spiked (5 ppm 1248)	
001	Aromatic solvent	<5	<5	≥5	
002	Aviation gas	<5	<5	≥5	
003	Chiller oil	<5	<5	≥5	
004	Compressor oil	<5	<5	≥5	
005	Coolant + water	<5	<5	≥5	
006	Coolant oil	NR[b]	NR	≥5	
007	Coolant oil	NR	<5	≥5	
008	Cutting oil	<5	<5	≥5	
009	Cutting oil	<5	<5	≥5	
010	Degreaser still bottom	<5	<5	≥5	
011	Dope oil	<5	<5	≥5	
012	Draw Lube oil	<5	<5	≥5	
013	Fleet crankcase oil	<5	<5	≥5	
014	Floor sealer	<5	<5	≥5	
015	Fuel oil	<5	<5	≥5	
016	Hi-BTU oil	<5	<5	≥5	
017	Honing oil	<5	<5	≥5	
018	Hydraulic oil	<5	<5	≥5	
019	Hydraulic oil	<5	<5	≥5	
020	Hydraulic oil	<5	<5	≥5	
021	Machine oil	NR	<5	NR	
022	Mineral oil	<5	<5	≥5	
023	Mineral spirits	<5	<5	≥5	
024	Mineral spirits + ink	<5	≥5	≥5	FP
025	Mixed flammables	<5	<5	≥5	
026	Mixed solvents	<5	<5	≥5	
027	Naphtha	<5	<5	≥5	
028	Oil	<5	<5	≥5	
029	Oil	<5	<5	≥5	
030	Oil	<5	<5	≥5	
031	Oil	<5	<5	≥5	

TABLE 11 (cont.)

ID	Matrix	GC Results Unspiked ppm	Immunoassay Result		Interp.
			Unspiked ppm	Spiked (5 ppm 1248)	
032	Oil	<5	<5	≥5	
033	Oil	<5	<5	≥5	
034	Oil + 1,1,1-trichloroethane	<5	<5	≥5	
035	Oil sludge	<5	≥5	≥5	FP
036	Oil + freon	<5	<5	≥5	
037	Oil + mineral spirits	<5	<5	≥5	
038	Oil + scum solution	<5	<5	≥5	
039	Oily water	<5	<5	≥5	
040	Paint thinner	<5	<5	≥5	
041	Paint thinner	<5	<5	≥5	
042	Paint thinner	<5	<5	≥5	
043	Paint waste	<5	<5	≥5	
044	Paint waste + thinner	<5	<5	≥5	
045	Perce + oil	<5	<5	≥5	
046	Petroleum distillates	<5	≥5	≥5	FP
047	Petroleum naphtha	<5	<5	≥5	
048	Pumping oil	<5	<5	≥5	
049	RAC-1 SKOS	<5	<5	≥5	
050	Sk oil	NR	<5	≥5	
051	Sk oil	<5	<5	≥5	
052	Smog Hog	<5	<5	≥5	
053	Toluene + hexane	<5	<5	≥5	
054	Toluene + stain	<5	<5	≥5	
055	1,1,1-Trichloroethane	<5	≥5	≥5	FP
056	1,1,1-Trichloroethane	<5	<5	≥5	
057	1,1,1-Trichloroethane	<5	<5	≥5	
058	1,1,1-Trichloroethane	<5	<5	≥5	
059	1,1,1-TCE + methanol	<5	<5	≥5	
060	Trichloroethylene	<5	<5	≥5	
061	Trichloroethylene	<5	<5	≥5	
062	Trichloroethylene	<5	<5	≥5	
063	Turpentine	<5	<5	≥5	

TABLE 11 (cont.)

ID	Matrix	GC Results Unspiked ppm	Immunoassay Result		Interp.
			Unspiked ppm	Spiked (5 ppm 1248)	
064	Used n-butylacetate	<5	<5	≥5	
065	Used oil + freon	<5	<5	≥5	
066	Used oil + freon	<5	<5	≥5	
067	Used oils	<5	<5	≥5	
068	Used petroleum	<5	<5	≥5	
069	Used petroleum	<5	<5	≥5	
070	Used synthetic oil	<5	<5	≥5	
071	Varnish + stain	<5	<5	≥5	
072	Varsol	<5	<5	≥5	
073	Waste coolant + oil	<5	<5	≥5	
074	Waste ink + solvent	<5	<5	≥5	
075	Waste naphtha	<5	<5	≥5	
076	Waste oil	<5	<5	≥5	
077	Waste oil	<5	<5	≥5	
078	Waste oil	<5	<5	≥5	
079	Waste oil	<5	<5	≥5	
080	Waste oil	<5	<5	≥5	
081	Waste oil	<5	<5	≥5	
082	Waste oil	<5	<5	≥5	
083	Waste oil	<5	<5	≥5	
084	Waste oil	<5	<5	≥5	
085	Waste oil + kerosene	<5	<5	≥5	
086	Waste oil + gas	<5	<5	≥5	
087	Waste paint	<5	<5	≥5	
088	Waste paint	<5	<5	≥5	
089	Waste paint	<5	<5	≥5	
090	Waste paint	<5	<5	≥5	
091	Waste paint	<5	<5	≥5	
092	Waste paint	<5	<5	≥5	FP
093	Waste SC-49 solvent	<5	<5	≥5	
094	Waste solvent	<5	<5	≥5	
095	Waste stoddard	<5	<5	≥5	
096	Waste toner	<5	<5	≥5	

TABLE 11 (cont.)

ID	Matrix	GC Results Unspiked ppm	Immunoassay Result		Interp.
			Unspiked ppm	Spiked (5 ppm 1248)	
097	Waste tramp oil	<5	<5	≥5	
098	Waste transmission fluid	<5	<5	≥5	
099	Xylene	<5	≥5	≥5	FP
100	Not Recorded	<5	<5	NR	
No. of False Positive Results Rate		6/99 6.1%			
No. of False Negative Results Rate				0/98 0.0%	

[a] Trial 2 data

[b] NR = not run

STRATEGIC DIAGNOSTICS INC.

RaPID Assay® PAH Test Kit
A00156/A00157

Intended Use

The RaPID Assay® PAH (polyaromatic hydrocarbons) Test Kit can be used as a quantitative, semi-quantitative or qualitative enzyme immunoassay (EIA) for the analysis of PAH in water (groundwater, surface water, well water). For soil application please refer to specific procedure. For applications in other matrices please contact our Technical Service department or refer to the soil application procedure provided. The RaPID Assay® PAH Test Kit allows reliable and rapid screening for PAH (measured and reported as phenanthrene) and related compounds, with quantitation between 2.66 and 66.5 (as phenanthrene). The minimum detection level of the kit is 0.93 (as phenanthrene) in water.

Test Principles

The PAH RaPID Assay® kit applies the principles of enzyme linked immunosorbent assay (ELISA) to the determination of PAH and related compounds. The sample to be tested is added, along with an enzyme conjugate, to a disposable test tube, followed by paramagnetic particles with antibodies specific to PAH attached. Both the PAH (which may be in the sample) and the enzyme labeled PAH (the enzyme conjugate) compete for antibody binding sites on the magnetic particles. At the end of an incubation period, a magnetic field is applied to hold the paramagnetic particles (with PAH and labeled PAH analog bound to the antibodies on the particles, in proportion to their original concentration) in the tube and allow the unbound reagents to be decanted. After decanting, the particles are washed with Washing Solution.

The presence of PAH is detected by adding the enzyme substrate (hydrogen peroxide) and the chromogen (3,3',5,5' – tetramethylbenzidine). The enzyme labeled PAH analog bound to the PAH antibody catalyzes the conversion of the substrate/chromogen mixture to a colored product. After an incubation period, the reaction is stopped and stabilized by the addition of acid. Since the labeled PAH (conjugate) was in competition with the unlabeled PAH (sample) for the antibody sites, the color developed is inversely proportional to the concentration of PAH in the sample.

NOTE: Color development is inversely proportional to the PAH concentration.

Darker color = lower concentration
Lighter color = higher concentration

The determination of the PAH level in an unknown sample is interpreted relative to the standard curve generated from kit standards after reading with a spectrophotometer.

Performance Characteristics

The PAH RaPID Assay® will detect PAH and related compounds to different degrees. Refer to the table below for data on several of these compounds. The PAH RaPID Assay® kit provides screening results. As with any analytical technique (GC, HPLC, etc.) positive results requiring some action should be confirmed by an alternative method.

The PAH RaPID Assay® immunoassay test does not differentiate between PAH and other related compounds. The table below shows compounds at the method detection limit (MDL) which is the lowest concentration of the compound that can be picked up in the assay in a water matrix. The limit of quantitation (LOQ) is an approximate concentration in water required to yield a positive result at the lowest standard. **This is the lowest concentration of the compound that can be quantified in the assay in water.** The IC50 is the concentration required to inhibit one half of the color produced by the negative control. It is also used to calculate cross-reactivity values to similar compounds.

Compound	MDL (ppb)	LOQ (ppb)	IC50 (ppb)
Phenanthrene	0.93	2.66	21.9
Fluoranthene	0.43	0.76	6.25

Benzo(a)pyrene	0.67	1.12	9.18
Pyrene	0.27	1.24	10.24
Chrysene	0.53	1.26	10.4
Anthracene	0.72	1.77	14.6
Indeno(1,2,3-c,d)pyrene	1.04	4.4	36.2
Benzo(a)anthracene	1.02	4.6	37.8
Fluorene	2.19	5.7	46.8
Benzo(b) fluoranthene	1.21	8.77	72.1
Acenaphthylene	13.3	72.3	595
Benzo(k) fluoranthene	1.02	84.7	697
Acenaphthalene	17.2	111.1	915
Benzo(g,h,i) perylene	19.6	>162	>1330
Naphthalene	86.5	>162	>1330
Dibenzo(a,h) anthracene	34.2	>162	>1330
Heating Fuel	17.02	47.2	388.4
JP-5	452.2	1011.3	8326
JP-4	811.3	>1615	>13300
Gasoline	1330	>1615	>13300
Kerosene	1662.5	>1615	>13300
Jet A Fuel	>13300	>13300	>13300

The presence of the following substances up to 250 ppm were found to have no significant effect on PAH RaPID Assay® results: calcium, copper, iron, manganese, magnesium, mercury, nickel, nitrate, phosphate and zinc. In addition, sodium chloride up to 1.0M, sulfate to 10,000 ppm, sulfite and thiosulfate to 100 ppm, showed no significant effect on results.

The Total PAH (sum of 16 PAH compounds) of the indicated contaminant types in soil samples are expressed below, at each of the three kit calibrator (standards) levels, in units comparable to results from GC Method 8270 or HPLC Method 8310.

PAH RaPID Assay®
Total PAH in Water (in ppb)

Contaminant	S1 Equivalent	S2 Equivalent	S3 Equivalent
Creosote	0.532	4	13.3
Coal Tar Oil	0.532	2.66	13.3
Diesel	0.133	1.33	5.32
Turbine Jet Fuel	2	10.64	53.2
Fuel Oil #1	2	10.64	53.2
Fuel Oil #2	0.133	1.33	6.65
Fuel Oil #4	0.133	0.665	3.33
Fuel Oil #5,6	0.133	0.4	1.33

Precautions

- Training is strongly recommended prior to using the RaPID Assay® test system. Contact Strategic Diagnostics for additional information.
- Treat PAH, solutions that contain PAH, and potentially contaminated samples as hazardous materials.
- Use gloves, proper protective clothing, and methods to contain and handle hazardous material where appropriate.
- Reagents must be added in a consistent manner to the entire rack. A consistent technique is the key to optimal performance. Be sure to treat each tube in an identical manner.
- Water samples should be at a neutral pH prior to analysis. Samples containing gross particulate should be filtered (e.g. 0.2 um Anotop™ 25 Plus, Whatman, Inc.) to remove particles.
- Store all test kit components at 2°C to 8°C (36°F to 46°F). Storage at ambient temperature (18°C to 27°C or 64°F to 81°F) on the day of use is acceptable. *Test tubes require no special storage and may be stored separately to conserve refrigerator space.*
- Allow all reagents to reach ambient temperature (18°C to 27°C or 64°F to 81°F) before beginning the test. This typically requires at least 1 hour to warm from recommended storage conditions.
- Do not freeze test kit components or expose them to temperatures above 100°F (39°C).
- Do not use test kit components after the expiration date.
- Do not use reagents or test tubes from one test kit with reagents or test tubes from a different test kit.
- Do not mix reagents from kits of different lot numbers.
- Use approved methodologies to confirm any positive results.

- Do not under any circumstances attempt to disassemble the base of the magnetic rack. Magnets will be violently attracted to each other.

- Adequate sample number and distribution are the responsibility of the analyst.

- The photometer provided in the accessory kit requires electricity and comes with a 110V adapter. Adapters for 220V are available. Do not attempt to operate with a car adaptor.

- Do not expose color solution to direct sunlight.

- Do not dilute or adulterate test reagents or use samples not called for in the test procedure; this may give inaccurate results.

- Tightly recap the standard vials when not in use to prevent evaporative loss.

Materials Provided

- Antibody Coupled Paramagnetic Particles in buffered saline containing preservative and stabilizers.

  30 test kit: one 20 mL vial
  100 test kit: one 65 mL vial

- Lyophilized Enzyme Conjugate

  1 vial

- Enzyme Conjugate Diluent

  30 test kit: one 10 mL vial (minimum)
  100 test kit: one 35 mL vial (minimum)

- Standards

  Three concentrations (2.0, 10.0, 50.0 ppb) of Phenanthrene standards (as phenanthrene analog) in buffered saline containing preservative and stabilizers are supplied. Each vial contains 4 mL.

- Control

  A concentration (approximately 25 ppb) of Phenanthrene (as phenanthrene analog) in buffered saline containing preservative and stabilizers. A 4 mL volume is supplied in one vial.

- Diluent/Zero Standard

  Buffered saline containing preservative and stabilizers without any detectable PAH.

  30 test kit: one 10 mL vial
  100 test kit: one 35 mL vial

- Color Solution containing hydrogen peroxide and 3,3',5,5'-tetramethylbenzidine in an organic base.

  30 test kit: one 20 mL vial
  100 test kit: one 65 mL vial

- Stop Solution containing a solution of 2M sulfuric acid.

  30 test kit: one 20 mL vial
  100 test kit: one 60 mL vial

- Washing Solution containing preserved deionized water with detergent.

  30 test kit: one 70 mL vial
  100 test kit: one 250 mL vial

- Polystyrene test tubes

  30 test kit: one 36 tube box
  100 test kit: three 36 tube boxes

- User's Guide

Materials Required and Ordered Separately

See "Ordering Information" for the appropriate catalogue numbers.

Rapid Assay® Accessory Kit

Accessory equipment may be rented or purchased from Strategic Diagnostics. See "Ordering Information" for the appropriate catalogue numbers.

The accessory kit contains the following items:

- Adjustable Volume Pipet
- Eppendorf™ Repeater® Pipettor
- Electronic timer
- Portable balance capable of weighing 10 g (for soil samples)
- Vortex mixer
- Magnetic separation rack

- RPA-I RaPID Analyzer (or equivalent spectrophotometer capable of reading 450 nm in a 1 mL sample size).

Other Items

- 12.5 mL Combitips® for the Repeater pipettor - for 0.25 mL to 1.25 mL dispensing volumes (5)
- Pipet tips for adjustable volume pipet (100-1000 uL)

NOTE: Order replacement Combitips® and pipet tips separately. See the "Ordering Information" section.

Materials Required but Not Provided

- Methanol (HPLC grade or equivalent) for water samples
- Protective clothing (e.g., latex gloves)
- Absorbent paper for blotting test tubes
- Liquid and solid waste containers
- Marking pen
- Instructional video (optional)

Suggestions for Pipettor Use

- Practice using both pipettes (adjustable volume and Repeater pipettor) with water and extra tips before you analyze your samples.
- Use a new tip each time you use the Repeater pipettor to pipette a different reagent to avoid reagent cross-contamination. Tips can be rinsed thoroughly, dried completely and reused. By using the same tip to dispense the same reagent each time you can avoid cross contamination.

NOTE: Repeator tips should be changed periodically (after ~10 uses) since precision deteriorates with use.

- Draw the desired reagent volume into the Repeater pipettor and dispense one portion of the reagent back into the container to properly engage the ratchet mechanism. If you do not do this, the first volume delivered may be inaccurate.
- To add reagents using the Repeater pipettor, pipette down the side of the test tube just below the rim.
- When adding samples and standard using the positive displacement pipettor, always pipette into the bottom of the tube without touching the sides or bottom of the tube.
- Use a new adjustable volume pipet tip each time you pipette a new unknown.

Assay Procedure

Prior to performing your first Rapid Assay®, please take time to read the package inserts in their entirety and review the videotape if available. **On site training is strongly recommended for new users of this test system.** Please contact your account manager for further information. This procedure is designed for quantitative analysis. For running the kit semi-quantitatively or qualitatively, please contact Technical Support.

Reagent Preparation

The PAH Enzyme Conjugate is provided as a lyophilized preparation that must be reconstituted prior to use.

1. Prepare the conjugate by adding approximately 3 mL of the conjugate diluent to the lyophilized conjugate vial using the disposable transfer pipet.
2. Swirl gently to dissolve the conjugate.
3. Accurately transfer the vial contents to the diluent bottle.
4. Repeat this procedure twice more with 3 mL aliquots of conjugate diluent.
5. Invert diluent bottle several times to mix completely and let stand approximately 5 minutes before use.
6. Enter the date of reconstitution on the side label of the PAH Conjugate Diluent bottle. Also, enter the expiration date of the PAH Enzyme Conjugate solution which is **21 days** from the date of reconstitution.
7. If the conjugate cannot be used up within 21 days of reconstitution, aliquots should be prepared and frozen. *Frozen aliquots of reconstituted conjugate may be used until the expiration date found on the kit box label.*

Collect/Store the Sample

The following steps explain how to properly collect and store your samples.

1. Water samples should be collected in glass vessels with teflon cap liners. **Immediately upon collection, water samples should be diluted with (HPLC grade) methanol (1:3 or 1 part water sample to 3 parts of methanol) to prevent adsorptive losses to the glass containers.** This is a 1.33x dilution, which must be accounted for when interpreting results. See "Results Interpretation", Section 3a for further details. Use this diluted sample as "sample" in "Perform the Test".

NOTE: This 1.33x dilution is not required for soil samples.

2. Samples should be collected in appropriately sized and labeled containers.
3. If testing soil samples, follow the SDI Sample Extraction Kit User's Guide or the appropriate technical bulletin to properly collect and store your sample.
4. Samples should be tested as soon as possible after collection. If this is not possible, storage at 4°C (39°F) is recommended to minimize evaporative losses.

Set Up

1. Remove kits from refrigerator. All reagents must be allowed to come to room temperature prior to analysis. Remove reagents from packaging and place at room temperature at least 1 hour prior to testing.
2. Turn on the RPA-1 or other spectrophotometer. The RPA-1 should be warmed up for at least 30 minutes prior to the run.
3. Label five 12.5 mL Combitips "Conjugate", "Particles", "Wash", "Color" and "Stop". In addition, add the name of the compound you are testing for to each Combitip.
4. Remove nine clean blank test tubes for standards and control and one test tube for each sample (if testing in singlicate). Label the test tubes according to contents as follows.

Tube #	Contents
1	Negative control (replicate 1)
2	Negative control (replicate 2)
3	Standard 1 (replicate 1)
4	Standard 1 (replicate 2)
5	Standard 2 (replicate 1)
6	Standard 2 (replicate 2)
7	Standard 3 (replicate 1)
8	Standard 3 (replicate 2)
9	Control
10	Sample 1
11	Etc.

***Label at top of tubes to avoid interference with reading of tubes in photometer**

Sample Extraction and Dilution

Filtration may be necessary to remove gross particulate from the water sample. If testing at levels higher than standard kit levels is desired, contact SDI for special instructions. Please follow the instructions from the SDI Sample Extraction Kit to prepare and dilute the soil extract prior to running the assay. Dilute water samples as described in "Collect/Store the Sample."

Perform the Test

1. Separate the upper rack from the magnetic base. Place labeled test tubes into the rack.
2. Add **250 uL** of standards, control or samples to the appropriate tubes using the adjustable volume pipet with the dial set on **0250**. The negative control, standards and control must be run with each batch of samples.

NOTE: Sample should be added to the bottom of the tube by inserting the pipet tip into the tube without touching the sides or the bottom of the tube. Take care not to contact sample with pipette tip once dispensed into bottom of the tube.

3. Using the Repeater Pipettor with the "Conjugate" tip attached and the dial set on **"1"**, add **250 uL** of Enzyme conjugate down the **inside wall** of each tube. (Aim the pipet tip ¼" to ½" below the tube rim or tube wall; deliver liquid gently to avoid splashback.)
4. Thoroughly mix the magnetic particles by swirling (avoid vigorous shaking) and attach the "Particles" tip

to the Repeater Pipettor. With the dial set on **"2"** add **500 uL** of magnetic particles to each tube, aiming down the side of the tube as described above. Vortex, mixing each tube 1 to 2 seconds at low speed to minimize foaming. Pipetting of magnetic particles should be kept to 2 minutes or less.

5. Incubate 30 minutes at room temperature.

6. After the incubation, combine the upper rack with the magnetic base and press all tubes into the base; allow 2 minutes for the particles to separate.

7. With the upper rack and magnetic base combined, use a smooth motion to invert the combined rack assembly over a sink and pour out the tube contents.

NOTE: If the rack assembly inadvertently comes apart when lifting to pour out tube contents, re-combine and wait an additional 2 minutes to allow particles to separate.

8. **Keep the rack inverted** and gently blot the test tube rims on several layers of paper towels. It is important to remove as much liquid as possible but **do not bang** the rack or you may dislodge the magnetic particles and affect the results.

9. Set the Repeater Pipettor dial to **"4"** and put on the tip labeled "Wash". Add **1 mL** of Washing Solution down the inside wall of each tube by using the technique described earlier. Vortex tubes for 1-2 seconds. **Wait 2 minutes** and pour out the tube contents as described previously. **Repeat this step one more time.**

NOTE: The number of washes and wash volume are important in ensuring accurate results.

10. Remove the upper rack (with its tubes) from the magnetic base. With the "Color" tip attached to the Repeater Pipet and the dial set to **"2"** add **500 uL** of Color Reagent down the inside wall of each tube as described previously. Vortex 1 to 2 seconds (at low speed).

11. Incubate 20 minutes at room temperature. During this period, add approximately 1 mL of Washing solution to a clean tube for use as an instrument blank for "Results Interpretation".

12. After the incubation, position the Repeater pipettor at Setting **"2"** and use the "Stop" tip to add **500 uL** of Stop solution to all test tubes.

13. Proceed with results interpretation.

WARNING: **Stop solution contains 2M sulfuric acid. Handle carefully.**

Results Interpretation

1. After addition of Stop Solution to the test tubes, results should be read within 15 minutes.

2. Wipe the outside of all antibody coated tubes prior to photometric analysis to remove fingerprints and smudges.

Photometric Interpretation Using the RPA-I

1. The RPA-I photometer (provided in the Rapid Assay® Accessory kit) can be used to calculate and store calibration curves. It is preprogrammed with various RaPID Assay® protocols. To obtain results from the PAHs Rapid Assay® test kit parameters are as follows:

Data Reduct: Lin. Regression
Xformation : Ln/LogitB
Read Mode : Absorbance
Wavelength : : 450 nm
Units : PPB
Rgt Blk : 0

Calibrators:
# of Cals : 4
# of Reps : 2

Concentrations:
#1: 0.00 ppb
#2: 2.00 ppb
#3: 10.0 ppb
#4: 50.0 ppb
Range : 0.7 – 50.0

Correlation : 0.990
Rep. %CV : 10%

NOTE: Prior to analysis the RPA-I User's Manual should be thoroughly reviewed for more detailed operation instructions.

2. Follow the instrument prompts to read the absorbance of all tubes:

Instrument Display	Operator Response
SELECT COMMAND	Press RUN
RUN PROTOCOL	Scroll using the YES [] or NO [] keys until the desired protocol appears. Then press ENTER
SPL. REPLICATES (1-5)	Press 1 (for analysis of samples in singlicate.) Press ENTER
BLANK TUBE, INSERT TUBE, EVALUATING TUBE,	Insert blank tube containing 1mL wash solution.
REMOVE TUBE (Beep)	Remove tube
CAL #1, REP. #1, INSERT TUBE, EVALUATING TUBE,	Insert Tube #1
REMOVE TUBE (Beep)	Remove tube

Follow prompts to read tubes.

NOTE: Tube order is important. The RPA-I expects to see the standards in ascending order, in duplicate, starting with the negative control.

Following evaluation of all standards, the instrument will display:

PRINTING DATA,	Data will print
PRINTING CURVE	Curve will print only if programmed to print (See RPA1 User's Manual).
CTRL #1 REP #1, INSERT TUBE, EVALUATING TUBE,	Insert Control Tube
REMOVE TUBE (Beep)	Remove Tube
EDIT CALIBRATORS YES/NO	Press NO (if editing is necessary press YES and refer to the RPA1 User's Manual).
SPL #1 REP#1 INSERT TUBE EVALUATING TUBE	Insert first sample tube
REMOVE TUBE (Beep)	Remove tube

Continue to follow prompts. After all samples have been read, press STOP.

Expected Results:

- **%CV (coefficient of variation) between standard duplicates of 10% or less.**
- **Absorbance reading for the 0 ppb standard should be between 0.8 and 2.0 for all assays.**
- **Correlation (r) of 0.990 or greater for all assays.**
- **Kit control within range specified on vial.**
- **Absorbance of negative control and standards should be as follows:**

  Negative Control>Std. 1>Std. 2>Std. 3.

3. Concentrations will be indicated for all samples on the RPA-I printout.

   a) The concentration, as indicated on the printout, is multiplied by the appropriate dilution factor (if applicable) introduced in the procedure. The quantitation range of the kit is also multiplied by this factor.

   EXAMPLE: Water samples were diluted 1.33 with methanol upon collection (see "Collect/Store the Sample" in the User's Guide). As a result, the concentrations listed on the printout should be multiplied by 1.33 to determine the sample concentration. The standard concentrations are also multiplied by 1.33 to give a quantitation range in water 2.66 to 66.5 ppb.

   b) Samples with an "nd" and no concentration listed have an absorbance greater than the negative control; therefore, no concentration can be computed for these samples. Results must be reported as <2.66 ppb (or Standard 1 multiplied by the dilution factor).

c) Samples with an "nd" next to a listed concentration have an estimated concentration below the minimum detection level of the test kit. Results must be reported as <2.66 ppb (or Standard 1 multiplied by the dilution factor).

NOTE: Any samples with concentrations determined to be lower than Standard 1 (the limit of quantitation) must be reported as <2.66 ppb (or Standard 1 multiplied by the dilution factor). Quantitation is not possible below this standard as this is outside the linear range of the assay.

d) Similarly, samples with a "hi" next to a listed concentration have an estimated concentration higher than Standard 3 and must be reported as >66.5 ppb (or Standard 3 multiplied by the dilution factor).

NOTE: In order to determine the concentration of samples with concentrations greater than Standard 3, they must be subjected to repeat testing using a diluted sample. A ten-fold or greater dilution of the sample is recommended with an appropriate amount of PAH diluent. This additional dilution must then be taken into account when calculating the concentration. Please contact Technical Support for assistance in performing dilutions.

Photometric Interpretation Using Other Photometers

Other photometers may also be used to interpret results obtained from the RPA-I photometer. It is important that the photometer be able to read absorbance at 450nm and that the instrument can read at a 1 mL fill volume. Absorbances obtained from other spectrophotometers (reading at 450 nm) may be used to manually calculate sample concentrations as outlined below.

1. Calculate the mean absorbance for each of the three standards and the negative control.

2. Determine the standard deviation and %CV (coefficient of variation) of each standard and ensure %CV is less than 10% for each.

3. Calculate the %B/Bo for each standard by dividing the mean absorbance value for the standard by the mean absorbance value for the negative control and multiplying the results by 100.

4. Construct a standard curve by plotting the %B/Bo for each standard on the vertical logit (y) axis versus the corresponding analyte concentration on the horizontal logarithmic (x) axis on the graph paper provided in the test kit. **Graph papers are specific for each method. Use only the graph paper supplied with each kit.**

5. Draw the best straight line through all points. Using the %B/Bo of the sample, the concentration can be interpolated from the standard curve.

6. Multiply results by the appropriate dilution factor (if applicable) introduced in the procedure. For example, if the sample was diluted 10-fold to increase the detection levels of the kit then the results must be multiplied by 10. This dilution also changes the range of the assay (standards) by the same factor.

Limitations of the Procedure

The Rapid Assay® PAH Test Kit is a screening test **only**. Sampling error may significantly affect testing reliability. Adequate sample number and distribution are the responsibility of the analyst.

Ordering Information

Description	**Catalogue Number**
Rapid Assay® PAH 30 Tube Kit	A00156
Rapid Assay® PAH 100 Tube Kit	A00157
Rapid Assay® Accessory Kit**	6050100
Adjustable Volume Pipet Tips (100-1000 uL)	A00013
12.5 mL Combitip for Repeating Pipette (1 each)	A00009
PAH Diluent	A00159
PAH Soil Proficiency Sample	A00158
Rapid Assay® Rental Accessory Kit	6997010
**** To obtain part numbers and pricing for individual items in the Accessory Kit contact SDI at the number below.**	

Ordering/Technical Assistance

Should you have any questions regarding this procedure prior to analysis contact Technical Service to avoid costly mistakes.

To Place an Order or Receive Technical Assistance, please call Strategic Diagnostics Inc. at:

Call toll-free **800-544-8881`**

Or 302-456-6789 Phone
302-456-6782 Fax
Web site: www.sdix.com
E-mail: techservice@sdix.com

General Limited Warranty

SDI's products are manufactured under strict quality control guidelines and are warranted to be free from defects in materials and workmanship. New instruments and related non-expendable items are warranted for one year from date of shipment against defective materials or workmanship under normal use and service.

Warranty obligation is limited to repair or replacement of the defective product or to refund of the purchase price, at the discretion of SDI. Other warranties, express or implied, are disclaimed. SDI's liability under any warranty claim shall not exceed the refund of the purchase price paid by the customer. Under no circumstances shall SDI be liable for special, indirect or consequential damages.

Safety

To receive an MSDS for this product, visit our web site at www.sdix.com.

Z00304.1, Rev 4/6/00

Operation of the Repeater Pipet

To Set or Adjust Volume

To determine the pipetting volume, the dial setting (1-5) is multiplied by the minimum pipetting volume of the tip (indicated on the side of the Combitip, e.g. 1≃100 uL.)

To Assemble Pipet Tip

Slide filling lever down until it stops. Then raise the locking clamp and insert the tip until it clicks into position. Be sure the tip plunger is fully inserted into the barrel before lowering the locking clamp to affix the tip in place.

To Fill Tip

With tip mounted in position on pipet, immerse end of tip into solution. Slide filling lever upward slowly. Combitip will fill with liquid.

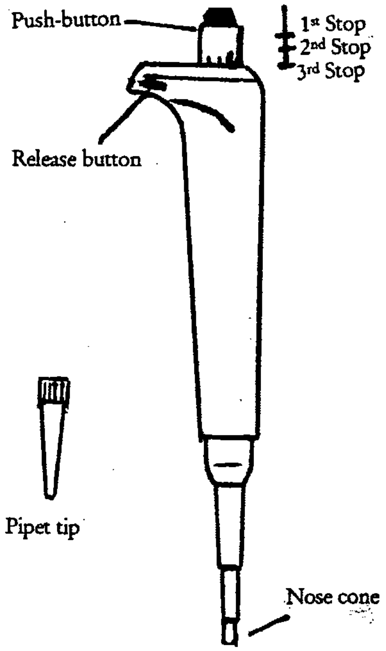
To Dispense Sample

Check the volume selection dial to ensure pipetting volume. Place tip inside test tube so that tip touches the inner wall of tube. Completely depress the pipetting lever to deliver sample. NOTE: Dispense one portion of reagent back into the container to engage the ratchet mechanism and ensure accuracy.

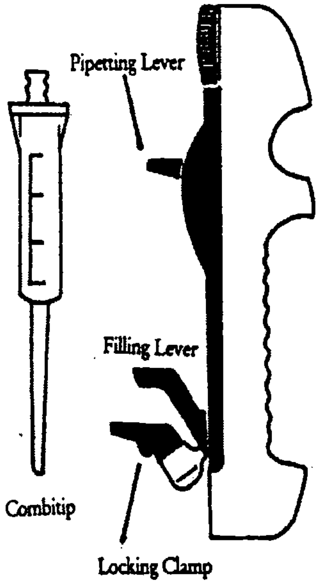
To Eject Tip

Empty tip of any remaining solution into appropriate container by pushing filling lever down. Raise locking clamp upward, and remove the Combitip.

Adjustable Volume Pipet



Repeater Pipet



Operation of the Adjustable Volume Pipet

To Set or Adjust Volume

Press release button on side of pipette and turn the push-button to adjust volume up or down. Volume setting is displayed on top of pipet. See kit instructions for appropriate setting. Pipet will accurately dispense volumes between 100 and 1000 uL.

To Assemble Pipet Tip

Gently push nose cone of pipet firmly into a pipet tip contained in the pipet tip rack.

To Withdraw Sample

Keep pipet almost vertical. With tip mounted in position on pipet, press push-button to 1st stop and hold it. Place tip at bottom of liquid sample and slowly release push-button to withdraw measured sample. Ensure that no air bubbles exist in the pipette tip. If bubbles exist, dispense sample and re-withdraw. Slide tip out along the inside of the vessel.

To Dispense Sample

Wipe any liquid from outside of tip taking care not to touch orifice. Place tip into tube, almost to the bottom, and slowly press push-button to 2nd stop. Hold push-button at 2nd stop when removing tip from tube.

To Eject Tip

Press push-button to 3rd stop. Tip is ejected.

METHOD 4035

SOIL SCREENING FOR POLYNUCLEAR AROMATIC HYDROCARBONS BY IMMUNOASSAY

1.0 SCOPE AND APPLICATION

1.1 Method 4035 is a procedure for screening soils to determine when total polynuclear aromatic hydrocarbons (PAHs) are present at concentrations above 1 mg/kg. Method 4035 provides an estimate for the concentration of PAHs by comparison with a PAH standard.

1.2 Using the test kit from which this method was developed, $\geq$95% of samples confirmed to have concentrations of PAHs below detection limits will produce a negative result in the 1 ppm test configuration.

1.3 The sensitivity of the test is influenced by the binding of the target analyte to the antibodies used in the kit. The commercial PAH kit used for evaluation of this method is most sensitive to the three (i.e., phenanthrene, anthracene, fluorene) and four (i.e., benzo(a)anthracene, chrysene, fluoranthene, pyrene) ring PAH compounds listed in Method 8310, and also recognizes most of the five and six ring compounds listed.

1.4 The sensitivity of the test is influenced by the nature of the PAH contamination and any degradation processes operating at a site. Although the action level of the test may vary from site to site, the test should produce internally consistent results at any given site.

1.5 In cases where the exact concentration of PAHs are required, quantitative techniques (i.e., Methods 8310, 8270, or 8100) should be used).

1.6 This method is restricted to use by or under the supervision of trained analysts. Each analyst must demonstrate the ability to generate acceptable results with this method.

2.0 SUMMARY OF METHOD

2.1 An accurately weighed sample is first extracted and the extract filtered using a commercially available test kit. The sample extract and an enzyme conjugate reagent are added to immobilized antibody. The enzyme conjugate "competes" with the PAHs present in the sample for binding to the immobilized anti-PAH antibody. The test is interpreted by comparing the response produced by testing a sample to the response produced by testing standard(s) simultaneously.

2.2 A portion of all samples in each analytical batch should be confirmed using quantitative techniques.

3.0 INTERFERENCES

3.1 Chemically similar compounds and compounds which might be expected to be found in conjunction with PAH contamination were tested to determine the concentration required to produce a positive result. These data are shown in Tables 1 and 2.

3.2 The kit was optimized to respond to three and four ring PAHs. The sensitivity of the test to individual PAHs is highly variable. Naphthalene, dibenzo(a,h)anthracene, and benzo(g,h,i)perylene have 0.5 percent or less than the reactivity of phenanthrene with the enzyme conjugate.

3.3 The alkyl-substituted PAHs, chlorinated aromatic compounds, and other aromatic hydrocarbons, such as dibenzofuran, have been demonstrated to be cross-reactive with the immobilized anti-PAH antibody. The presence of these compounds in the sample may contribute to false positives.

4.0 APPARATUS AND MATERIALS

PAH RISc^{TM} Soil Test (EnSys, Inc.), or equivalent. Each commercially available test kit will supply or specify the apparatus and materials necessary for successful completion of the test.

5.0 REAGENTS

Each commercially available test kit will supply or specify the reagents necessary for successful completion of the test.

6.0 SAMPLE COLLECTION, PRESERVATION, AND HANDLING

6.1 See the introductory material to this chapter, Organic Analytes, Sec. 4.1.

6.2 Soil samples may be contaminated, and should therefore be considered hazardous and handled accordingly.

7.0 PROCEDURE

7.1 Method 4035 is intended for field or laboratory use.

7.2 Follow the manufacturer's instructions for the test being used. Those test kits used must meet or exceed the performance indicated in Tables 3-7.

7.3 The action limit for each application must be within the operating range of the kit used.

8.0 QUALITY CONTROL

8.1 Follow the manufacturer's instructions for the test kit being used for quality control procedures specific to the test kit used. Additionally, guidance provided in Chapter One should be followed.

8.2 Use of replicate analyses, particularly when results indicate concentrations near the action level, is recommended to refine information gathered with the kit.

8.3 Do not use test kits past their expiration date.

8.4 Do not use tubes or reagents designated for use with other kits.

8.5 Use the test kits within the specified storage temperature and operating temperature limits.

9.0 METHOD PERFORMANCE

9.1 The extraction efficiency of a commercially available test kit was tested (PAH RISc^{TM} Test, EnSys Inc.) by spiking phenanthrene, benzo(a)anthracene and benzo(a)pyrene into PAH negative soil matrices (PAH-116 and PAH-141 are field samples). The soils were spiked using detection limits established for each compound (see Table 1), extracted and determined by immunoassay. The results for these 3-, 4- and 5-ring PAHs (Table 4) demonstrated that they were extracted with good recovery and yielded the correct assay interpretation.

9.2 A single laboratory study was conducted with a commercially available test kit (PAH RISc^{TM} Test, EnSys Inc.), using 25 contaminated soil samples. Four replicate determinations were made on each test sample and the data compared with values obtained using HPLC Method 8310. Several analysts performed the immunoassay analyses. The immunoassay data agreed in all cases with the external HPLC data obtained (Table 5).

9.3 An additional single laboratory validation study on 30 randomly selected, PAH-contaminated field samples from multiple sites was run by the USEPA Region X Laboratory. Results are reported in Table 6 on an as found basis, and reported in Table 7 normalized to phenanthrene, based on cross-reactivity data (from Table 1). The false positive rate at the 1 ppm action level was 13% for unnormalized results and 19% for normalized results based on 31 analyses. The false negative rate at 1 ppm was 0 in both cases. At the 10 ppm action level, the false positive rate was 19% unnormalized and 26% normalized. False negative rates at 10 ppm were 6% unnormalized and 3% normalized.

9.4 The probabilities of generating false positive and false negative results at an action level of 1 ppm are listed in Table 3.

10.0 REFERENCES

1. PAH-RISc^{TM} Users Guide, EnSys Inc.

2. P. P. McDonald, R. E. Almond, J. P. Mapes, and S. B. Friedman, "PAH-RISc^{TM} Soil Test - A Rapid, On-Site Screening Test for Polynuclear Aromatic Hydrocarbons in Soil", J. of AOAC International (accepted for publication document #92263)

3. R. P. Swift, J. R. Leavell, and C. W. Brandenburg, "Evaluation of the EnSys PAH-RISc^{TM} Test Kit", Proceedings, USEPA Ninth Annual Waste Testing and Quality Assurance Symposium, 1993.

TABLE 1

Cross-reactivity of Method 8310 PAHs

Compound	Concentration Giving a Positive Result (ppm Soil Equivalent)	Percent Cross-Reactivity
2 Rings		
Naphthalene	200	0.5
3 Rings		
Acenaphthene	8.1	12
Acenaphthylene	7.5	13
Phenanthrene	**1.0**	**100**
Anthracene	0.81	123
Fluorene	1.5	67
4 Rings		
Benzo(a)anthracene	1.6	64
Chrysene	1.2	84
Fluoranthene	1.4	73
Pyrene	3.5	29
5 Rings		
Benzo(b)fluoranthene	4.6	22
Benzo(k)fluoranthene	9.4	11
Benzo(a)pyrene	8.3	12
Dibenzo(a,h)anthracene	>200	<0.5
6 Rings		
Indeno(1,2,3-c,d)pyrene	11	9.4
Benzo(g,h,i)perylene	>200	<0.5

TABLE 2

Cross Reactivity of Other PAHs and Related Compounds

Compound	Concentration Giving a Positive Result (ppm, Soil Equivalent)	Percent Cross-Reactivity
Other PAHs		
1-Methylnaphthylene	54	1.8
2-Methylnaphthylene	58	1.7
1-Chloronaphthylene	59	1.7
Halowax 1013	18	5.7
Halowax 1051	>200	<0.5
Dibenzofuran	14	7.2
Other Compounds		
Benzene	>200	<0.5
Toluene	>200	<0.5
CCA	>200	<0.5
Phenol	>200	<0.5
Creosote	5.4	18.5
2,4,6-Trichlorobenzene	>200	<0.5
2,3,5,6-Tetrachlorobenzene	>200	<0.5
Pentachlorobenzene	>200	<0.5
Pentachlorophenol	>200	<0.5
Bis(2-ethylhexyl) phthalate	>200	<0.5
Aroclor 1254	>200	<0.5
Aroclor 1260	>200	<0.5

TABLE 3

Probability of False Negative and False Positive Results for PAHs at A 1 ppm Action Level

Spike Concentration Phenanthrene (ppm)	Probability of False Positive (Mean ± SD)	Probability of False Negative (Mean ± SD)
0	0% ± 0%	N/A
0.4	23% ± 17%	N/A
0.8	94% ± 13%	N/A
1.0	N/A	0% ± 0%

Results were obtained from spiking four different validation lots, using 3 operators, 12 matrices for a total of 201 determinations at each concentration of phenanthrene.

N/A = No false positive or negative possible above action limit.

TABLE 4

Spike Recovery of Phenanthrene, Benzo(a)anthracene and Benzo(a)pyrene

Compound	**Spike (ppm)**	**Soil**	**PAH RISc™ Results**
Blank	0	Wake	<1
Blank	0	PAH-116	<1
Phenanthrene	1	Wake	1-10
Phenanthrene	1	PAH-116	1-10
Phenanthrene	1	PAH-141	1-10
Phenanthrene	10	Wake	>10
Phenanthrene	10	PAH-116	>10
Phenanthrene	10	PAH-141	>10
Benzo(a)anthracene	1.6	Wake	1-10
Benzo(a)anthracene	1.6	PAH-116	1-10
Benzo(a)anthracene	16	Wake	>10
Benzo(a)anthracene	16	PAH-116	>10
Benzo(a)pyrene	8.3	Wake	1-10
Benzo(a)pyrene	8.3	PAH-116	1-10
Benzo(a)pyrene	83	PAH-116	>10

TABLE 5

Powerplant Field Samples (Soil) Evaluated by Immunoassay

Field Sample Number	EnSys Method Immunoassay (ppm)	Method 8310 HPLC (ppm)
PAH-137	>10	<21
PAH-141	<1	<21
PAH-118	1-10	<26
PAH-136	>10	26
PAH-139	>10	<28
PAH-126	1-10, >10	<32
PAH-127	>10	<33
PAH-122	>10	<33
PAH-138	>10	33
PAH-131	>10	<34
PAH-128	>10	<35
PAH-132	>10	<43
PAH-112	>10	<48
PAH-140	>10	50
PAH-130	>10	54
PAH-116	<1	<61
PAH-135	>10	71
PAH-133	>10	<91
PAH-119	>10	<100
PAH-120	>10	<161
PAH-124	>10	<167
PAH-134	>10	182
PAH-114	>10	<247
PAH-113	>10	<294
PAH-115	>10	<343

TABLE 6

Total PAH Content of Region X Field Samples Using EnSys PAH RISc™ Immunoassay Test Kit

Sample ID	1 ppm Test		10 ppm Test		GC/MS Lab Result (ppm)[1]	False +/-	
	<1	>1	<10	>10		Eval @ 1 ppm	Eval @ 10 ppm
PAH-1		*		*	0.2	+	+
PAH-2				*	12.2		
PAH-3				*	16.0		
PAH-4	*				0.00		
PAH-5	*				0.5		
PAH-6		*		*	8.7		+
PAH-7				*	148		
PAH-8				*	182		
PAH-9		*		*	4.4		+
PAH-10		*		*	0.2	+	+
PAH-11	*				0.00		
PAH-12				*	85.4		
PAH-12Dup				*	85.4		
PAH-13				*	28.5		
PAH-14	*		*		0.3		
PAH-15		*			0.6	+	
PAH-16	*		*		0.00		
PAH-17		*		*	1.8		+
PAH-18		*	*		3.4		
PAH-19		*	*		6.7		
PAH-20	*		*		0.9		
PAH-21				*	43.2		

[1] Sum of all PAHs detected.

TABLE 6 (cont.)

Sample ID	1 ppm Test		10 ppm Test		GC/MS Lab Result (ppm)[1]	False +/-	
	<1	>1	<10	>10		Eval @ 1 ppm	Eval @ 10 ppm
PAH-22				*	72.8		
PAH-23		*		*	1.3		+
PAH-24		*	*		0.3	+	
PAH-25	*		*		0.4		
PAH-26			*		27.9		-
PAH-27	*		*		0.00		
PAH-28			*		16.4		-
PAH-29	*		*		0.4		
PAH-30		*	*		9.6		

TABLE 7

Total PAH Content of Region X Field Samples Using EnSys PAH RISc$^{\text{TM}}$ Immunoassay Test Kit Normalized to Cross-reactivity

Sample ID	1 ppm Test		10 ppm Test		GC/MS Lab Result (ppm)[1]	False +/-	
	<1	>1	<10	>10		Eval @ 1 ppm	Eval @ 10 ppm
PAH-1		*		*	0.1	+	+
PAH-2				*	8.1		+
PAH-3				*	9.0		+
PAH-4	*				0.00		
PAH-5	*				0.2		
PAH-6		*		*	5.2		+
PAH-7				*	56.9		
PAH-8				*	73.2		

[1] Sum o f all PAHs detected.

TABLE 7 (cont.)

Sample ID	1 ppm Test		10 ppm Test		GC/MS Lab Result (ppm) [1]	False +/-	
	<1	>1	<10	>10		Eval @ 1 ppm	Eval @ 10 ppm
PAH-9		*		*	0.1	+	+
PAH-10		*		*	0.00	+	+
PAH-11	*				0.00		
PAH-12				*	47.3		
PAH-12Dup				*	47.3		
PAH-13				*	11.5		
PAH-14	*		*		0.2		
PAH-15		*			0.5	+	
PAH-16	*		*		0.00		
PAH-17		*		*	1.2		+
PAH-18		*	*		1.7		
PAH-19		*	*		3.6		
PAH-20	*		*		0.6		
PAH-21				*	27.5		
PAH-22				*	49.2		
PAH-23		*		*	0.8	+	+
PAH-24		*	*		0.1	+	
PAH-25	*		*		0.2		
PAH-26			*		13.5		-
PAH-27	*		*		0.00		
PAH-28			*		6.4		
PAH-29	*		*		0.2		
PAH-30		*	*		2.8		

[1] Sum of all PAHs detected.

APPENDIX K

X-RAY FLUORESCENCE SOP

SPECTRACE 9000 FIELD PORTABLE X-RAY FLUORESCENCE OPERATING PROCEDURES

SOP#: 1713
DATE: 01/26/95
REV. #: 0.0

1.0 SCOPE AND APPLICATION

The purpose of this Standard Operating Procedure (SOP) is to serve as a guide to the start-up, check out, operation, calibration, and routine use of the Spectrace 9000 field portable x-ray fluorescence instrument for field use in screening hazardous or potentially hazardous inorganic materials. It is not intended to replace or diminish the use of the Spectrace 9000 Operating Instructions. The Operating Instructions contain additional information for optimizing instrument performance and for utilizing different applications.

The procedures contained herein are general operating guidelines which may be changed as required, depending on site conditions, equipment limitations, limitations imposed by Quality Assurance\Quality Control (QA\QC) procedure or other protocol limitations. In all instances, the procedures finally employed should be documented and included in any or all final reports. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

1.1 Principles of Operation

X-ray Fluorescence (XRF) spectroscopy is a non destructive qualitative and quantitative analytical technique used to determine the chemical composition of samples. In a source excited XRF analysis, primary X-rays emitted from a sealed radioisotope source are utilized to irradiate samples. During interaction with samples, source X-rays may either undergo scattering (dominating process) or absorption by sample atoms in a process known as the photoelectric effect (absorption coefficient). This phenomenon originates when incident radiation knocks out an electron from the innermost shell of an atom creating a vacancy. The atom is excited and releases its surplus energy almost instantly by filling the vacancy with an electron from one of the higher energy shells. This rearrangement of electrons is associated with the emission of X-rays characteristic (in terms of energy) of the given atom. This process is referred to as emission of fluorescent X-rays (fluorescent yield). The overall efficiency of the fluorescence process is referred to as excitation efficiency and is proportional to the product of the absorption coefficient and the fluorescent yield.

1.1.1 Characteristic X-rays

The Spectrace 9000 utilizes characteristic X-ray lines originating from the innermost shells of the atoms: K, L, and occasionally M. The characteristic X-ray lines of the K series are the most energetic lines for any element and, therefore, are the preferred analytical lines. The K lines are always accompanied by the L and M lines of the same element. However, with energies much lower than those of the K lines, they can usually be neglected for those elements for which the K lines are analytically useful. For heavy elements such as cerium (Ce) (atomic number [Z]=58), to uranium (U, Z=92), the L lines are the preferred lines for analysis. The L_α and L_β lines have almost equal intensities, and the choice of one or the other depends on what interfering lines might be present. A source just energetic enough to excite the L lines will not excite the K lines of the same element. The M lines will appear together with the L lines.

The Spectrace 9000 Operating Instructions contain a table that identifies the X-rays (K or L) and elements measured for each excitation source.

An X-ray source can excite characteristic X-rays from an element only if the source energy is greater than the absorption edge energy for the particular line group of the element (e.g., K absorption edge, L absorption edge, M absorption edge). The absorption edge energy is somewhat greater than the corresponding line energy. Actually, the K absorption edge energy is approximately the sum of the K, L, and M line energies, and the L absorption edge energy is approximately the sum of the L and M line energies of the particular element.

Energies of the characteristic fluorescent X-rays are converted (within the detector) into a train of electric pulses, the amplitudes of which are linearly proportional to the energy. An electronic multichannel analyzer (electronic unit) measures the pulse amplitudes, which is the basis of a qualitative X-ray analysis. The number of counts at a given energy is representative of element concentration in a sample and is the basis for quantitative analysis.

1.1.2 Scattered X-rays

The source radiation is scattered from the sample by two physical processes: coherent or elastic scattering (no energy loss), and Compton or inelastic scattering (small energy loss). Thus, source backscatter (background signal) actually consists of two components with X-ray lines close together. The higher energy line is equal to the source energy. Since the whole sample takes part in scattering, the scattered X-rays usually yield the most intense lines in the spectrum. Furthermore, the scattered X-rays have the highest energies in the spectrum and, therefore, contribute most of the total measured intensity signal.

1.2 Sample Types

Solid and liquid samples can be analyzed for elements aluminum (Al) through uranium (U) with proper X-ray source selection and instrument calibration. Typical environmental applications are:

- Heavy metals in soil (in-situ or samples collected from the surface or from bore hole drillings, etc.), sludges, and liquids (e.g., lead (Pb) in gasoline)
- Light elements in liquids (e.g., phosphorus [P], sulphur [S], and chlorine [Cl] in organic solutions)
- Heavy metals in industrial waste stream effluents
- PCB in transformer oil by Cl analysis
- Heavy metal air particulates collected on membrane filters, either from personnel samplers or from high volume samplers.
- Lead (Pb) in paint

2.0 METHOD SUMMARY

The Spectrace 9000 Portable XRF Analyzer employs three radioactive isotope sources: iron-55 (Fe-55), cadmium-109 (Cd-109), and americium-241 (Am-241) for the production of primary X-rays. Each source emits a specific set of primary X-rays which excite a corresponding range of elements in a sample. When more than one source can excite the element of interest, the appropriate source is selected according to its excitation efficiency for the element of interest. See page 1-2 of the Spectrace 9000 Operating Instructions for a chart of source type versus element range.

The sample is positioned in front of the source-detector window and sample measurement is initiated which exposes the sample to primary radiation from the source. Fluorescent and backscattered X-rays from the sample enter through the beryllium (Be) detector window and are counted in the high resolution mercuric iodide (HgI_2) detector.

Elemental concentrations are computed using a Fundamental Parameter (FP) algorithm of the form:

$$\text{Concentration} = R \times S \times (1 + \text{SUM}\{A_n \times C_n\})$$

"R" is the measured analyte X-ray intensity relative to the pure element; "S" is a calculated sensitivity coefficient. The quantity SUM{} is a summation of "n"-element absorption-enhancement terms containing calculated alpha-coefficients and iteratively computed element concentrations. The Spectrace 9000 utilizes FP XRF calibrations derived from theoretical considerations (as opposed to empirical data). The menu-driven software in the Spectrace 9000 supports multiple XRF calibrations called "applications." Each application is a complete analysis configuration including elements to be measured, interfering elements in the sample, and a set of FP calibration coefficients.

The measurement time of each source is user-selectable. The shorter source measurement times (15 - 30s) are generally used for initial screening and hot spot delineation, while longer measurement times (30 - 500s) are typically used for higher precision and accuracy requirements.

3.0 SAMPLE PRESERVATION, CONTAINERS, HANDLING AND STORAGE

This SOP specifically describes equipment operating procedures for the Spectrace 9000; hence, this section is not applicable to this SOP.

4.0 INTERFERENCES AND POTENTIAL PROBLEMS

The total method error for XRF analysis is defined as the square root of the sum of squares of both instrument precision and user or application related error. Generally, the instrument precision is the least significant source of error in XRF analysis. User- or application-related error is generally more significant and will vary with each site and method used. The components of the user or application related error are the following.

4.1 Sample Placement

This is a potential source of error because the X-ray signal decreases as the distance from the radioactive source is increased. However, this error is minimized by maintaining the same distance for each sample.

4.2 Sample Representivity

In order to accurately characterize site conditions, samples collected must be representative of the site or area under investigation. Representative soil sampling ensures that a sample or group of samples accurately reflects the concentration of the contaminant(s) of concern at a given time and location. Analytical results from representative samples reflect the variation in pollutant presence and concentration range throughout a site. Variables affecting sample representativeness include: (1) geologic variability, (2) contaminant concentration variability, (3) collection and preparation variability, and (4) analytical variability. Attempts should be made to minimize these sources of variability. For additional information on representative sampling, refer to the "Removal Program Representative Sampling Guidance, Volume 1 - Soil."(1)

4.3 Reference Analysis

Soil chemical and physical matrix effects may be corrected by using site-specific soil samples which have been analyzed by Inductively-Coupled Plasma (ICP) or Atomic Absorption (AA) spectroscopy as calibration samples. A major source of error can result if these samples are not representative of the site and/or if the analytical error is large. Additionally, when comparing XRF results with reference analyses results, the efficiency of the sample digestion reference analysis should be considered. Some digestion methods may breakdown different sample matrices more efficiently than others.

4.4 Chemical Matrix Effects (Due to the Chemical Composition of the Sample)

Chemical matrix effects result from differences in concentrations of interfering elements. These effects appear as either spectral interferences (peak overlaps) or as X-ray absorption/enhancement phenomena. Both effects are common in soils contaminated with heavy metals. For example, iron (Fe) tends to absorb copper (Cu) X-rays, reducing the intensity of Cu measured by the detector. This effect can be corrected mathematically through the use of FP coefficients.

4.5 Physical Matrix Effects (Due to Sample Morphology)

Physical matrix effects are the result of variations in the physical character of the sample. They may include such parameters as particle size, uniformity, homogeneity, and surface condition. For example, consider a sample in which the analyte exists in the form of very fine particles within a matrix composed of much courser material. If two separate aliquots of the sample are prepared in such a way that the matrix particles in one are much larger than in the other, then the relative volume of analyte occupied by the analyte-containing particles will be different in each. When measured, a larger amount of the analyte will be exposed to the source X-rays in the sample containing finer matrix particles; this results in a higher intensity reading for that sample and, consequently, an apparently higher measured concentration for that element.

4.6 Application Error

Generally, the error in the application calibration model is insignificant (relative to the other sources of error) **PROVIDED** the instrument's operating instructions are followed correctly. However, if the sample matrix varies significantly from the design of the application, the error may become significant (e.g., using the soils application to analyze a 50 percent iron mine tailing sample).

4.7 Moisture Content

Sample moisture content will affect the analytical accuracy of soils or sludges. The overall error may be secondary when the moisture range is small (5-20 percent), or it may be a major source of error when measuring the surface of soils that are saturated with water.

4.8 Cases of Severe X-ray Spectrum Overlaps

When present in the sample, certain X-ray lines from different elements can be very close in energy and, therefore, can interfere by producing a severely overlapped spectrum.

The typical spectral overlaps are caused by the K_β line of element Z-1 (or as with heavier elements, Z-2 or Z-3) overlapping with the K_α line of element Z. This is the so-called K_α/K_β interference. Since the $K_\alpha:K_\beta$ intensity ratio for the given element usually varies from 5:1 to 7:1, the interfering element, Z-1, must be present in large concentrations in order to disturb the measurement of analyte Z. The presence of large concentrations of vanadium (V) could disturb the measurement of chromium (Cr). The V K_α and K_β energies are 4.951 and 5.427 Kev, respectively. The Cr K_α energy is 5.41 Kev. The resolution of the detector is approximately 270 eV. Therefore, large amounts of V in a sample will result in spectral overlap of the V K_β with the Cr K_α peak (see Figure 1, Appendix A) and the measured X-ray spectrum will include TOTAL counts for Cr plus V lines.

Other interferences arise from K/L, K/M, and L/M line overlaps. While these are less common, the following are examples of severe overlap:

As K_α/Pb L_α , S K_α/Pb M_α

In the arsenic (As)/lead case, Pb can be measured from the Pb L_β line, and arsenic from either the As K_α or the As K_β line; this way the unwanted interference can be corrected. However, due to the limits of mathematical corrections, measurement sensitivity is reduced. Generally, arsenic concentrations can not be efficiently calculated in samples with Pb:As ratios of 10:1 or more. This may result in zero arsenic being reported regardless of what the actual concentration is.

The Spectrace 9000 uses overlap factors to correct for X-ray spectral overlaps for the elements of interest for a given application.

5.0 EQUIPMENT / APPARATUS

5.1 Description of the Spectrace 9000 System

The analyzer utilizes the method of Energy Dispersive X-Ray Fluorescence (EDXRF) spectrometry to determine the elemental composition of soils, sludges, aqueous solutions, oils, and other waste materials.

The Spectrace 9000 analyzer includes three compact, sealed radiation sources contained in a measuring probe: Fe-55, Cd-109, and Am-241. The analyzer software automatically selects which sources to use as well as measurement time for each source based on stored information for each application. The probe is equipped with a high resolution HgI_2 detector, which is connected by cable to an environmentally sealed electronic module.

The electronic unit provides internal non volatile memory for storage of 120 spectra and 300 multi-element analysis reports. An RS-232 serial port is provided for downloading data and spectra to a peripheral device. The multi-element analysis reports and the 2000-channel spectra can be displayed on the instrument's LCD panel. The replaceable and rechargeable internal battery provides for field-portable operation.

The Spectrace 9000 is supplied with three factory-installed FP-based applications (calibrations). The "Soil Samples" application is for analysis of soils where the balance of the sample (that portion not directly measured by the instrument) is silica (SiO_2). The "Thin Film" application is for analysis of thin films such as air monitoring filters or wipes. Finally, the "PbK in Paint" application is for analyzing Pb in paint films and is reasonably independent of the type of substrate. Spectrace Instruments will also develop calibrations to meet new user application requirements (e.g., adding elements to the present "Soil Samples" application). The PC-based Spectrace 9000 Application Generater software may also be used to develop new applications.

The Spectrace 9000 can be powered from a 115-volt (or 220-volt) wall outlet or from its 4-hour capacity battery. It can be operated in temperatures ranging from 32 to 120° Fahrenheit (F). Furthermore, the probe and electronic unit may be exposed to a light rain. However, additional protection is provided when the system (electronic unit and probe) is contained in the optional water repellant carrying case.

5.2 Equipment and Apparatus List

5.2.1 Spectrace 9000 Analyzer System

The complete Spectrace 9000 Analyzer System includes:

- Analyzer unit for data acquisition, processing, and display
- Hand-held probe including:
  - High-resolution HgI_2 detector
  - Three excitation sources(^{55}Fe, ^{109}Cd, ^{241}Am)
  - Safety cover
- Probe laboratory stand with the following:
  - Base for table top use
  - Safety shield over sample
  - Positioning fixtures for standard 30-mm and 40-mm X-ray sample cups
- Interconnecting cable
- RS-232C Serial I/O Interface cable
- Two blank check samples
- Pure element check samples
- Battery charger
- Battery pack
- System carrying/shipping case
- Spectrace 9000 Operating Instructions, application software, and utilities software. The application software is specific to each unit and cannot be interchanged between different units. The software is identified by the serial number of the unit.

5.2.2 Optional Items

- 31-mm diameter sample cups
- XRF polypropylene film, 0.2 mil thick
- Field carrying case
- Peripheral devices such as a printer and IBM compatible Personal Computer (PC)
- Spare probe window assembly
- Spare battery pack, charger, and charger adaptor (required to charge spare battery outside of electronic unit)

See the Spectrace 9000 Accessories Price List for additional options.

For mobile lab or laboratory X-ray sample preparation accessories (such as drying ovens, grinders, sieves, etc.), consult general laboratory equipment suppliers.

5.2.3 Limits and Precautions

The probes should be handled in accordance with the following radiological control practices.

1. The probe should always be in contact with the surface of the material being analyzed, and that material should completely cover the probe opening (aperture) when the sources are exposed. Do not remove a sample or move the probe while the indicators show **SOURCE ON**.

SOURCE ON indicators are:

- the message on the screen **"SOURCE ON"**
- the flashing light at the base of the probe.

2. When the sources are exposed, under no circumstances should the probe be pointed at the operator or surrounding personnel.
3. Do not place any part of the operator's or co-worker's bodies in line of exposure when the sources are exposed or partially covered.

4. The probe must be covered with the safety cover or laboratory safety shield when not in use.

5. Spectrace Instruments must be notified immediately of any condition or concern relative to the probe's structural integrity, source shielding, source switching condition, or operability.

6. The appropriate state agency or the Nuclear Regulatory Commission (NRC) office must be notified immediately of any damage to the radioactive source, or any loss or theft of the device (see factory supplied data on radiological safety).

7. Labels or instructions on the probe(s) must not be altered or removed.

8. The user must not attempt to open the probe.

9. The source(s) in the probe must be leak-tested every 6 months as described in the Spectrace 9000 Operating Instructions. The leak test certificates must be kept on file, and a copy must accompany the instrument at all times.

10. The probe laboratory safety shield assembly must be used when the probe is inverted for measuring samples contained in cups.

11. During operation, the probe must be kept at least 10 feet from computer monitors and any other source of radio frequency (RF). Some monitors have very poor RF shielding and will affect measurement results.

12. The Spectrace 9000 should not be dropped or exposed to conditions of excessive shock or vibration.

13. The electronic unit should be left on whenever the battery charger is connected to it. If the electronic unit is shut off with the battery charger plugged in, the battery may be damaged due to overcharging.

Additional precautions include:

1. The probe cable must never be pulled while unplugging the probe. The probe plug should be grasped at the ribbed metal connector and squeezed and pulled gently while the connector is unplugged. The connector must never be forced when plugging in the connector.

2. The handle of the electronic unit must not be rotated unless the release buttons on each side of the handle are depressed.

3. The Spectrace 9000 should not be stored at an ambient temperature below -4°F or above 110°F.

4. The battery charging unit should only be used indoors in dry conditions.

5. Battery packs should be changed only in dry conditions.

5.3 Peripheral Devices

The Spectrace 9000 may be used with a wide range of peripheral devices for electronic data capture or printed readout as long as they are compatible with the RS-232 serial I/O protocol. Such devices include terminals, printers, electronic data loggers, personal computers, etc.

5.3.1 Communication Cable Connection

Plug the 25-pin connector of the RS-232 Serial I/O cable into the Spectrace 9000 25-pin connector (the connection just below the display screen on the electronic unit) and the 9-pin connector of the cable into the serial port of the receiving device.

5.3.2 Communication Port Setup

To communicate with an external device, the Spectrace 9000 **MUST** be set at the same baud rate, word length, and parity as the receiving device. The Spectrace 9000 allows you to select various configurations for these parameters in the communication (Comm.) port setup portion of the More submenu (which can be accessed from the main menu).

The default COM setup for application and utilities software is 9600,N,8,1.

5.3.3 User Software

Refer to your PC software manual for details on additional settings that may be required for proper interfacing between the Spectrace 9000 and your particular software.

5.4 Instrument Maintenance

5.4.1 Probe Window

Should the probe window become damaged or punctured, it should be replaced as soon as possible to prevent dust and moisture from entering the probe. Replacement window assemblies can be ordered from Spectrace Instruments. Note the location of the window aperture; it is closer to one end of the window plate. Simply unscrew the old window plate, press any corner of it, and remove it. Stretch the O-ring for 10 seconds, and lay it back in the groove. The O-ring must lie flat in the groove in order for the new window plate to be installed. Install the new window assembly in the same manner as the old. If the surface of the window plat is not flush with the face of the probe, the O-ring has probably come out of the grove. Remove the assembly, and try the same procedure again.

5.4.2 Further Information and Troubleshooting

Refer to the Spectrace 9000 Operating Instructions for additional detailed operational and/or maintenance and troubleshooting instructions. If no solution is found in the manual, contact Spectrace Instruments for assistance.

An instrument log should be maintained to document specific corrective actions taken to alleviate any instrumental problems, or for recording any service that has been performed.

6.0 REAGENTS

Generally, calibration standards are not necessary for site screening and extent of contamination analyses with the Spectrace 9000. Optionally, an application (only the Soil Sample application will be discussed here) can be optimized or verified to be 1:1 proportional to another analytical (reference) method (see Section 9.3 and 10.1). This can be done by analyzing a suitable set of Site-Specific Calibration Standards (SSCS) or Standard Reference Materials (SRMs) and performing a regression analysis on the reference (dependent) and the Spectrace 9000 results (independent) for each element of concern. SCSS and SRMs must be representative of the sample matrix to be analyzed by XRF, for example, National Institute of Standards and Technology (NIST) SRMs 2709, 2710, and 2711 for the soil application. In an application, any element's calibration can be adjusted by entering the desired slope and offset (intercept) in the Adjust Calibration menu. If any element's calibration has been adjusted in an application, "adj" will appear on the results screen. An adjusted element calibration can always be changed back to the initial slope and offset values of 1 and 0, respectively.

7.0 PROCEDURE

7.1 Prerequisites

If the Spectrace 9000 will be used in a location where AC power outlets are conveniently accessible, connect the battery charger to the electronic unit and plug the charger cord into the outlet. The probe cable must be connected before switching on the power. Plugging and unplugging this cable with the power on can damage the detector.

To connect the battery, set the electronics unit on its face and use a flat blade screwdriver to loosen the two one-quarter turn fasteners on the back. Remove the battery pack. Inside, find the cord with the red cap covering the three-pronged plug. Remove the cap and plug it into the battery pack. Put the battery pack into the unit and tighten the fasteners.

Apply power to the Spectrace 9000 by pressing the <ON> button. The electronic unit may not come on with the battery charger hooked up if the battery has been totally drained. The drained battery may require a 10 minute charge prior to startup. In a few seconds the display shows the version of software. If necessary, adjust the contrast knob located on the underside of the front display. This knob can be turned so far that the display appears blank.

The initial screen displays for about 10 seconds and then a prompt will ask if the time and date are set correctly. The date **MUST** be set correctly otherwise serious errors in source-decay compensation can result. Additionally, results tables include the time and date of analysis. The main menu appears after the time and date screens.

If a "battery low" message appears, recharge or change the battery before proceeding, or operate the unit using line voltage.

Allow the Spectrace 9000 to warm up for approximately 30 minutes after it has been turned on before performing analysis.

7.1.1 Gain Control

Automatic gain compensation is a feature of both Soil and Thin Samples applications, which allows operation of the instrument over a wide range of ambient temperatures and from one day to another without standardization. To maintain gain control compensation, it is necessary to occasionally operate with a minimum acquisition time of 50 seconds on the Cd-109 source. If the automatic gain control fails or is out of range, an error message will appear on the screen. If the error message continues to appear after repeat analyses, then the Cd-109 measurement time should be checked and/or an energy calibration should be performed. If the problem continues, contact Spectrace Instruments for help.

7.1.2 Setting Data and Spectrum Store/Send Mode

The Set store/send modes option is located in the More screen which can be accessed from the main menu. Data and/or Spectrum storage must be enabled for automatic on-board storing to occur. Sufficient memory is available to store up to 300 sets of analysis results and up to 120 spectra (40 samples since each sample has three spectra). When the available memory is full, the respective spectra or results storage mode is automatically disabled. The spectra or results memory must be cleared (deleted) and the respective store mode enabled before results and/or spectra can be stored again.

7.2 General Keys and Menu Software

This section outlines the general keys and basic menu software. Flow charts which describe the menu structure in detail are located on pages 4-13 through 4-17 in the Spectrace 9000 Operating Instructions.

7.2.1 The Keyboard

The row of numeric keys under the LCD screen performs functions defined by labels (a menu) written to the bottom line of the display by the Spectrace 9000 software. As the operator moves through the various menus, the keys are redefined to provide an efficient user interface.

The keypad to the right of the screen is used for numeric entry. The <Cont/Pause> key (referred to as the <Cont>) is used:

- to enter information as an <Enter> key
- to begin an analysis
- to pause an analysis in progress

The left arrow <←> key is used to edit entries before pressing <Cont>.

7.2.2 The Measure (Ready) Screen

This main menu selection displays the application name, revision date, measurement time for each source, and accesses other options (see flow diagrams in Spectrace 9000 Operating Instructions).

7.2.3 The Choose an Application Screen

This main menu selection lists the applications currently loaded in the unit. Applications are selected and source measurement times may be modified in this screen (see flow diagrams in Spectrace 9000 Operating Instructions).

7.2.4 The Review Stored Results Screen

This main menu selection lists the stored results. *Up* and *Down* scroll are used on many screens. When *Up* and *Down* are displayed, pressing the <0> (zero) key will toggle to *PgUP* and *PgDN* for rapid movement through long lists. Stored results may be reviewed, deleted, or downloaded to the COM port (see flow diagrams in Spectrace 9000 Operating Instructions).

7.2.5 The Review Stored Spectra Screen

This main menu selection lists the stored spectra which may be deleted or transmitted to the COM port (see flow diagrams in Spectrace 9000 Operating Instructions). You cannot display spectra under this screen. Spectra may be displayed in the *Examine Spectrum* portion of the More screen (accessed from the main menu) or in the *Examine Spectrum* selection from the Results screen under the *More Options* menu selection.

7.2.6 The More (Other Functions) Screen

This main menu selection lists the following functions:

- *Set clock/calendar*
- *Comm. port setup*
- *Set store/send modes*
- *Application maintenance*
- *Examine spectrum*

7.2.7 The Results Screen

The Results screen is displayed at the end of the analysis. If the automatic *Store Results* mode is enabled, you will be prompted for sample identification (*ID*) before the Results screen is displayed. *Up* or *Down* scrolls the screen to view more results. When *Up* and *Down* are displayed, pressing the <0> (zero) key will toggle to *PgUP* and *PgDN* for rapid movement through long lists. *Send* transmits results to the COM port. *Store* prompts for an ID and then stores results in memory. *Measr* will immediately begin another analysis cycle. *Opts* displays the first of two screens listing special options under the Results screen (the second screen is located under *More Opts* of the first screen. See flow diagrams in Spectrace 9000 Operating Instructions). The most frequently used functions are the *Examine Spectrum* and *Enable/Disable Display Thresholds* located on the second screen of options.

7.3 Preoperational Checks

7.3.1 Energy Calibration Check

An energy calibration should be performed after an instrument is shipped and periodically (approximately 2 weeks) to ensure proper energy calibration. The *Energy Calibration* function is located in the *Options* section of the Measure Screen. You will be prompted to place the safety shield on the probe and then initiate a 600- second analysis that will update the X-ray energy calibration.

The energy calibration check is performed in the field daily and after an energy calibration to verify proper energy calibration. To perform an energy calibration check, place the safety shield on the probe. Select the *Soil Samples* application and measure the safety shield using a minimum acquisition time of 60 seconds for each source. Save the results and spectra for documentation. Select *Opts*, *More Options*, and then *Examine Spectrum*. Examine the spectrum of each source. Locate and record the centroid KeV (using the x12 horizontal magnification) for each of the following peaks:

Source	**Peak**		**Theoretical**
Specification			
		(KeV)	**(KeV)**
Cd-109	Pb L-alpha	10.54	± 0.040
	Pb L-beta	12.61	± 0.040
	Pb L-gamma	14.76	± 0.040
	Source line	22.10	± 0.040
Fe-55	S K-alpha	2.31	± 0.020
	Source line	5.89	± 0.020
Am-241	Pb L-alpha	10.54	± 0.050
	Pb L-beta	12.61	± 0.050
	Source line	59.5	± 0.200

Perform an *Energy calibration* (see Spectrace 9000 Operating Instructions) and then do another energy calibration check if any of the peaks fail to meet specification. The energy calibration check should be performed once at the beginning of the day, after an energy calibration, after loading an application, and whenever the instrument exhibits a persistent drift.

7.3.2 Resolution Check

The resolution check examines the detector's ability to resolve X-ray energies. This should be performed once at the beginning of the day. Select the *Soil Samples* application, and measure a sample of iron using a minimum acquisition time of 60 seconds for the Cd-109 source. Save the results and spectra for documentation. Select *Examine spectrum* under the More Options section of the Results screen. Examine the Cd-109 spectrum. Locate and record the maximum peak counts (must be >1000 counts)of the iron K-alpha peak (6.4 KeV) using the x12 horizontal magnification (see Figure 2, Appendix A). Divide the maximum peak counts by two. Examine the right (high energy) side of the peak and record the counts and KeV of the channel with counts less than or equal to one-half the maximum peak count value (channel

B, Figure 2). Examine the left (low energy) side of the peak and record the counts and KeV of the channel with counts less than or equal to one-half the maximum peak count value (channel A, Figure 2). Subtract the left-side KeV from the right-side KeV (KeV at B - Kev at A, Figure 2). The difference should be less than 0.300 KeV. If the unit fails to meet this specification, call Spectrace Instruments for assistance.

7.3.3 Blank (Zero) Sample Check

The blank (Zero) sample check is performed to monitor the instrument's zero drift in the selected application. The blank sample check and the *Aquire Background Data* operation (discussed below) only apply to the application currently selected. This should be done once at the beginning of the day, after an energy calibration, after loading an application, and whenever the instrument exhibits a persistent drift on a blank or low-level sample.

Mount the probe in the laboratory stand and select the *Soil Samples* application. Disable the display thresholds. This will permit results less than one standard deviation (STD) to be displayed (even negatives). Measure the quartz blank provided with the unit (or a "clean" sand sample) using a minimum acquisition time of 60 seconds for each source. Review the results table. All elemental results for target elements with atomic number 24 (Cr) and higher in the periodic table should be within 3 standard deviations of zero ($0 \pm 3 \cdot |STD|$); all non-target element results should be within 5 standard deviations ($0 \pm 5 \cdot |STD|$). Repeat the measurement if the unit fails to meet these specifications. If several elements continue to be significantly out of these specifications, check the probe window and the blank sample for contamination or perform the *Acquire background data* operation located in the Measure (Ready) screen option. Perform the blank (Zero) sample check again. Save the results and spectra for documentation. Enable the display thresholds prior to sample analysis after the blank sample check procedure is completed.

7.3.4 Target Element Response Check

The purpose of the target element response check is to ensure that the instrument and the selected application are working properly prior to performing sample analysis. This check should be performed at the beginning of the day. Use low, mid, and high samples, or standards with known concentrations for some or all of the target elements to be checked. Select a low sample near the quantitation limit of the target elements. Select a mid sample near the site action level and a high sample near the maximum concentration of the target elements expected on site.

These samples should be measured using the same source acquisition times that will be used for sample analysis. Save the sample check results and spectra for documentation.

7.4 Selecting Source Measuring Time

The source measuring time may be modified under the Measure screen. **Zero (seconds) measuring time should never be selected for any source for any application**. Generally, the element detection limit is reduced by 50 percent for every four-fold (x4) increase in source measuring time. Although counting statistics improve as measurement time increases, the practical limit for typical applications is 600 to 800 seconds. The elements are grouped together according to the radioisotope used for their excitation with typical minimum detection limits shown in Sections 7.4.2. and 7.4.3.

Automatic gain compensation is a feature of both the Soil and Thin Samples applications which allows operation of the instrument over a wide range of ambient temperatures and from one day to another without standardization. To maintain this gain control compensation, it is necessary to occasionally operate with a minimum acquisition time of 50 seconds on the Cd-109 source.

The *Real/live* option toggles between real time (true clock time) and live time (total time the instrument is counting). The latter adds time to the analysis to correct for the time the system is busy processing pulses.

7.4.1 Minimum Source Measuring Times

A minimum measuring time (real or live) of 15 seconds for the Fe-55 source, 30 seconds for the Cd-109 source, and 10 seconds for the Am-241 source is recommended when using the Soil Samples application. Measuring times for a source that excites a target element can be increased if lower detection limits are required.

When using the Thin Samples application, the measuring time for any source may be reduced to 10 seconds if the source does not excite a target element since this application does not correct for interelement effects. If a source excites a target element, a minimum measuring time (real or live) of 60 seconds for the Fe-55 source, 60 seconds for the Cd-109 source, and 120 seconds for the Am-241 source is recommended.

A minimum of 60 seconds is recommended for the Cd-109 source when using the PbK in Paint application.

7.4.2 Typical Minimum Detection Limits (MDLs) for the Soil Samples Application

For source measuring times of 60 seconds, typical element MDLs (in milligram per kilogram, mg/kg) for the Soil Samples application are:

Source	Element	MDL (mg/kg)
Fe-55	Potassium (K)	325
	Calcium (Ca)	150
	Titanium (Ti)	110
	Chromium (CrLo)	180
Cd-109	Chromium (CrHi)	525
	Manganese (Mn)	410
	Iron (Fe)	225
	Cobalt (Co)	205
	Nickel (Ni)	125
	Copper (Cu)	90
	Zinc (Zn)	70
	Mercury (Hg)	60
	Arsenic (As)	50
	Selenium (Se)	35
	Lead (Pb)	30
	Rubidium (Rb)	10
	Strontium (Sr)	10
	Zirconium (Zr)	10
	Molybdenum (Mo)	10
Am-241	Cadmium (Cd)	180
	Tin (Sn)	100
	Antimony (Sb)	65
	Barium (Ba)	20

NOTE: These typical MDLs are provided as an aid for selecting source measurement times; observed values for a given situation may vary depending on the matrix of the soil standard used to calculate MDLs, age of sources, moisture content, and other factors discussed in Section 4.

Generally, the detection limit is reduced by 50 percent for every four-fold (x4) increase in source measuring time. Additionally, more elements may be added to the Soil Samples application. Contact Spectrace Instruments for information about modifications to applications.

7.4.3 Typical Minimum Detection Limits (MDLs) for the Thin Samples Application

For source measuring times of 200 seconds for the Fe-55 and Cd-109 sources, and 800 seconds for the Am-241 source, typical element MDLs (in microgram per square centimeter, µg/cm^2) for the Thin Samples application are:

Source	Element	MDL (µg/cm^2)
Fe-55	Potassium (K)	0.40
	Calcium (Ca)	0.20
	Titanium (Ti)	0.15
	Chromium (CrLo)	0.40
Cd-109	Chromium (CrHi)	0.90
	Manganese (Mn)	0.65
	Iron (Fe)	0.65
	Cobalt (Co)	0.50
	Nickel (Ni)	0.30
	Copper (Cu)	0.65
	Zinc (Zn)	0.40
	Mercury (Hg)	0.45
	Arsenic (As)	0.40
	Selenium (Se)	0.15
	Lead (Pb)	0.50
	Rubidium (Rb)	0.10
	Strontium (Sr)	0.10
	Zirconium (Zr)	0.15
	Molybdenum (Mo)	0.10
Am-241	Cadmium (Cd)	2.5
	Tin (Sn)	2.5
	Antimony (Sb)	1.5
	Barium (Ba)	0.70

NOTE: These typical MDLs are provided as an aid for selecting source measurement times; observed values for a given situation may vary depending on the thin sample standard used to calculate MDLs, age of sources, and other factors discussed in Section 4.

Generally, the detection limit is reduced by 50 percent for every four-fold (x4) increase in source measuring time. Use of thick filters or filters with high background or contamination will result in higher MDLs and require a background subtraction. Additionally, more elements may be added to the Thin Samples application. Contact Spectrace Instruments for information about modifications to applications.

7.5 Sample Handling and Presentation

When making XRF measurements, be sure to maintain constant measurement geometry in order to minimize variations in analysis results. Document any anomalies in measurement geometry, sample surface morphology, moisture content, sample grain size, and matrix (see Section 4.0).

7.5.1 Soil Samples

Soil samples may be analyzed either in-situ or in prepared X-ray sample cups. The Soil Samples application assumes the sample to be infinitely thick. For in-situ measurements this is almost always the case. However, for sample cup measurements it is advisable to fill the cup nearly full and tap it on the bench to compact the soil. This ensures that the sample is as uniformly thick as possible from analysis to analysis. The Spectrace 9000 laboratory stand and safety shield should be used when analyzing sample cups.

An area for in-situ analysis should be prepared by removing large rocks and debris. The soil surface should be rendered flat and compact prior to analysis. The Spectrace 9000 probe should be held firmly on the ground to maximize instrument contact with the ground. The probe should not be moved during analysis. Analysis of water saturated soils should be avoided. A thin layer of 0.2-mil polypropylene XRF film may be mounted on the surface probe to minimize contamination. Use of varying thicknesses of plastic (bags) have been shown to interfere in the light element (low atomic number) measurement and may affect the FP calibration of the other element concentrations.(2) Additionally, plastic may contain significant levels of target element contamination.

Course-grained soil conditions or nuggets of contaminated material may preclude a truly representative sample and adversely affect the analysis results (typically by under reporting the target element). Such samples should be prepared before analysis. Preparation consistency is important to minimize variation in analytical results.

This application is specifically designed for soil with the assumption that the balance of the material is silica. If samples with a much lighter (lower atomic number) balance are analyzed, the results will typically be elevated by a factor of two to four. Contact Spectrace Instruments for help in analysis of different matrices.

7.5.2 Thin (Filter) Samples

The Thin Samples application is for analysis of thin samples such as filters or wipes. The detection limits are affected by the thickness of the substrate. Best results are obtained on the thinnest substrates. Always use the probe safety cover when measuring thin samples. This is not only for user safety, but also ensures a controlled background environment and provides a reference signal for the automatic gain control. Probe safety covers should never be interchanged between instruments.

Filters and wipes should be prescreened before use to establish background and contamination levels. Care should be used to prevent zinc oxide contamination from disposable gloves. Small 37-mm filters can be mounted between two layers of 0.2-mil thick polypropylene XRF film on 40-mm XRF cups for analysis. Larger filters can be placed on the probe with a sheet of 0.2-mil thick polypropylene XRF film between the filter and probe to prevent the window from being contaminated. Then the probe safety cover may be placed over the filter prior to analysis. Filters should be presented loaded side down and wrinkle free.

7.5.3 Lead in Paint

The area selected for analysis should be smooth, representative and free of surface dirt. The Spectrace 9000 probe should be held firmly on the surface to maximize instrument contact. The probe should not be moved during analysis.

When used for specimen application (e.g., on paint chips or nonbacked films) remember to use the probe safety cover. In the PbK Application, you should also position a thick neutral sample, such as the quartz disk (blank), behind the specimen before closing the safety lid. Otherwise, the PbK X-rays excited in the safety cover will be sensed by the detector. In this application, do not perform the *Acquire background data* option from the list of options under the Ready screen.

8.0 CALCULATIONS

The Spectrace 9000 is a direct readout instrument that does not require any calculations.

9.0 QUALITY ASSURANCE/ QUALITY CONTROL

9.1 Precision

The precision of the method is monitored by reading a low- or mid-target element concentration sample (or SSCS or SRMs selected as described in Sections 6.0) at the start and end of sample analysis and after approximately every tenth sample. (A daily total of seven measurements is recommended.) Determining the precision around the site action level can be extremely important if the XRF results are to be used in an enforcement action. Therefore, selection of a sample with a target element concentration at or near the site action level or level of concern is recommended. The sample is analyzed by the instrument for the normal field analysis time, and the results are recorded. The standard deviation for each target element is calculated. The relative standard deviation (RSD) of the sample mean can be used to calculate precision. The RSD should be within ± 20 percent for the data to be considered adequately precise.(3)

9.1.1 The Method Detection Limit (MDL) and Method Quantitation Limit (MQL)

The MDL and MQL may be calculated from the measurement of either a low or blank sample, (or a SSCS or SRMs selected as described in section 6.0), at the start and end of sample analysis, and after approximately every tenth sample (a daily total of seven measurements is recommended). Alternatively, the quartz blank or "clean" sand may be used if a blank soil or sediment sample is unavailable.

Disable the display thresholds. This will permit results less then one standard deviation (STD) to be displayed (even negatives). Measure the sample using the same application and measuring time used for the samples. Enable the display thresholds prior to analyzing the next sample.

The sample standard deviation of the mean for each target element is calculated. If the standard deviation has a fractional component, round up to the next whole number prior to calculating the MDL and MQL.

The definition of the MDL is three times the calculated standard deviation value.

The definition of the MQL is 10 times the calculated standard deviation value.

9.2 Reporting Results

All raw XRF data should be reported including the individual results of multiple analyses of samples and sampling points. The average and concentration range of each multiple analysis should also be reported.

A "reported" value for each analysis or average of multiple analyses should be processed in the following manner.

1. Round the value to the same degree of significance contained in the SSCS or SRM sample assay values (usually two) if the element's calibration has been adjusted (see Section 6.0). Round to 2 significant figures for sample results. DO NOT round results for standards used to determine MDL or RSD values (use raw data).
2. Report all values less than the MDL as not detected (ND).
3. Flag and note all values greater than or equal to the MDL and less than the MQL (usually with a "J" next to the reported value).
4. Report all values equal to or greater than the MQL and within the linear calibration range (if the element's calibration has been adjusted [see section 6.0]).
5. Flag and note all values above the linear calibration range (greater than the highest SSCS used in the calibration adjustment procedure) if SSCS were used and the

calibration was adjusted.

9.3 Accuracy

Accuracy, relative to a specific digestion method and elemental analysis procedure, is determined by submitting an XRF analyzed sample (prepared sample cups may be submitted) for AA or ICP analysis at a laboratory.

The on-site analysis of soils by XRF instrumentation should be considered a screening effort only (QA1 data). Data derived from the instrument should be used with discretion. Confirmatory analyses on a subset of the screening samples (minimum 10 percent) can be used to determine if the XRF data meets QA2 data objectives. The confirmation samples should ideally be selected randomly from the sample set and include a number of samples at or near the critical level. The results of the metal analysis (dependent) and the XRF analysis (independent) are evaluated with a regression analysis. The correlation factor (R^2) should be 0.7 or greater.(3)

XRF results may be multiplied by the slope prior to substitution for metal analysis results in contouring, kriging programs, or removal volume estimates. Correcting the XRF results based on confirmatory analyses should only be undertaken after careful consideration. It must be understood that the confirmatory analysis (AA or ICP) is an estimate of the concentration of metal contamination and is dependent upon the specific instrumentation and sampling methodology used. Since XRF is a total elemental technique, any comparison with referee results must account for the possibility of variable extraction, dependent upon the digestion method used and its ability to dissolve the waste or mineral form in question.

9.3.1 Matrix Considerations

Other types of QA/QC verification should include verification that the instrument calibration is appropriate for the specific site to be assessed. This includes verification of potential multiple soil matrix types that may exist at a site. Matrix differences which affect the XRF measurement include large variations in calcium content, which may be encountered when going from siliceous to calcareous soils, as well as large variations in iron content.

10.0 DATA VALIDATION

10.1 Confirmation Samples

Confirmation samples are recommended at a minimum rate of 10 percent and are required if QA2 data objectives have been established for site activities.(3) Ideally, the sample cup that was analyzed by XRF should be the same sample that is submitted for AA/ICP analysis. When confirming an in-situ analysis, collect a sample from a 6-inch by 6-inch area for both an XRF measurement and confirmation analysis.

The XRF and metals results are analyzed with a regression analysis using a statistical program such as SAS® or Statgraphics® with the intercept calculated in the regression. The correlation factor between XRF and AA/ICP data must be 0.7 or greater for QA2 data objectives.(3)

10.2 Recording Results

Record all results and monitoring activities in a laboratory or field notebook. Alternatively, record results electronically on a hard drive or floppy disk.

10.3 Downloading Stored Results and Spectra

Results (analytical reports) and spectra which have been stored in the Spectrace 9000 internal memory should be downloaded and captured in disk files on a PC (see section 5). Spectrace Instruments provides software for this purpose. Additionally, they provide software to prepare results or spectra for importing into a spreadsheet. Refer to the instructions provided with the programs for details on their operation.

Alternatively, other software with terminal data logging capabilities may be used to capture results and spectra to disk files.

After capturing results to a file, print a copy and save both the disk files and the printout for future reference and documentation purposes.

11.0 HEALTH AND SAFETY

When working with potentially hazardous materials, follow U.S. EPA, OSHA, corporate and/or any other applicable health and safety practices.

12.0 REFERENCES

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(3) U.S. EPA/ERT, Quality Assurance Technical Information Bulletin. "Field-Portable X-Ray Fluorescence," Volume 1, Number 4, May, 1991.

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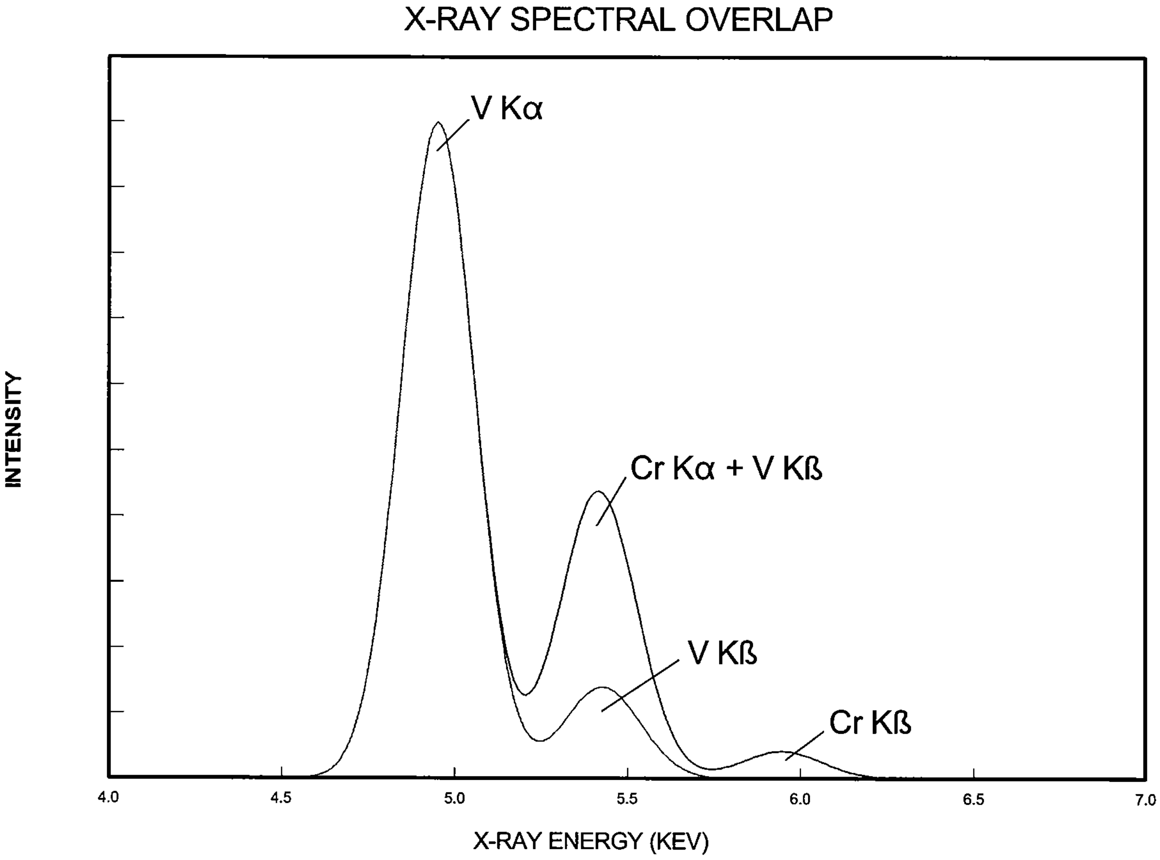
APPENDIX A

Figures

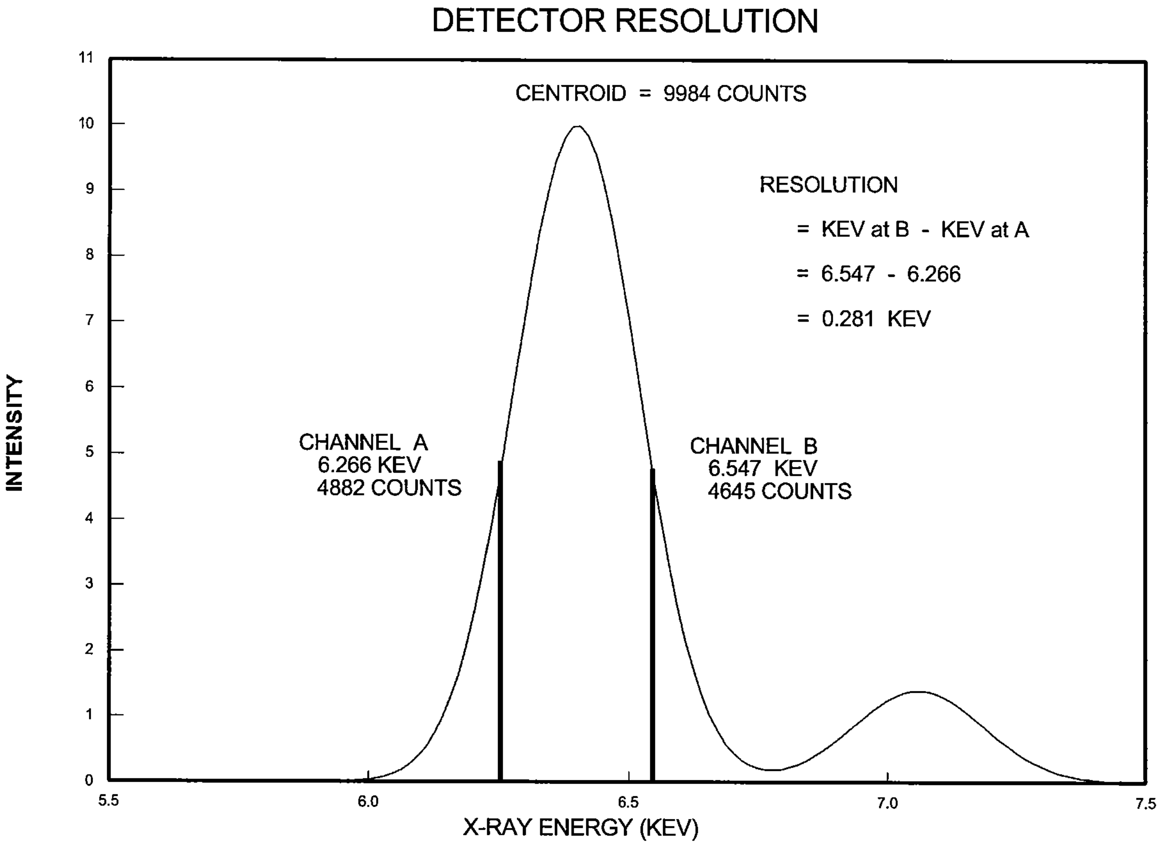
FIGURE 1. X-Ray Spectral Plot Showing Overlap of Vanadium K_{β} X-Rays in the Chromium K_{α} Measurement Region.



APPENDIX A (CON'T)

Figures

FIGURE 2. Iron X-Ray Spectrum Illusrating Detector Resolution Measurement



APPENDIX L

PROJECT-SPECIFIC TECHNICAL PROFILE

Contracted Laboratories
Technical Profile Notes
for the
USACE Raritan Arsenal Project

1. Matrix QC samples will be selected by field samplers and indicated on the COC(s).

2. Samples received at temperatures > 10 ^{o}C will require notification to the Weston Project Manager [Scott Vozza at (732) 417-5814)].

3. Standard turnaround requirements are 28 calendar days. Electronic Data Deliverable (EDD) must be provided in a format that meets the specifications outlined in this technical profile. The EDDs will be submitted along with the hard copy deliverables.

4. If soil samples are wet, Weston field Personnel will notify Weston Project Manager and mark notes on the COC. Weston Project Manager will in turn notify Laboratory Project Manager verbally by phone. The lab will expedite the % solids determination to increase (if necessary) sample weights for metals digestion only in order to increase likelihood of meeting project action limits. The percent moisture results will be available within 3 business days and will be reviewed by the Laboratory Project Manager and then provided to Weston Project Manager.

5. Tables 2-1 through 2-6 provide applicable regulatory levels. Contracted laboratories' reporting limits must be one-half of these regulatory levels. Compounds of special concern are presented in Table 2-7. Tables 2-8 through 2-15 summarized applicable analytical methods, holding times, and acceptable QC limits.

6. All metals analyses with the exception of Hg will be analyzed by conventional or trace ICP as long as project limits are met. If the project limits cannot be met for the analyses of As, Pb, Se, Tl, Cd, and Sb, contracted laboratory must inform WESTON so that a laboratory certified by NJDEP and USACE can be contracted to analyze these analytes by graphite furnace AA.

7. New Jersey reduced data deliverables apply.

8. Soil and sediment samples will be collected in EnCore samplers for VOA analysis. Soxhlet extraction will be used to prepare soil samples collected for pesticides/PCBs, while sonication extraction (with 10 grams of soil) will be used to prepare soil samples for SVOCs and PAHs.

9. All samples will be sent to the laboratory through an overnight courier or will be picked up by a courier provided by the contracted laboratory, if arranged in advance.

10. For Pesticides/PCBs analysis, GPC cleanup is optional for soil samples. Florisil cleanup is optional for water samples. Sulfur cleanup is required only when sulfur is detected in the sample. Sulfuric acid cleanup is mandatory for PCB analysis.

11. For SVOC, pesticides, and PCBs, undiluted sample extracts will be analyzed initially. If the chromatographic peaks indicate potential high concentrations of analytes (target or non-target) are present, the sample extracts will be subjected to GPC cleanup to remove potential interferences. Dilutions may be still required after the GPC cleanup. If the dilution is necessary, it will be done so that the analyte concentrations are within the upper half of the calibration range.

12. Volatile water samples will be analyzed initially without dilution, in order to meet the project-specified reporting limits. Based on the initial analysis, samples will be diluted, if necessary, so that the analyte concentrations are within the upper half of the calibration range which satisfy the method criteria. If the screening data indicated the presence of high levels of analytes, the contracted laboratory may use dilution as initial analysis and report the results from such analysis. When analyzing groundwater samples that have historically exhibited high levels of VOCs, the laboratory must attempt to provide the lowest level of detection for TCE degradation compounds.

13. Blank spike, MS, and MSD will be spiked with all analytes of interest, with the exception of toxaphene, Aroclors 1221, 1232, 1242, 1248, and 1254.

14. Explosive analyses require the use of surrogate compound; triple injections are not required for calibration. Spiking of all target analytes is required. Reverse Salting Out Extraction (RSOE) will be used to prepare water samples requested for the explosive analysis. Re-extraction/Re-analysis, without additional cost to WESTON, will be performed if the blank spike analysis does not meet the recovery QC limits.

15. Since DDT, DDD, and DDE are all contaminants of concern, a DDT degradation check shall be performed at the beginning of each analytical sequence. The DDT degradation shall not exceed 20%.

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APPENDIX M

LABORATORY DATA TRANSFER STANDARD

ENVIRODATA VERSION 1.6

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Data Management • GIS • Graphics • Internet

Laboratory Data Transfer Standard

Enviro Data® Version 1.6

This document is provided by Geotech Computer Systems, Inc. to our customers and prospective customers for their use in working with the laboratories that supply them with data. These customers may give it to their laboratories for the purpose of designing data output routines. Any other use is strictly prohibited.

Purpose

The purpose of this document is to provide a description of three related standard formats for laboratories and other data providers to use when creating electronic data deliverables (EDDs) for submitting data to be included in **Enviro Data**. These formats are intended to be flexible enough to accommodate the majority of the analytical and other technical evaluation and monitoring data for projects. At times there may be data that will not fit into this standard. In that case, the organization supplying that data should contact their project manager to discuss how data transfer can be accommodated. The outline for this dialogue is contained in a section below entitled Non-Conforming Data.

A primary design goal of these standard formats is that files in one of these formats can be created relatively easily using software tools available to those creating the files. If a data provider anticipates additional costs for providing data in one of the formats presented here, they must provide estimates of these additional costs to their project manager prior to finalization of contract terms, so that this information can be used in the vendor selection process.

Database Background Information

Data of concern for this standard includes **Sites** (facilities or projects), **Stations** (observation points), **Samples** (individual observation events), and **Analyses** (specific individual values from an event). The data being transmitted in one of the formats of this standard will be placed in two tables in **Enviro Data**. These tables are **Samples** and **Analyses**. Some of the entries in these tables must have values that match those in other tables, called lookup tables, coded values, or valid value lists. Information on how to match these values is included below, and typical coded entries are listed in Appendix A. Note that for the lookup data, in some cases it is the value that is reported and in others the code, based on common industry practice.

This document contains the description of the latest and most comprehensive DTS version, Version 1.6. Data for this version can be delivered in one of three file formats, tab-delimited ASCII, Excel spreadsheet, and Access relational, as described below. Older DTS versions 1.4 and 1.2a, and the very basic Simplified Import, are still supported, and contain progressively smaller subsets of the data in 1.6. Clients and data providers should agree on the version and format that best fits data availability and project needs. Geotech can provide descriptions of the less-comprehensive formats, however, it is usually best to use the most comprehensive format when possible to be prepared for unanticipated future needs.

Laboratories wanting to ensure that the values delivered in the EDD match those in their client's database should obtain the Laboratory Data Checker software from Geotech Computer Systems and compare EDDs against client data prior to issuing the data. For laboratories familiar with previous versions of the DTS, the changes made between Versions 1.4 and 1.6 are summarized in Appendix B.

Data Content

This section covers the content of the data being transmitted. The following section covers the format of that data. In this document the content is organized by the target table in the database and by the order of the fields in the file. In the text file and spreadsheet formats all of the content is in one structure. In the database format the content is separated into three tables. In the following descriptions, fields are described as "Optional" or "Required". These denote program requirements, usually resulting from relations with lookup tables. Clients should instruct the laboratories if any of the program "Optional" fields are required for a given project. For fields that are required, but the data is not known to the laboratory, a default value such as "Unknown" or "z" (a code often used for "Unknown") should be used. Which one to use depends on whether the field contains a value or code, as described for each field.

General comments on data content

This standard supports import of duplicate sample and reanalyzed analytical data into the database. Indicate the preferred sample and analysis by entering a 0 in the corresponding *DuplicateSample* and *Superseded* fields respectively. If more than one duplicate sample is being reported, increment the *DuplicateSample* field, i.e. 0, 1, 2, etc. and enter the appropriate *QCSampleCode* (See Appendix A). If more than one analysis is being reported, increment the *Superseded* field, i.e. 0, 1, 2, etc. and enter the appropriate code in the *ValueCode* field to designate reanalyzed, dilution, reextracted, etc. Important: These are two different things. The *DuplicateSample* field is used when more than one physical sample is taken in the field from the same station on the same date. The *Superseded* field is used when more than one result is reported for the same parameter for the same physical sample.

For laboratory control spike and matrix spike samples, include two records. In one record, include the measured spike concentration in the *Value* field, the measured units in the *ReportingUnits* field, and the spike concentration in the *SpikeAmount* field. In a second record, report the recovery percent in the *Value* field and "%" in the

ReportingUnits field. Moisture content should be reported as a separate analytical record, with the units in %. They should be entered on a “by weight” basis, based on total weight.

All dates should include four-character years.

Sites and Stations

SiteName - The name of the site (project, facility, etc.) from which the samples were taken. This field must match a site in the **Enviro Data** database. Required.

StationName - The name of the well, boring, etc. from which the sample was taken. The entry must match a station name in the client’s **Enviro Data** database for the site name provided. Required.

Samples

A Sample is a unique sampling event for a station. Each station can be sampled at various depths (such as with a soil boring), at various dates (such as with a monitoring well), or, less commonly, both.

SampleDate_D - The date on which the sample was taken. Required.

SampleTypeCode - This is a code for the type of sample. Entries are compared to the **SampleTypes** look-up table in the database. If this information is unavailable to the lab, “z” should be reported. Required.

SampleMatrix - The material that the sample is primarily composed of. Provide the full sample matrix name, such as “Water”. Required.

SampleTop and *SampleBottom* - Soil sample depths or elevations, as instructed by the client. The fields should contain only numeric values. If these fields are not applicable (i.e. water samples) or are unknown to the laboratory, then they should be populated with zeros, for compatibility with ODBC databases. Required.

DepthUnits - Units for sample top and sample bottom. This is a coded field that is linked to the **ReportingUnits** lookup table. If this information is unavailable to the lab, “Unknown” should be reported. These units can be entered into the import file by a Data Administrator. Required.

DuplicateSample - This field was discussed above. It should be a zero unless this is a duplicate sample. All analyses must have an entry for this field, with multiple QC samples entered as values incremented from one. Required.

Extracted - Is this an extracted sample? Optional.

FieldSampleID - The client-assigned field ID number for each sample. If this information is not available, enter “Unknown” or “None”. Required.

LabSampleID - The sample identification number used internally by the laboratory. If this information is not available, enter “Unknown” or “None”. Required.

AltSampleID - Another sample identification number if needed. Optional.

CoolerID - Number to identify cooler in which primary samples and QC samples were shipped. Optional.

Sampler - Person taking the sample. Optional.

Description - Description of the sample, such as its condition. Optional.

WeightVolume - The weight or volume of the sample submitted to the laboratory in agreed-upon units, such as liters or kilograms. Optional.

SampleMethodCode - Coded value for the method used to collect the sample. Entries are compared to the **SamplingMethod** look-up table in the database. Required

LogCode - Coded value identifying the company collecting samples or performing field tests. Optional.

COCNumber - Chain-of-Custody tracking number. Optional.

DeliveryGroup - Sample delivery group. This field is provided for use as a lab tracking field. It is used to define a group of samples reported together. Optional.

AmbientBlankLot - Ambient blank field lot identifier. Optional.

EquipmentBlankLot - Equipment blank field lot identifier. Optional.

TripBlankLot - Trip blank field lot identifier. Optional.

FilteredSample - Filter information at the sample level. Was the sample filtered, and if so, what size filter was used? It could also be used to identify whether the filtering occurred in the field or the lab. Entries are compared to the **Filtered** look-up table in the database. The lab can supply either the code or the Filter description, whichever is most consistent with their system (i.e. TOT vs. total), but must coordinate this with the client. Required.

QCSequenceID - QC sequence identifier. This field is another lab tracking field, used to relate field samples to lab samples. Optional.

QCSampleCode - Code to identify QC samples. It ties to the **QCCodes** table, which contains codes for both the sample and analysis levels. The lab should supply the code if available, e.g. DUP for duplicate sample, or O for original sample. If this information is not available to the lab, enter “z” for Unknown. Required.

TaskNumber - The administrative task number under which sampling is done. Optional.

PrimarySample - Stores the Field Sample ID of the primary sample to which the QC sample is tied. This field is blank for original samples, and may be blank for field QC samples that have been submitted blind to the lab. This number can be entered into the temporary import table by a Data Administrator. The import routine converts this to the sample number of the primary sample before storing it in the database. Optional.

SampleResult - The result of the sampling process, such as “Successful”, “Dry”, or “No access”. Its primary use is to indicate that obtaining a sample was attempted unsuccessfully. If not available from the lab, this field can be entered into the temporary import table by a Data Administrator. Optional.

If a sample was attempted unsuccessfully, the sample fields should be filled in, however all fields associated with analyses, including parameter name, CASNumber and AltParamNumber, should be left blank. The system will then import the sample information, but not create any analyses records.

LabRecvDate_D - Date (and optionally time) on which the lab received the sample. Optional.

Analyses

An Analysis, as used in this document and in the **Enviro Data** data management system, is the observed value of a parameter related to a sample. This term is intended to be interpreted broadly, and not to be limited to chemical analyses. For example, field parameters such as “pH”, “temperature”, and “turbidity” also are considered analyses.

ParameterName, CASNumber, AltParamNumber - Various combinations of these fields are used to identify the name of the parameter (constituent) analyzed for. *ParameterName* should always be provided. The system compares *ParameterName* to the entries in the **Parameters** and **ParameterAlias** lookup tables. *CASNumber* and *AltParamNumber* are not required, but should be provided if possible to help ensure the correct parameter name assignment. If *ParameterName* does not match a lookup entry, the system compares either the *CASNumber*, or the *AltParamNumber* (frequently used for STORET codes), to **Parameter** table entries. Care should be taken that consistent numbers be provided. If *ParameterName* is left blank, but a *CASNumber* or *AltParamNumber* is provided, the system assigns a parameter name from the lookup tables based on a number match. Using only numbers to designate the parameter is not recommended. Optional.

Superseded - This field is discussed above. It should be a zero unless the analysis is superseded by a later value in the same file, in which case the entry should be 1. This field is used in conjunction with the *ValueCode* field, discussed later in this section. All analyses should have an entry. Required.

AnalyticMethod - Method used to perform the analysis. Optional.

Value - Measured result of the analysis. Optional, but should almost always be provided unless the constituent was not detected.

ReportingUnits - Units of the analysis. The entry provided should be the full abbreviation, such as “mg/l”. Entries must match an entry in the **ReportingUnits** lookup table in the database. Detection limits and radiologic error must be reported in the same units as the value. Required.

FlagCode - One to four coded entries for the analytical flag describing the analysis. Each character in the field must match an entry in the **AnalyticFlags** lookup table in the database. More than one flag can be entered. For example, if “b” (detected in blank) and “j” (estimated value) are both entered in the lookup table, then “bj” can be entered as an analytic flag (estimated value, detected in blank). If the analysis is considered a usable value, and would not otherwise have a flag, this field should contain the code for

Detected Value (usually a “v”). If the flag is unknown, the field should contain a “z”. Required.

ProblemCode - Analytic problems are usually described in the narrative, and not included in the electronic format. If this field data is not provided, the field should contain a “z” for unknown. If the laboratory chooses to supply problems in the electronic file, then the codes must match entries in the **AnalyticProblems** table. As with the *FlagCode* field, the entry can consist of from one to four approved codes. Required.

ValidationCode - One to four flags associated with validation of analyses. The data validation organization usually provides this field, which can contain from one to four of these codes. Others should place a “z” for Unknown in this field. If the laboratory chooses to supply validation flags in the electronic file, then the codes must match entries in the **ValidationFlags** table. Required.

DetectedResult - Supplied by the lab, this field should contain either “y” for yes, the analyte was detected, or “n” for no, the analyte was not detected. This field overlaps slightly with FlagCode. The purpose of this field is to separate the non-detect flag from other lab qualifiers, such as “j” or “b”, for statistical, evaluation and validation purposes. Optional.

Detect - First (primary) detection limit for the analysis. Detection limits must be reported in the same units as the value. Optional.

LimitType - Type of limit contained in the Detect field, such as “MDL”, “PQL”, “RL”, etc. Optional.

Detect2 - A second detection limit. Standards should be set for which type of limit should be entered in each field for a given site, for example: IDL or MDL in the first column, CRDL or PQL in the second. Optional.

LimitType2 - Limit type for second detection limit. Optional.

Detect3 - A third detection limit. Optional.

LimitType3 - Limit type for third detection limit. Optional.

SpikeAmount - Spike amount added to the sample. Should be reported in the same units as the Value. Used only for spiked analyses. Optional.

RetentionTime - Retention time for this analysis. Optional.

Error - Standard error for radioactivity measurements. Optional.

DilutionFactor - Amount that the sample was diluted prior to analysis. Optional.

Basis - Analyzed wet or dry. Should be “w” for wet or “d” for dry. Can also report “n” for not applicable, or “z” for unknown. Required.

FilteredAnalysis - Filter or measure basis information at the analysis level. Entries are compared to the **Filtered** look-up table in the database. As with the *FilteredSample* field, the lab can supply either the code or the description for this field. Required.

LeachMethod - Method used to leach sample. Entries are compared to the **LeachMethod** lookup table to maintain consistency. Lab should supply the full name of the method, e.g.: TCLP. If the analysis was not leached, “None” should be reported. Required.

PrepMethod - Method used to prepare sample separate from leaching. Optional.

PreparationLot - The batch designator of an autonomous group of environmental samples and associated QC samples prepared together. Optional.

ReportableResult - Flag for whether the result is to be used in reports. Report “Y” for yes, or “N” for no. Reported by labs or selected by Project Managers for multiple analyses from a selected sample, such as analyses at multiple dilutions. Optional.

AnalDate_D - Date (and optionally time) on which the analysis was performed. Optional.

ExtractDate_D - Date (and optionally time) on which the material was extracted for analysis. Optional.

LabReportDate_D - Date (and optionally time) on which the lab reported the analysis. Optional.

Lab - Name of the laboratory performing the analysis. Optional.

LabComments - Lab comments about this analysis. Optional.

AnalysisLabID - Lab identification number at the analysis level. LabSampleID tracks lab analyses at the sample level. This field is for identification numbers at the analysis level. Optional.

AnalyticalBatch - Lab batch identification number. Optional.

ValueCode - Parameter value classification. This field identifies the analytical trial, and supplies the reason for a superseded analysis. It is a coded entry enforced by the **ValueCode** lookup table. The lab should report the code, such as “RE” for re-extracted, “DL” for dilution, etc., or “O” for original analysis. Required.

RunCode - Confirmation run identification. This is a coded entry enforced by the **RunCode** lookup table. The lab should supply the code, such as “PR” for primary run, “n” for not applicable, or “z” for Unknown. Required.

QCAnalysisCode - QC code at the analysis level. It ties to the **QCCodes** table, which contains codes for both the sample and analysis levels. The lab should supply the code for this field, such as “TIC” for tentatively identified compound, or “O” for original analysis. Required.

AnalysisGroup - Group of methods for this analysis. Optional.

Acceptable File Formats

Enviro Data will accept three file formats when receiving laboratory data for inclusion in the database: Flat ASCII File, Spreadsheet, and Relational.

Flat ASCII File Format

The simplest format for data delivery under this standard is in a flat ASCII file with tab delimiters. The file must contain specific data elements as described above in the particular order described below. All modern word processors, spreadsheets, and database manager programs can save data in this format without special programming. There are three components to a text file: encoding, structure and content. Each of these components is described in the following sections.

Encoding

ASCII (American Standard Code for Information Interchange, pronounced “ask-ee”) is a character-encoding scheme that allows letters, numbers, punctuation, and other characters to be stored in computer files. All modern computer systems can accommodate this format. The first seven bits (128 characters) of this eight-bit code are well defined and are platform-independent. **Enviro Data** will accept ASCII files using this “low bit” character set if it contains the data elements as described in the following paragraphs. In most cases, if the “Save as ASCII” or “Save as Text” option is used in saving the file, it will be saved with the proper encoding.

Structure

The file should have each observation on a line in the file followed by a line delimiter (sometimes called a paragraph mark, ASCII 13 followed by ASCII 10). Within each line, the file should have each data element (which corresponds to a field in a database manager or a cell in a spreadsheet) in the order specified below. Each data element should be separated by an ASCII Tab character (09). A text data element can be shorter than the specified length but not longer.

Content

The ASCII text file must have the following columns present in the order shown, and the fields marked as required (bold text) must be populated. The file should have the first line in the file be the first line of data. The file should not have the field names in the first record.

Field Name	Data Type	Field Size [6]	Description	Table [9]
SiteName[1]	Text	50	Site Name	Sites
StationName	Text	50	Station identifier or name	Stations
SampleDate_D	Date/Time		Date sample was taken	Samples
SampleTypeCode	Text	5	Type of sample	Samples
SampleMatrix	Text	15	Sample matrix	Samples
SampleTop[2]	Number(Sg) [3]		Sample top	Samples
SampleBottom	Number(Sg)		Sample Bottom	Samples
DepthUnits	Text	15	Units for sample top and sample bottom	Samples
DuplicateSample	Number(Int) [4]		Duplicate samples[7]	Samples
Extracted	Text	1	Is this an extracted sample?	Samples
FieldSampleID	Text	40	Client assigned field sample ID	Samples
LabSampleID	Text	40	Lab sample ID	Samples

AltSampleID	Text	40	Alternate sample identification	Samples
CoolerID	Text	40	Cooler ID number - for QA/QC	Samples
Sampler	Text	50	Name of person taking sample	Samples
Description	Text	50	Sample description	Samples
WeightVolume	Number(Sg)		Weight or volume of the sample	Samples
SampleMethodCode	Text	4	Code for method used to collect the sample	Samples
LogCode	Text	4	Company obtaining samples or field results	Samples
COCNumber	Text	40	Chain-of-custody number	Samples
DeliveryGroup	Text	25	Sample delivery group	Samples
AmbientBlankLot	Text	8	Ambient blank field lot identifier	Samples
EquipmentBlankLot	Text	8	Equipment blank field lot identifier	Samples
TripBlankLot	Text	8	Trip blank field lot identifier	Samples
FilteredSample	Text	20	Filter size	Samples
QCSequenceID	Text	40	QC sequence identifier	Samples
QCSampleCode	Text	3	QC code for this sample	Samples
TaskNumber	Text	40	Task number under which sampling is done	Samples
PrimarySample	Text	40	Primary sample to which QC sample is tied	Samples
SampleResult	Text	255	Result of attempted sampling	Samples
ParameterName	Text	60	Name of material analyzed for	Analyses
CASNumber	Text	20	CAS number of material analyzed for	Analyses
AltParamNumber	Text	20	Alternative number for parameter	Analyses
Superseded	Number(Int)		Analysis superseded by re-analysis? [8]	Analyses
AnalyticMethod	Text	40	Method for performing analysis	Analyses
Value	Number(Sg)		Value measured during analysis	Analyses
ReportingUnits	Text	15	Units of the analysis	Analyses
FlagCode	Text	4	Data qualifier	Analyses
ProblemCode	Text	4	Problems encountered during analysis	Analyses
ValidationCode	Text	4	Code from data validation	Analyses
DetectedResult	Text	1	Was analyte detected	Analyses
Detect	Number(Sg)		Detection limit	Analyses
LimitType	Text	4	Detection limit type	Analyses
Detect2	Number(Sg)		2nd detection limit	Analyses
LimitType2	Text	4	2nd detection limit type	Analyses
Detect3	Number(Sg)		3rd detection limit	Analyses
LimitType3	Text	4	3rd detection limit type	Analyses
SpikeAmount	Number(Sg)		Spike amount added to the sample	Analyses
RetentionTime	Number(Sg)		Retention time for this analysis	Analyses
Error	Number(Sg)		Error range for this analysis	Analyses
DilutionFactor	Number(Sg)		Dilution factor	Analyses
Basis	Text	1	Analyzed wet or dry	Analyses
FilteredAnalysis	Text	20	Filter/measure basis at analytical level	Analyses
LeachMethod	Text	20	Leaching method	Analyses
PrepMethod	Text	40	Lab preparation method	Analyses
PreparationLot	Text	10	Batch designator for samples and assoc. QC	Analyses
ReportableResult	Text	1	Designates analysis as reportable result	Analyses
AnalDate_D	Date/Time		Date the analysis was performed	Analyses
ExtractDate_D	Date/Time		Date the extraction was performed	Analyses
LabReportDate_D	Date/Time		Lab analysis reporting date	Analyses
LabRecvDate_D	Date/Time		Date the lab received the sample	Samples
Lab	Text	20	Name of lab conducting analysis	Analyses
LabComments	Text	50	Lab comments about this analysis	Analyses
AnalysisLabID	Text	40	Lab identification number for analysis	Analyses
AnalyticalBatch	Text	40	Lab batch ID number	Analyses
ValueCode	Text	6	Differentiates between different results	Analyses
RunCode	Text	5	Run code for GC analyses	Analyses
QCAnalysisCode	Text	3	QC code for this analysis	Analyses
AnalysisGroup	Text	20	Group of methods for this analysis	Analyses

[1] Field names in **bold** are required fields. The others may be blank.

[2] SampleTop and SampleBottom are required. Numbers for depth or elevation should be entered for soil analyses; they should be zero if not applicable.

[3] (Sg) Single-precision floating point numbers. A Single variable is stored as a 32-bit (4-byte) number that can be reported with up to 7 significant figures.

[4] (Int) A number ranging from -32,768 to 32,767.

[5] (Lg) Stores numbers from -2,147,483,648 to 2,147,483,647 (no fractions).

[6] Character width for text fields. Does not apply directly to numbers.

[7] Numbered values for duplicate samples, with 0 for preferred sample, increasing by one for each additional value. Must fill in all duplicates or none.

[8] Numbered values for superseded analyses, with 0 for current analysis, increasing by one for each older value.

[9] Database table to receive data, either directly or after conversion using a lookup table.

Spreadsheet Format

The **Enviro Data** spreadsheet format contains the same data as the ASCII format, but the data is contained in the format of a spreadsheet program. The spreadsheet selected for this standard is Microsoft Excel for Office 2000. Other brands of spreadsheet programs can save their files in Excel format. The spreadsheet file should contain all of the data on the first sheet. Each row should represent one observation (such as the value of a chemical analysis) and each column a data item for that observation. The first row of the file must contain the field names as listed in the above table. The spreadsheet file must contain the above columns in the order shown, and the fields marked as required (bold text) must be populated. Geotech provides a spreadsheet with the software that can be used as a template.

Database Format

The **Enviro Data** database format contains the same data as the previous two formats, but the data is contained in a database file, with the data elements split into several different tables. The client anticipates that more sophisticated data providers will use this format, especially for large data sets. It is a more efficient way of storing and transferring data because it minimizes data redundancy. This also helps reduce errors caused by minor variations in data content such as spelling and punctuation of the data elements.

The database selected for this format is Microsoft Access 2000. The file submitted should have the following tables and fields. Some of the fields are Key Fields, which means that they are used to relate data in one table to data in another. For example, the *StationNumber* field is contained in both the **Stations** and **Samples** tables. Samples can be related to their respective stations with this number. The actual value of the numbers are not significant to **Enviro Data**, since the values themselves will not be imported, but the numbers must be consistent between the tables within each database file submitted. The data file must have the fields present in the order shown, and the fields marked as required must be populated.

Stations

Field Name	Data Type	Record Size[8]	Description	Relationships
StationNumber[1]	Number(Au) [2]		Unique station number generated by system	Samples
StationName	Text	50	Station identifier or name	
SiteName	Text	50	Site Name	Sites

Samples

Field Name	Data Type	Record Size[8]	Description	Relationships
SampleNumber[1]	Number(Au) [2]		Unique sample number generated by system	Analyses
StationNumber	Number(Lg) [3]		Foreign key linking to Stations table	Stations
SampleDate_D	Date/Time		Date sample was taken	
SampleTypeCode	Text	5	Type of sample	SampleTypes
SampleMatrix	Text	15	Sample matrix	SampleMatrix
SampleTop	Number(Sg) [4]		Sample top	
SampleBottom	Number(Sg)		Sample Bottom	
DepthUnits	Text	15	Units for sample top and sample bottom	ReportingUnits

DuplicateSample	Number(Int) [5]		Duplicate samples[7]	
Extracted	Text	1	Is this an extracted sample?	
FieldSampleID	Text	40	Client assigned field sample ID	
LabSampleID	Text	40	Lab sample ID	
AltSampleID	Text	40	Alternate lab sample ID	
CoolerID	Text	40	Cooler ID number - for QA/QC	
Sampler	Text	50	Name of person taking sample	
Description	Text	50	Sample description	
WeightVolume	Number(Sg)		Weight or volume of the sample	
SampleMethodCode	Text	4	Code for method used to collect the sample	SampleMethod
LogCode	Text	4	Company obtaining samples or field results	
COCNumber	Text	40	Chain-of-custody number	
DeliveryGroup	Text	25	Sample delivery group	
AmbientBlankLot	Text	8	Ambient blank field lot identifier	
EquipmentBlankLot	Text	8	Equipment blank field lot identifier	
TripBlankLot	Text	8	Trip blank field lot identifier	
FilteredSample	Text	20	Filter size	Filtered
QCSequenceID	Text	40	QC sequence identifier	
QCSampleCode	Text	3	QC code for this sample	QCCode
TaskNumber	Text	40	Task number under which sampling is done	
PrimarySample	Text	40	Primary sample to which QC sample is tied	
SampleResult	Text	255	Result of attempted sampling	

Analyses

Field Name	Data Type	Record Size[8]	Description	Relationships
SampleNumber[1]	Number(Lg) [3]		Foreign key linking to Samples table	Samples
ParameterName	Text	60	Name of material analyzed	
CASNumber	Text	20	CAS number of material analyzed	
AltParamNumber	Text	20	Alternative number for parameter	
Superseded	Number(Int) [5]		Analysis superseded by re-analysis? [6]	
AnalyticMethod	Text	40	Method for performing analysis	
Value	Number(Sg) [4]		Value measured during analysis	
ReportingUnits	Text	15	Units of the analysis	ReportingUnits
FlagCode	Text	4	Data qualifier	AnalyticFlags
ProblemCode	Text	4	Problems encountered during analysis	AnalyticProblems
ValidationCode	Text	4	Data validation code	ValidationFlags
DetectedResult	Text	1	Was analyte detected?	
Detect	Number(Sg)		Detection limit	
LimitType	Text	4	Detection limit type	
Detect2	Number(Sg)		2nd detection limit	
LimitType2	Text	4	2nd detection limit type	
Detect3	Number(Sg)		3rd detection limit	
LimitType3	Text	4	3rd detection limit type	
SpikeAmount	Number(Sg)		Spike amount added to the sample	
RetentionTime	Number(Sg)		Retention time for this analysis	
Error	Number(Sg)		Error range for this analysis	
DilutionFactor	Number(Sg)		Dilution factor	
Basis	Text	1	Analyzed wet or dry?	
FilteredAnalysis	Text	20	Filter/measure basis at analyitcal level	Filtered
LeachMethod	Text	20	Leaching method	LeachMethod
PrepMethod	Text	40	Lab preparation method	
PreparationLot	Text	10	Batch designator for samples and assoc. QC	
ReportableResult	Text	1	Designates analysis as reportable result	
AnalDate_D	Date/Time		Date the analysis was performed	
ExtractDate_D	Date/Time		Date the extraction was performed	
LabReportDate_D	Date/Time		Date lab reported the analysis	
LabRecvDate_D	Date/Time		Date the lab received the sample	
Lab	Text	20	Name of lab conducting analysis	
LabComments	Text	50	Lab comments about this analysis	
AnalysisLabID	Text	40	Lab identification number for analysis	
AnalyticalBatch	Text	40	Lab batch ID number	
ValueCode	Text	6	Differentiates between different results	ValueCode

RunCode	Text	5	Run code for GC analyses	RunCode
QCAnalysisCode	Text	3	QC code for this analysis	QCCode
AnalysisGroup	Text	20	Group of methods for this analysis	

[1] Field names in **bold** are required fields. The others may be blank.
[2] (Au) Number automatically assigned by the system.
[3] (Lg) A four-byte integer (a whole number between -2,147,483,648 and 2,147,483,647, inclusive)
[4] (Sg) Single-precision floating point numbers. A Single variable is stored as a 32-bit (4-byte) number that can be reported with up to 7 significant figures.
[5] (Int) A number ranging from -32,768 to 32,767.
[6] Numbered values for superseded analyses, with 0 for current analysis, increasing by one for each older value
[7] Numbered values for duplicate samples, with 0 for preferred sample, increasing by one for each additional value.
[8] Character width for text fields. Does not apply directly to numbers.

Submittal Requirements

File Names

Files submitted for import into **Enviro Data** should be given names that describe the contents and format of the file, such as “Rad Industries Sampling March 1997.MDB”. The name should include a site name, supplied by the project manager or their consultant, and the date the file is issued. In keeping with the DOS/Windows tradition of using a three-character file extension to describe the file type, the following extensions should be used for the three supported file formats:

File Type	Extension
Flat ASCII Files	.TXT
Spreadsheet Files	.XLS
Database Files	.MDB

When the data is submitted, documentation about the data content and format of each file should accompany the submitted disk, such as on the disk label or in the accompanying email.

Delivery Media and Formats

The client is prepared to receive data in a variety of media and standard formats, and these formats can be expected to change and evolve over time. Submitters should communicate with their project manager prior to delivering data about the best format for the type and volume of data to be delivered. At a minimum, **Enviro Data** will accept data in these media and formats:

- 1.44 megabyte floppy disks in DOS/Windows format. Data that will not fit on one diskette can be compressed and, if necessary, split onto more than one diskette using WinZip or compatible software as a file with an extension of .ZIP containing a file with one of the above formats and extensions.
- CD-ROM in ISO 9660 or compatible format.

Delivery via electronic mail, compressed or uncompressed, is acceptable, subject to approval by the project manager.

Consistency of Content

It is very important for data submitters to submit consistent data. Data elements must be entered exactly the same way from submittal to submittal. For example, if a well was called "MW-1" in a previous submittal, then it must be called "MW-1" in all subsequent submittals, not "MW 1" or "Mw-01". Data items such as station names are used to associate the data from the current submittal with data previously submitted. If the spelling is changed, the association will not be successful. In this example, if the laboratory or consultant suspects that the sampler may have inadvertently misnamed a well (e.g. Mw-01 or MW 1 instead of MW-1), the laboratory or consultant should contact the sampler or project manager and correct the data before submitting the data set.

Another example of consistency of content is the spelling of chemical analytical compounds (parameter names). Data elements must be entered exactly the same way from submittal to submittal. If the spelling is changed without instructions from or notification to the client, the association on import will not be successful. A standardized list of parameter names should be provided to laboratories that supply data to the client, and these are the names that should be used. This can be easily done with **Enviro Data** using the reference file system, and the laboratory can use the **Enviro Data** data checker version to check for consistency prior to issuing the EDD.

This system is also designed to promote consistency between the different labs and projects, however, if for project reasons the names cannot be kept consistent, the client has the ability to alias parameter names. This list can also be supplied to the laboratories.

Coded Entries

In order to foster consistency in the database, a number of data elements in the database tables are Coded. This means that each of these data items must contain one of a list of values. Examples of coded entries that are supplied by the laboratory include *Analyses.ProblemCode*, *Analyses.FlagCode*, and *Analyses.ValidationCode*. These codes describe problems encountered during the analysis, the data qualifier, and the validation data qualifier, respectively. There are a limited number of analytical problems and flags describing an analysis, so codes are used to represent each choice. Example lists of the codes to be used are attached in Appendix A, but this information can be expected to change over time and from project to project.

Non-Conforming Data

The purpose of this DTS is to facilitate the accurate transfer of data by providing a standard format for data delivery. It is our intention that this format be flexible enough to accommodate the majority of the analytical data for most projects. There may at times be data that will not fit into this standard. In that case, the organization with the data should contact their project manager to begin a dialogue about how that data can be accommodated. The outline for this dialogue is contained in this section.

When data is identified which does not appear to easily conform to one of the formats of this DTS, there is a four-step process that should be followed to determine how to handle this data:

1. **Determine whether the data is really non-conforming.** This DTS was designed to accommodate a wide variety of different types of site analytical and other data. Someone knowledgeable about the data to be transferred and someone

knowledgeable about the **Enviro Data** database management system should jointly try to fit the data to the transfer standard. The effort expended in this dialogue should be commensurate with the value of the data to the project. Any decisions made about necessary compromises, or other changes to make the data fit the standard, should be made with great concern for preserving the quality and integrity of the data.

2. **If the data is found to be non-conforming, determine how important it is to have it in the database.** If the data is significant to the management of the project, and must be viewed in relationship to other project data or to data in other projects, then it should be placed in the data management system. If the data is of a supporting nature, but will not be used in combination with other data, then it should be archived in the format provided and effort should not be expended in fitting it into the database system. Often the answer to these questions will not be a simple “yes” or “no”. In that case, the decision on whether to integrate the data into the database will need to take into consideration the cost of integrating the data.

3. **Determine the cost to integrate the data.** Adding data to the data management system that does not fit into the structure of the existing tables can be costly. Tasks which must be performed in order for this integration to be successful include analysis of the data, modification of the data model, creation of editing screens, queries and reports, and, sometimes, modification of the menu system and other user interface components. These modifications can, in some cases, adversely affect other users.

4. **Modify the data management system as necessary.** If the value of the data to be integrated (or, more precisely, the value of the use of the data in the data management system) exceeds the cost to integrate it, then resources should be allocated to performing the integration, and modifications to the software made.

Appendix A - Coded Entries

This section contains example lists of data values for use in transferring data into the **Enviro Data** database. In the EDD, some values should match a code, others should match the data value. Each of the following lists contains either the data values, or the data values and the codes that represent them, depending on which is to be delivered in the EDD. The coded fields are indicated by “code” at the end of the field name. The example entries for each field are given below. The values for each data field are based on industry practice. There will be times when values required by the system will not be known to the data provider. We have attempted to standardize codes for these values, with the ‘z’ code referring to Unknown, and the ‘n’ code referring to “None” or “Not Applicable”, to use in these situations.

Your clients should make an effort to have these tables contain an extensive list of the codes that will be used in connection with the data. Labs should request approved codes from their clients, or a lab reference file, which can be created using the **Enviro Data** software. Data submitters and database users should use these codes whenever possible. Where it is not possible to use an existing code because a different value is needed, this information should be provided to the client representative or data administrator before the data is submitted or entered. The decision to add a new code should not be taken lightly. This must be balanced with the need to accurately represent in the database what actually happened in the field or laboratory.

SiteName - This is not a coded value, but still must match the list provided by the client.

StationName - This is not a coded value, but still must match the list provided by the client.

SampleTypeCode - Type of sample:

Sample Type Code	Sample Type
c	Composite
d	Disturbed
g	Grab
s	Discrete
u	Undisturbed
z	Unknown

SampleMatrix - Matrix of sample:

Sample Matrix
Air
DNAPL
Gas
Leachate
Sediment
Sludge
Other
Petroleum

LNAPL
Reagent
Soil
Water
Waste
Unknown

SampleMethodCode -

Sample Method Code	Sample Method
as	Automatic sampler
ba	Bailer
bp	Bladder Pump
Gb	Grab
Pe	Peristaltic Pump
sp	Spigot
Ss	Stainless steel bucket
Su	Submersible Pump
z	Unknown

LogCode - The contents of this field will vary from project to project.

FilteredSample and ***FilteredAnalysis*** link to the *Filtered* lookup table.

FilteredCode	FilteredDescrip
DIS	Dissolved
CLF	Clay fraction
F1	Field - unknown
F45u	Field 0.45u
FIL	Filtered
L1	Lab - unknown
L5u	Lab 5u
N	Not applicable
TOT	Total
TRC	Total Recoverable
z	Unknown

QCSampleCode and ***QCAnalysisCode*** link to the **QCCodes** lookup table, which contains codes for both the sample and analysis levels.

QC Code	QC Type	QCScope
AB	Ambient blank	Samples
DUP	Field duplicate	Samples
EB	Equipment blank	Samples
FB	Field blank	Samples
FR	Field replicate	Samples
FS	Field sample spike	Samples
MS	Matrix spike	Samples

MSD	Matrix spike duplicate	Samples
NQ	Not a QC item	Samples
O	Original data	Not applicable
PE	Performance evaluation	Samples
RB	Rinsate blank	Samples
RD	Referee duplicate	Samples
RM	Reference material	Samples
RMD	Reference material dup	Samples
SP	Split samples	Samples
SPD	Split-duplicate samples	Samples
TB	Trip blank	Samples
SUR	Surrogate spikes	Analyses
TAR	Target compound	Analyses
TIC	Tentatively identified	Analyses
Z	Unknown	Not applicable

ParameterName, CASNumber, AltParamNumber - AltParamNumbers may be Storet codes, or other codes decided on between the laboratory and the client. Contact your project manager for a current project parameters list. Do not make up CAS numbers for parameters for which CAS does not provide them. Due to the number of possible parameters and the great variability from project to project, the following list contains examples only.

Parameter Name	CAS Number
1,1,1,2-Tetrachloroethane	630-20-6
1,1-Biphenyl, Dimethyl-	
1,2,4-Trichlorobenzene	120-82-1
1,2-Dibromo-3-chloropropane	96-12-8
2,3,4,6-Tetrachlorophenol	58-90-2
2,3,7,8-TCDD C13 (surrogate)	
2,4,5-T	93-76-5
2,4-D	94-75-7
2,4-DB	
2-Hexanone	591-78-6
4,4'-DDD	72-54-8
4,6-Dinitro-2-methylphenol	534-52-1
Acenaphthene	83-32-9
Acenaphthylene	208-96-8
Acetone	67-64-1
Acidity	
Aldrin	309-00-2
Alkalinity (as CaCO3)	
Aluminum	7429-90-5
Ammonia	
Aramite	140-57-8
Aroclor-1016	12674-11-2
Aroclor-1221	11104-28-2
Arsenic	7440-38-2
Barium	7440-39-3
Benz(a)anthracene	56-55-3
Benzene	71-43-2
Benzene, Trimethyl-	25551-13-7
Benzoic acid	
Bicarbonate	
Biochemical oxygen demand	
Chemical oxygen demand	
Chloride	
Chlorinated Hydrocarbons	
Chromium	7440-47-3
Corrosivity PH	l50-50-5
Cyanide	
Endosulfan I	959-98-8
Endosulfan II	33213-65-9
Endosulfan Sulfate	1031-07-8
Field Conductivity	
Field pH	
Field turbidity	
Floaters	
Gross Alpha	
Gross Beta	
Groundwater Elevation	
Hardness (as CaCO3)	
Ignitability	
Indene	95-13-6
Iron	7439-89-6
Laboratory conductivity	
Laboratory pH	
Laboratory Temperature	
Lead	7439-92-1
Methyl yellow	60-11-7
Nitrate	
Nitrate/Nitrite	7727-37-9
Nitrite	
No. 6 Fuel Oil C12-C24	
o,o,o-Triethylphosphorothioate	126-68-1
Oil and grease	
Ortho-Phosphate	
Other Gamma	
Pb-210 - insoluble	
Pb-210 - soluble	
Percent moisture	
Pet. Hydrocarb.	
Phenol	108-95-2

Phenol-D5 (surrogate)	4165-62-2
Pyridine	110-86-1
Quinoline	91-22-5
Ra-224 - insoluble	
Ra-224 - soluble	
Ra-224 - Total	
Reactive Cyanide	
Reactive Sulfide	

Sinkers	
Temperature	
Tin	7440-31-5
Total Dissolved Solids	
Total Organic Carbon	
Total phenols	
Zinc	7440-66-6

ReportingUnits and ***DepthUnits*** - link to the ReportingUnits lookup table. Units of measure for depths or analyses.

Reporting Units
s.u.
umhos/cm
Deg C
days
Deg F
ft
fmsl
hours
in
ppb
ppm
mg/kg
mg/l
ms/cm
meters
NTUs
Other
%
pCi/g
pg/l
pCi/l
mmhos/m
um/cm
ug/g
ug/kg
ug/l
uS/cm
weeks
ug/filter
Unknown

FlagCode - This field can contain up to four coded entries for the flag describing the analysis.

Flag Code	Flag
*	Surrogate outside QC limits
a	Not available
b	Analyte detected in blank and sample
c	Coelute
d	Diluted
e	Exceeds calibration range
f	Calculated from higher dilution
i	Insufficient sample
j	Est value: concentration <quan. limit
m	Matrix interference
q	Uncertain value
s	Surrogate
u	Not detected
v	Detected value
z	Unknown

AnalyticProblems lookup table.

Problem Code	Analytic Problem
a	Exceeds holding time
b	< cont lim, > inst lim
d	Percent RPD criteria not met
e	Exceeds extr holding time
g	Cooler above 10°C
h	Cooler above 4°C
I	Interference
k	Bottle broke; resample value
m	Matrix effect
n	No problems
o	Spike not in control limit
p	Zero headspace not achieved
r	Re-extracted
s	Meth of std additions
t	Diluted
v	Est because of interference
z	Unknown

ValidationFlags - Coded flags associated with validation of analyses.

Validation Code	Flag
a	Anomolous data
j	Estimated data, useable value
r	Rejected data
u	Not detected due to contamination
z	None

LeachMethod - Method used to leach the sample.

LeachMethod
None (default)
TCLP
SPLP
Unknown

ValueCode - lookup table.

ValueCode	Explanation
RA	Re-analyzed
RE	Re-extracted and re-analyzed
RE2	Second re-extraction and re-analysis
DL	Dilution run
DL2	Second dilution run
REDL	Re-extraction of a diluted sample

N	None
O	Original analysis
Z	Unknown

RunCode lookup table.

RunCode	Explanation
OR	Original run
PR	Primary run result. For GC tests where the first and second columns are combined to produce this primary set or results
1C	First column result
2C	Second column result
N	None
Z	Unknown

Appendix B - Changes from previous versions of the Data Transfer Standard

The following changes were made from version 1.4 to 1.6. These changes were of two types, increase in field width and new fields.

Analyses table - Revised

Revised	ReportUnitsCode	Text - 4	Change from Text - 2
Revised	AnalyticMethod	Text - 40	Change from Text - 25
Revised	Lab	Text - 20	Change from Text - 10
Revised	AnalysisLabID	Text - 40	Change from Text - 20
Revised	PrepMethod	Text - 40	Change from Text - 20
New Field	Detect3	Num, Single	3rd detection limit for this analysis
New Field	LimitType3	Text - 4	Type of 3rd detection limit
New Field	RetentionTime	Num, Single	Retention time for this Analysis
New Field	PreparationLot	Text - 10	Batch designator of an autonomous group of environmental samples and associated QC samples prepared together
New Field	AnalysisGroup	Text - 20	Group of methods for this Analysis
New Field	SpikeAmount	Num, Single	Spike amount added to the sample

Samples table - Revised

Revised	SampleMatrixCode	Text - 4	Change from Text - 1
Revised	SampleTypeCode	Text - 5	Change from Text - 4
Revised	LabSampleID	Text - 40	Change from Text - 20
Revised	AltSampleID	Text - 40	Change from Text - 20
Revised	FieldSampleID	Text - 40	Change from Text - 20
Revised	DepthUnitsCode	Text - 4	Change from Text - 2
Revised	Description	Text - 50	Change from Text - 25
Revised	CoolerID	Text - 40	Change from Text - 20
Revised	DeliveryGroup	Text - 25	Change from Text - 10
Revised	QCSequenceID	Text - 40	Change from Text - 15
Revised	COCNumber	Text - 40	Change from Text - 20
Revised	TaskNumber	Text - 40	Change from Text - 20
Revised	PrimarySample	Text - 40	Change from Text - 20
New Field	LabRecvDate_D	Date/Time	Date lab received sample
New Field	WeightVolume	Num, Double	Weight or volume of sample
New Field	Extracted	Text - 1	Is this an extracted sample?
New Field	SampleMethodCode	Text - 4	Link to the SampleMethod table
New Field	LogCode	Text - 4	Coded value identifying the company collecting samples or performing field tests
New Field	AmbientBlankLot	Text - 8	Ambient Blank Field Lot Identifier
New Field	EquipmentBlankLot	Text - 8	Equipment Blank Field Lot Identifier
New Field	TripBlankLot	Text - 8	Trip Blank Field Lot Identifier

APPENDIX J

U.S. Army Corps of Engineers

FORMER RARITAN ARSENAL PROJECT ACCIDENT PREVENTION PLAN

New England Contract No. DACA41-92-D-8002/0015-0017
Baltimore Contract No. DACA31-00-D-0023/050, 056, and 069
Baltimore Contract No. W912DR-05-D-0022-0001

April 2006

Prepared by:

WESTON SOLUTIONS
205 Campus Drive
Edison, New Jersey

U.S. ARMY CORPS OF ENGINEERS

FORMER RARITAN ARSENAL PROJECT
ACCIDENT PREVENTION PLAN

New England Contract No. DACA41-92-D-8002/0015-0017
Baltimore Contract No. DACA31-00-D-0023/050, 056, and 069
Baltimore Contract No. W912DR-05-D-0022-0001

April 2006

Prepared for:

U.S. ARMY CORPS OF ENGINEERS

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TABLE OF CONTENTS

Section **Page**

TABLE OF CONTENTS
(CONTINUED)

Section **Page**

TABLE OF CONTENTS
(CONTINUED)

Section **Page**

LIST OF FIGURES

LIST OF TABLES

LIST OF ATTACHMENTS

LIST OF ACRONYMS

"The Site"	Former Raritan Arsenal Site
ACGIH	American Conference of Governmental Industrial Hygienists
AHA	Activity Hazard Analysis
ANSI	American National Standards Institute
APP	Accident Prevention Plan
BBP	Bloodborne Pathogens
CFR	Code of Federal Regulations
CIH	Certified Industrial Hygienist
COR	Contracting Officer's Representative
CPR	cardiopulmonary resuscitation
CSP	Certified Safety Professional
DOT	Department of Transportation
EHS	Environmental Health and Safety
EPA	U.S. Environmental Protection Agency
ERCP	*Emergency Response and Contingency Plan*
EZ	exclusion zone
FLDs	Field Operating Procedures
ft	feet
FSO	Field Safety Officer
GFCIs	Ground fault circuit interrupters
HAZWOPER	Hazardous Waste Operations and Emergency Response Regulations
HazCom	Hazard Communication Standard
MEC	munitions or explosives of concern
MSDS	Material Safety Data Sheets
NEC	National Electrical Code
NIOSH	National Institute for Occupational Safety and Health
OSHA	Occupational Safety and Health Administration
PM	Project Manager
PPE	personal protective equipment
PSM	Program Safety Manager
RMSF	Rocky Mountain Spotted Fever
SOW	*Scope of Work*
SSHO	Site Health and Safety Officer

LIST OF ACRONYMS
(Concluded)

SSHP	*Site Safety and Health Plan*
UL	Underwriters Laboratories
USACE	U.S. Army Corps of Engineers
UXO	unexploded ordnance
Weston®	Weston Solutions, Inc.

SECTION 1.0

SIGNATURE SHEET

1.0 SIGNATURE SHEET

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Paul Bovitz – Project Manager

Plan Concurrence________________________________, Weston – (603) 656-5442
Theodore L. Blackburn, CSP, CET – Program Safety Manager

Team personnel assigned to this project will be familiar with the possible hazards involved, the safety procedures, and other information outlined in this plan. Prior to the commencement of work, the Team Leader/Site Safety and Health Officer will discuss additional procedures to be implemented, addressing any other site-specific conditions that may arise. All on-site personnel of Weston and all subcontractors must sign the following Plan Acknowledgement Form (Figure 1-1).

By signing below, the undersigned certify they have had the opportunity to read and ask questions about this Accident Prevention Plan (APP), and that they understand the procedures, equipment, and restrictions of this plan and agree to abide by them.

Figure 1-1
Project Health and Safety Acknowledgement Form

No.	Name	Signature	Date	Company
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SECTION 2.0

BACKGROUND INFORMATION

2.0 BACKGROUND INFORMATION

2.1 CONTRACTOR

Weston Solutions, Inc.

2.2 CONTRACT NUMBER

New England Contract No. DACA41-92-D-8002/0015-0017
Baltimore Contract No. DACA31-00-D-0023/050, 056, and 069
Baltimore Contract No. W912DR-05-D-0022-0001

2.3 PROJECT NAME

Former Raritan Arsenal

2.4 BRIEF PROJECT DESCRIPTION

The former Raritan Arsenal site was used extensively by the U.S. Army from 1917 to 1963. Previous environmental studies of the site indicated the presence of buried ordnance and contamination of soil and groundwater with organic and inorganic hazardous substances and explosive compounds.

Weston Solutions, Inc. (Weston®) currently has delivery orders open under contracts with the following U.S. Army Corps of Engineers (USACE) districts:

- New England District contract number DACA41-92-D-8002 - Delivery Orders 0015 through 0017;
- Baltimore District contract number DACA31-00-D-0023 – Delivery Orders 0050, 0056, and 0069; and
- Baltimore District contract number W912DR-05-D-0022-0001.

The delivery orders under these contracts have been developed to carry out an additional environmental evaluation and restoration at the site. The Raritan Management Action Plan (MAP) document (USACE 2004) provides a description of project investigations and remedial activities already completed since project inception. The work currently covered under the contract Scope of Work (SOW) includes the professional services necessary for:

- Investigation of contaminated groundwater;
- Investigation of remaining soil issues;
- Ecological risk assessment;
- Investigation of potential vapor intrusion pathway into indoor air at site buildings; and
- Preparation of No Further Action letters.

2.5 CONTRACTOR ACCIDENT EXPERIENCE

Weston has performed numerous field investigation projects and has an excellent accident prevention record. Weston's Experience Modification Rate (EMR) was 0.43 in 2004 and 0.42 in 2005; below the national average of 1.0 for other companies performing similar work. Weston's Occupational Safety and Health Administration (OSHA) Recordable Incidence Rate (RIR) was 0.87 in 2005 and 0.36 in 2004. Within the past 3 years, Weston has undergone several limited OSHA Compliance Inspections and received no citations.

Weston is a company that considers safety to be the single most important part of what we do both on and off of the jobsite. Our continual commitment to safety in the workplace has enabled Weston to provide a safe work environment for all. Our team will work hard to prevent accidents, by following this Accident Prevention Plan, and the USACE Manual, EM 385-1-1.

2.6 HAZARD/RISK ANALYSIS:

Field work necessary for completion of the above mentioned activities consists of the following tasks and associated subtasks, as outlined in Table 2-1.

Table 2-1
Field Work Tasks

No.	Task/Subtask
1	UXO Survey/screening
2	Soil Sampling
3	Geoprobe®/GW SAMPLING
4	Monitoring well installation
5	GW sampling
6	Surveying
7	Sediment sampling
8	Surface water sampling
9	Benthic macroinvertebrate sampling
10	Fish sampling
11	Frog sampling
12	Fiddler crab sampling
13	Plant sampling
14	Earthworm sampling
15	Small mammal sampling
16	Indoor air sampling
17	Subslab soil gas sampling
18	Subslab soil sampling

Weston will mobilize all necessary personnel, equipment, materials, and subcontractors in order to implement specific tasks as outlined in this APP. Weston will designate work areas or zones (since this plan falls under Hazardous, Toxic and Radioactive Waste [HTRW] requirements) as suggested in *Occupational Safety and Health Guidance Manual for Hazardous Waste Site*

Activities, National Institute for Occupational Safety and Health (NIOSH)/OSHA/U.S. Coast Guard (USCG)/U.S. Environmental Protection Agency (EPA), dated October 1985.

All personnel performing the above-mentioned tasks will be required to use Level D Personal Protective Equipment (PPE) as outlined in Section 11.0. Upgrade to Modified Level D will be determined by the Site Safety and Health Officer (SSHO). Potential hazards associated with the tasks are included in the Activity Hazard Analysis (AHA) tables located in Section 14.0 of this APP.

UXO Survey and Screening

UXO screening will be performed prior to any intrusive activities in areas of the site where UXO could potentially be encountered based on past site activities. UXO screening will also be conducted in areas of the site that have not yet been investigated, for which intrusive activities are planned. UXO screening should not be necessary for subslab soil sampling or subslab soil gas sampling, since the depths to be sampled are immediately below the slab. The exception is any building falling within an area where past site activities indicate the potential for UXO to be encountered. Such buildings will be evaluated by USACE on a case-by-case basis.

Soil Sampling

Soil sampling will be conducted in accordance with soil sampling; sample preservation; volume and containers; and sample receipt, handling, and custody protocols listed in the Comprehensive Sampling and Analysis Plan (CSAP) and the New Jersey Department of Environmental Protection (NJDEP) *Technical Requirements for Site Remediation* (TRSR) (July 2005) and *NJDEP Field Sampling Procedure Manual* (FSPM) (August 2005).

Soil samples may be collected using a variety of methods and equipment. The methods and equipment used will be dependent on the depth of the desired sample, the type of sample required (disturbed versus undisturbed), and the soil type. Surficial soils may be easily sampled using a spade, trowel, and scoop (for non-volatile parameters). Sampling at greater depths may be performed using a hand auger, continuous flight auger, split-spoon, Geoprobe®, or, if required, a backhoe.

All soil samples collected will be described by a qualified Weston geologist utilizing Weston's Standard Soil Logging Form. Except for samples approved under work plans in effect prior to the 1996 adoption of the NJDEP Technical Requirements, volatile organic compound (VOC) fractions will be retrieved first from the sampling device (e.g., split spoon, direct push sampling sleeve), using an EnCore® sampling device. The soils will then be homogenized, if necessary, for collection of the remaining sample fractions. The samples will be placed in coolers and chilled to 4 degrees Celcius (°C) using wet ice.

Geoprobe® Groundwater Sample Collection

The Geoprobe® system will be utilized to determine the extent of contamination of concern in the shallow groundwater at the former Arsenal in accordance with the CSAP. The shallow groundwater sampling technique will follow NJDEP methods presented in the NJDEP *Alternative Ground Water Sampling Techniques Guide,* (July 1994). The shallow groundwater samples will be collected in accordance with either NJDEP Method Number AGWST 4.00 (groundwater sampling with the use of a passively placed, narrow-diameter point [PPNDP]) or AGWST 5.00 (groundwater sampling with the use of a small-diameter direct-push point [SDDPP]).

Once the shallow groundwater points have been installed, groundwater will be purged (if necessary) and sampled in accordance with the NJDEP protocol. All down-hole equipment including rods, well points, and bailers will be decontaminated prior to, and after use. Installation of the shallow groundwater sampling points will be temporary (less than 48 hours); the boreholes will be abandoned in accordance with NJDEP procedures.

Monitoring Well Installation

Installation of monitoring wells includes drilling of the borehole, construction of the well, and development of the well. The three listed steps will be conducted in accordance with their respective sections of the CSAP and NJDEP TRSR (July 2005) and FSPM (August 2005).

There is no ideal drilling technique for all conditions; therefore, overburden, bedrock, and hydrogeologic conditions at the site, as well as project objectives, should be considered before deciding which drilling method is appropriate. Two types of monitoring wells will be installed by Weston: overburden wells and bedrock wells. Based on information provided during previous drilling at the former Arsenal, hollow-stem augering will be utilized for the installation of shallow (<30 feet) overburden monitoring wells unless another well installation method is proposed and authorized by the project-specific FSP. Conventional drilling methods may also be used for soil sampling depending on local geologic conditions and proposed sample depth. It is anticipated that hollow-stem augering will also be utilized for soil sampling at depths greater than 30 feet below ground surface (bgs). Mud or air rotary drilling may be utilized for the installation of overburden wells greater than 30 feet if hollow-stem augering is ineffective. Rotary methods will also be utilized for installing bedrock wells. Lithologic description and all field measurements and comments will be recorded on the Borehole Logging Forms.

Piezometers (or observation wells) may also be installed in the overburden in certain areas throughout the former Arsenal for the primary purpose of collecting static water level data. The construction and development of these piezometers/observation wells will be identical to a 2-inch overburden monitoring well so that, if necessary, groundwater samples may be obtained from them.

Well construction information will be included on the Well Construction Form for each well installed. At a minimum, the well construction information will show depth from surface grade, the bottom depth of the boring, the screened interval, casing material, casing diameter, gravel pack location, grout seal and height of riser pipe above the ground.

Weston will initiate well development as soon as practical after installation, but no sooner than 48 hours after grouting is completed. There are a variety of methods that can be used in well development; however, pumping combined with surge blocking is the preferred method. Development will be considered complete when the criteria in the CSAP are met (e.g., water appearance, turbidity). The development data will be recorded on a Well Development Form.

Groundwater Sampling

Groundwater sampling will be conducted in accordance with groundwater sampling; sample preservation; volume and containers; and sample receipt, handling, and custody protocols outlined in the CSAP. Prior to sampling, the well will be purged to allow intrusion of fresh groundwater for sampling. This will be achieved using one of several instruments. The most common of these are the bailer and/or pump. Weston will utilize low-flow rate submersible pumps to purge and sample the monitoring wells. The selected pump will be used for both purging and sampling, unless a well exhibits such low yield/recharge that pumping becomes impractical. In cases where well yield/recharge is very low, a bailer or WaTerra pump (inertial pump) may be used for development, purging, and sampling in accordance with procedures outlined in the NJDEP FSPM (August 2005).

Equipment will be decontaminated prior to use and between monitoring well locations. The wells will be purged until field parameters (e.g., temperature, specific conductance, pH, turbidity, dissolved oxygen, and oxidation-reduction potential) stabilize. Stabilization is defined as three consecutive readings within a specified range, as defined by the NJDEP *Low-Flow Purging and Sampling Guidance* (December 2003). Less than three volumes may be removed from low yielding wells. Groundwater samples will be collected immediately following purging using the same adjustable low-flow rate pumping equipment (i.e., within 2 hours if sufficient recharge is available). Once purging is completed and the correct laboratory-cleaned sample containers have been prepared, sampling will immediately proceed. The following order of sample fraction collection will generally be followed; however, field conditions and well yield may require field decisions to modify the order on a case-by-case basis:

1. Conductivity, pH and temperature;
2. Volatile organics;
3. Metals;
4. Extractable organics including explosives;
5. Cyanide; and
6. Wet chemistry parameters (oil and grease, total dissolved solids [TDS], hardness, etc.).

The type of analysis for which a sample is being collected determines the type of bottle, preservative, holding time, and filtering requirements. Samples should be collected directly from the sampling device into appropriate laboratory-cleaned containers. Samples will not be collected through the flow-through cell.

Samples will be appropriately preserved, labeled, logged, and placed in a cooler to be maintained at 4°C. Samples will be shipped within the appropriate holding time; in most cases, within 24 hours of sample collection. A chain-of-custody will be initiated in the field and will travel with the samples. Custody seals will be affixed to the shipping container and sealed with clear tape.

Surveying

Surveying will be conducted in accordance with the surveying protocols outlined in the CSAP. For monitoring wells, the location and elevation of the top of the innermost casing of all new monitoring wells will be surveyed by a New Jersey-licensed surveyor. Elevations will be surveyed to within ± 0.01 foot and reported in feet above Mean Sea Level (MSL) using the National Geodetic Vertical Datum of 1988 (NGVD 88). Staff gauges will be surveyed in the same manner as monitoring wells. The locations and elevations of all monitoring wells will be determined with respect to on-site benchmarks. The horizontal coordinates will be measured to within ± 1 foot using the State Planar coordinate system, and will be referenced to the North American Datum of 1983 (NAD83).

Soil borings, surface soil, and sediment sample locations will be horizontally surveyed. Locations of soil and sediment samples may be recorded using a global positioning system (GPS) unit with submeter accuracy, properly calibrated and operated by a qualified user. Approval for survey data collection using GPS should be obtained by reviewing agencies in advance.

Sediment Sampling

Sediment samples will be collected following the sediment sampling protocols outlined in the CSAP. Sediment sampling will follow *in-situ* surface water measurements collected at each location and will follow surface water sample collection where applicable. Sediment samples will be collected from surficial (0-6 inch) depths with either a decontaminated stainless steel auger or Ponar dredge, whichever is most effective at a given location. Following collection, the sediment will be transferred to a decontaminated stainless steel bowl or other appropriate homogenization container and fully mixed. The homogenized sediment will be portioned into the appropriate sample containers, labeled, and secured. Samples then will be placed in a cooler, chilled to 4°C using wet ice, and prepared for shipping to the subcontracted laboratory.

Surfacewater Sampling

In-situ water quality measurements will be collected at each of the aquatic sampling locations, provided there is sufficient surface water in which to take measurements. *In-situ* measurements will be collected using an electronic meter which is calibrated prior to sampling. Data will be recorded on dissolved oxygen (DO), temperature, conductivity, salinity, pH, and turbidity by certified personnel. Surface water samples will be collected following the surface water sampling protocols found in the CSAP. Surface water sampling will follow *in-situ* surface water measurements collected at each location and will precede sediment sampling conducted at the same location. All surface water samples will be collected directly from the water surface using dedicated sampling equipment, apportioned into the appropriate sample containers, labeled, and secured. Samples then will be placed in a cooler, chilled to 4 degrees °C, and prepared for shipment to the subcontracted laboratory.

Benthic Macroinvertebrate Sampling

Benthic macroinvertebrates are collected from freshwater streams as per sampling protocols found in the CSAP. From each location, three replicate samples will be collected using a petite Ponar dredge. Samples will be sieved in the field to reduce the amount of fine sediment particles in the sample, placing the sample into stainless steel mesh bottom-lined bucket, and submerging the bottom of the bucket in the ambient water. Material remaining in the bucket will be transferred to 32-ounce polyethylene containers and preserved with 70% denatured ethanol.

Fish Sampling

A variety of collection techniques may be used to obtain a sufficient number of fish for tissue analysis. The preference is to use boat electroshocking (or backpack electrochocking, where applicable) due to its effectiveness in shallow water bodies, such as those found across the former Arsenal. However, electroshocking may not be feasible in soft-bottom areas or within brackish waters (due to the ineffectiveness of the electrical current circuit). Instead, other methods, such as gill netting, trotlining, minnow trapping or rod and reel sampling, may be employed. Each sampling technique will be conducted according to a measurable unit effort so that capture success can be compared for each technique between sampling locations. Field sampling personnel have been trained in the proper and safe use of all fish sampling equipment, including the safe use of electrofishing equipment.

Frog Sampling

Frogs will be primarily captured at night. A portable spotlight will be used from a boat or shore in order to spot and net frogs while they are blinded. If vegetation is too dense for netting, frogs may have to be speared using a long-handled gig or fork. If the latter method is used, the gig will be decontaminated between captures, and the captured frog immediately rinsed with deionized water. Upon capture, frogs will be given a unique identification number and returned to a central processing area.

Fiddler Crab Sampling

Fiddler crabs will be captured by hand or net at low tide across the intertidal flats at each sampling location. Upon capture, fiddler crabs from separate areas will be given a unique identification number and returned to a central processing area for distribution into composite samples. The fiddler crabs retained for analysis will be washed with distilled water to remove any sediment or organic material and processed for analysis immediately thereafter.

Plant Sampling

At each location, a sample of *Phragmites* root tissue will be collected using decontaminated equipment (e.g., shovel and knife). Each sample will be rinsed with distilled water and then placed into a labeled resealable plastic bag or glass jar.

Earthworm Sampling

Earthworms will be collected using a clean shovel decontaminated between locations. The worms will be collected by hand, rinsed with distilled water and composited into samples for analysis. Each composite sample will be collected from the surface litter layer and up to one foot bgs, within a 10-foot radius of a corresponding soil sample. Earthworms will be transferred to glass containers or plastic sealable bags that are labeled by location, and placed on wet ice.

Small Mammal Sampling

Small mammal trapping will consist of setting trap lines, each with 10 traps. Of the 10 traps set along each line, five will consist of Victor or Museum Special snap traps and five will consist of Sherman live box traps. When placed, the traps will generally be set alternately (i.e., every other one will be a Sherman trap). Traps will be set for two nights (up to three nights if necessary). Trapping will be curtailed as soon as the trapping objectives are reached. Once the traps are set, they will be checked twice daily in the field, during early morning and early evening hours. Animals caught live in the field that are chosen for analysis will be humanely killed by cervical dislocation with a steel rod. Recovered animals will be labeled and stored on wet ice in coolers before processing; if the animals are to be held more than 4 hours then they will be retained on wet or dry ice. Specimens retained for analysis will be transported to the central staging area in coolers. At the staging area they will be measured, and initially dissected. Metrics recorded will include total body weight, body length, tail length, and ear length.

Indoor Air Sampling

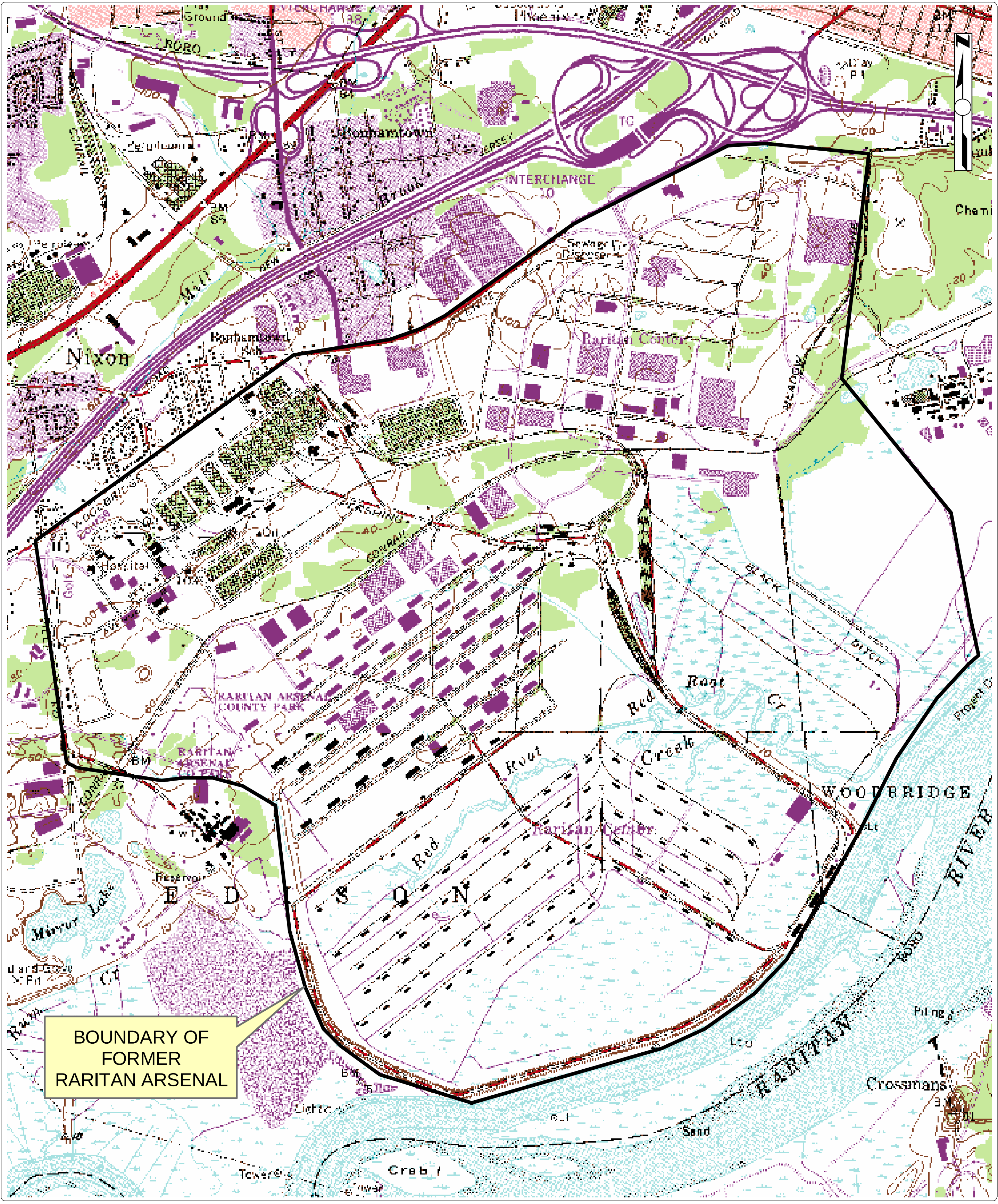
This task involves collecting indoor air and background samples. Air samples will be collected over a 24-hour period. The indoor samples will be collected from the breathing zone height (2 feet to 5 feet). All windows and overhead doors will be closed to the extent possible. In order to collect representative samples, it is important that the building windows and doors be closed 12 hours before measurements begin and the use of appliances which induce large pressure differences (e.g., exhaust fans) be avoided during sample collection time. Ventilation systems should be operated as normal. Air samples will be collected using Suma canisters equipped with a 24-hour regulator valve.

Subslab Soil Gas Sampling

Subslab soil gas sampling point installation will be performed in accordance with the *Draft Guidance for Soil Gas Sampling* (NJDEP 2004). A Suma canister equipped with a one-hour regulator valve will be utilized for sample collection. A 3/4-inch hole will be drilled approximately 1 to 2 inches below the concrete slab. Next, a vapor probe will be inserted flush with the top of the concrete slab. Quick expansive cement will be used to secure the vapor probe in place. Once secured, a “T” setup will be attached to the sample port. A portable vacuum pump will be used to purge the vapor probe through the purge line. As soon as the vapor probe is purged, the line will be closed, and the Summa canister valve will be opened to collect the sample. Subslab soil gas samples will be collected over a one-hour period.

Subslab Soil Sampling

Soil borings will be completed to a depth of 5 to 8 feet using a Geoprobe® macro-core sampler driven by a hand-operated Bosch hammer drill. Continuous soil samples will be collected at each boring location using 4-foot-long Geoprobe® macrocores with acetate sleeve liners. All soil samples will be screened with a photoionization detector (PID) for the presence of VOCs. In addition, a head-space reading will be obtained from a jarred soil sample collected at one-foot increments. Soil samples will be collected at the 6-inch interval where the highest PID readings are detected. If no PID readings are detected, subsurface soil samples will be collected at a depth of approximately 2.5-3 feet bgs.



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1,000 0 1,000 2,000

1 Inch = 2000 Ft.

SOURCE: U.S.G.S. TOPO QUAD - PERTH AMBOY/SOUTH AMBOY NJ

TITLE:

SITE LOCATION MAP

PROJECT:

FORMER RARITAN ARSENAL

CLIENT NAME:

U.S. ARMY CORPS OF ENGINEERS

DATE:

3-15-06

FIGURE #:

2-1

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SECTION 3.0

STATEMENT OF SAFETY AND HEALTH POLICY

3.0 STATEMENT OF SAFETY AND HEALTH POLICY

Weston's Corporate Environmental Health and Safety (EHS) program is proactive in assessing current EHS programs and setting strategies for years ahead, with emphasis on continuous compliance, continual improvement, and pollution prevention strategies. Due to the nature of Weston's work, it is essential that EHS needs be considered from the proposal stage through work execution and completion. Weston utilizes an integrated EHS management system to implement its corporate goal for *Safety Every Minute of Every Day*. Regulators, industry and clients are learning that integrated EHS management systems ensure a positive approach to compliance assurance and elevate opportunities for performance improvement. For these reasons, Weston embraces the key elements common to many strong EHS management systems as standard work practice for every job.

Six key EHS management system elements are uniformly implemented across Weston corporate projects and facilities. These include:

- Management Commitment;
- EHS Policy;
- Planning;
- Implementation;
- Checking and Corrective Action; and
- On-Going Review.

In performing its mission, Weston will conduct activities in a manner protective of human health and the environment, with a commitment to 100% safety and no releases to the environment, including:

- Commitment to regulatory compliance and applicable requirements;
- A manner protective of the worker, the public, and the environment;
- Pollution reduction goals and continual improvement targets;
- Communicating EHS awareness and policy to all personnel;
- Incentives for positive EHS performance;
- Making EHS policy available to the public;
- Seeking performance improvement input from stakeholders;
- Identifying environmental aspects with potential for significant impact; and
- Prescribing remedies to offset impact potential.

Additional information relative to Weston's EHS policy or specific programs can be found within the Weston *Field Safety Officer (FSO) Manual* (maintained on site).

3.1 PURPOSE/OBJECTIVES

The purpose of this APP is to establish standard safety and health procedures for Weston and subcontractor personnel in performance of their work. Any project activity is to be carried out in accordance with this APP and the associated *Site Safety and Health Plan* (SSHP). These documents are considered living documents and are subject to change based on review and the implementation of additional tasks.

This APP establishes the work practices necessary to help ensure protection of site personnel, the local community, and client personnel during site activities. The objective of this EHS program is to provide a mechanism for the establishment of safe working conditions. Specific hazard control methodologies have been evaluated and selected in an effort to minimize the potential of incident or injury.

All site activities will be performed in accordance with this APP, the associated SSHP, applicable Weston policies and procedures, OSHA and client requirements. The levels of personal protection and the procedures specified in this APP and the SSHP are based on the best available information from reference documents and current site data. Therefore, these recommendations represent the minimum safety and health requirements to be observed by all personnel engaged in this project. Unforeseeable site conditions or changes in SOW may warrant a reassessment of protection levels and controls stated. All adjustments to the site-specific EHS program must have prior approval by the Program Safety Manager (PSM) and the Client.

All Weston, client, and subcontractor personnel involved in this project will review and understand this document prior to the start of work. Any questions or concerns will be directed to the SSHO. All on-site personnel will follow the designated safety and health procedures, be alert to the hazards associated with working on site, and exercise reasonable caution at all times.

The regulations and guidelines listed in these documents provide employers (including the client) and employees with the information and training necessary to improve workplace safety and health, thereby minimizing the potential for injury and illness.

This APP and associated SSHP, which comprise the site-specific EHS program, are designed to anticipate, identify, evaluate, and control safety and health hazards, in addition to providing emergency response procedures relative to operations conducted at the site.

Weston’s site-specific EHS program for field activities requires preparation and compliance with the following documents:

- The APP – a standard document outlining criteria necessary for any field activity conducted in accordance with 29 Code of Federal Regulations (CFR) 1910.120 and/or USACE EM 385-1-1, and ER 385-1-92.

- The SSHP, which provides necessary site-specific information relative to site hazards with supporting procedures to assure worker safety.

- The *Emergency Response and Contingency Plan* (ERCP), which is designed to provide guidance, procedures, identify needed equipment or supplies and identify support agencies in the event of a site emergency. The ERCP is included as Section 12.0, Attachment A of the APP.

Additional plans, as referenced in Section 12.0, complete necessary regulatory and policy requirements. This APP and Weston's *FSO Manual* must be available on site and communicated to all workers or affected personnel.

3.2 REGULATIONS AND GUIDELINES

Compliance with all applicable requirements and regulations that are listed in the following publications will insure the safety and health of on-site personnel, visitors, Client, regulatory personnel, and the local community:

- 29 CFR 1910;
- 29 CFR 1926;
- Weston Corporate Health and Safety Program; and
- USACE EM 385-1-1.

Should additional guidelines or regulatory criteria prove necessary for worker or environmental safety, those materials will be referenced, accordingly.

3.3 DRUG AWARENESS AND DRUG-FREE WORKPLACE

Weston fully supports all aspects of the Drug-Free Workplace Act of 1988. Therefore, Weston has implemented SOPs for 1) a Drug-Free Workplace and 2) Drug and Alcohol testing. Strict disciplinary actions are enforced for any violation of these policies. All Weston employees, as a condition of employment, document understanding and receipt of these policies.

In the event that employee drug testing is required in the performance of an individual delivery order work under this Contract, those affected employees will be notified and actions taken in accordance with applicable rules and policies prior to initiation of site work activities.

The Weston Drug and Alcohol Testing Program is included in Section 12.0, Attachment H.

SECTION 4

RESPONSIBILITIES AND LINES OF AUTHORITY

4.0 RESPONSIBILITIES AND LINES OF AUTHORITY

4.1 ROLES AND RESPONSIBILITIES

The following is an identification and accountability of personnel responsible for safety – at both corporate and project level.

Name	Title	Phone #
Tony Riccio	Program Manager	(508) 520-6919
Paul Bovitz	Project Manager	(732) 417-5815
Ted Blackburn	Program H&S Manager/CSP	(603) 656-5442
Alanna Garrison	Edison EHS Officer	(732) 417-5893
Laura Amend-Babcock	Project QA/QC Manager	(732) 417-5811
Jim Soukup	Senior Hydrogeologist	(603) 656 5480
Melissa Bader	Senior Project Scientist	(732) 417-5891
Wen Fang	Senior Engineer	(732) 417-5813
Ryan Brown	Senior Ecologist	(732) 417-5850
Laura Clifford	Senior Geologist	(732) 417-5860

SSHOs will be determined on a task-by-task basis.

4.1.1 Program Manager

The Program Manager is responsible for establishing and executing project administrative matters, project controls, project-related policy matters, and project levels of authority, responsibility, and communication.

4.1.2 Project Manager

The Project Manager (PM) is responsible for the site-specific planning, coordination, and administration of task-specific activities in accordance with the specifications. The PM will document services by reviewing all safety plans and supporting documents, overseeing task performance, identifying task planning and resource requirements, and reviewing technical documents.

4.2 SAFETY AND HEALTH MANAGEMENT

4.2.1 Program Certified Safety Professional and/or Certified Industrial Hygienist

Project work will be performed under the guidance of a Certified Safety Professional (CSP) or Certified Industrial Hygienist (CIH), based upon site conditions and expertise necessary. Weston CSPs or CIHs will be certified by the Board of Certified Safety Professionals or by the American Board of Industrial Hygiene, respectively. The CSP or CIH will have the following responsibilities:

- Final approval of the site Safety Program in conjunction with the Weston PSM.
- Ensure that the Safety Program complies with all federal, state, local, and client health and safety requirements. If necessary, modify specific aspects of the APP to adjust for on-site changes that affect safety.
- Evaluate and authorize any changes to the Safety Program in conjunction with the PSM.
- Oversight of the Health and Safety Program.
- Assist in acting as liaison with government officials regarding health and safety related site matters.

4.2.2 Program Safety Manager

The PSM will act as the liaison between the site personnel and the CSP or CIH. The PSM may also function as the Project CSP or CIH. The PSM will have the following responsibilities:

- Technical direction and compliance with CSP or CIH role identified above.
- Development and review of the Safety Program.
- Coordinating with the CSP or CIH and the SSHO for implementation of the Safety Program.
- Providing technical direction to the SSHO and Site Management.
- Maintaining frequent communication with the SSHO and Site Management regarding site activities and implementation of the Safety Program.
- Assisting in training of site personnel in site-specific hazards.
- Ensuring site and personnel compliance with Weston's and the Client's Safety Program via mechanisms such as, but not limited to, audits, inspections, and periodic and routine communications.

4.2.3 Site Safety and Health Officer

The SSHO is responsible for ensuring that project activities conform to the requirements of the Safety Program. In this capacity, the SSHO will perform the following duties relative to implementation of the Safety Program:

- Ensure that all tasks and construction activities are performed in compliance with the Safety Program and applicable regulations.
- Process and prepare health- and safety- related documentation, reports, and submittals.
- Provide periodic health and safety audits.
- Update, maintain, and perform all site-specific monitoring requirements.

A listing of Weston SSHOs who will be utilized for this project is included in Attachment 1 of the APP.

4.2.4 Site Manager/Supervisor

The Site Manager will supervise and direct all field activities as described in the SOW. The Site Manager will ensure that the remedial tasks and field activites conform to the requirements of the Safety Program project specifications. Site-specific field responsibilities include the confirmation of all utility locations and structures; procurement of all permits; conformance to all site safety, security, and government guidance documents and regulations; coordination and direction of field activities; and completion of daily reports. The Site Manager will delegate responsibility as necessary to the SSHO and members of the field team.

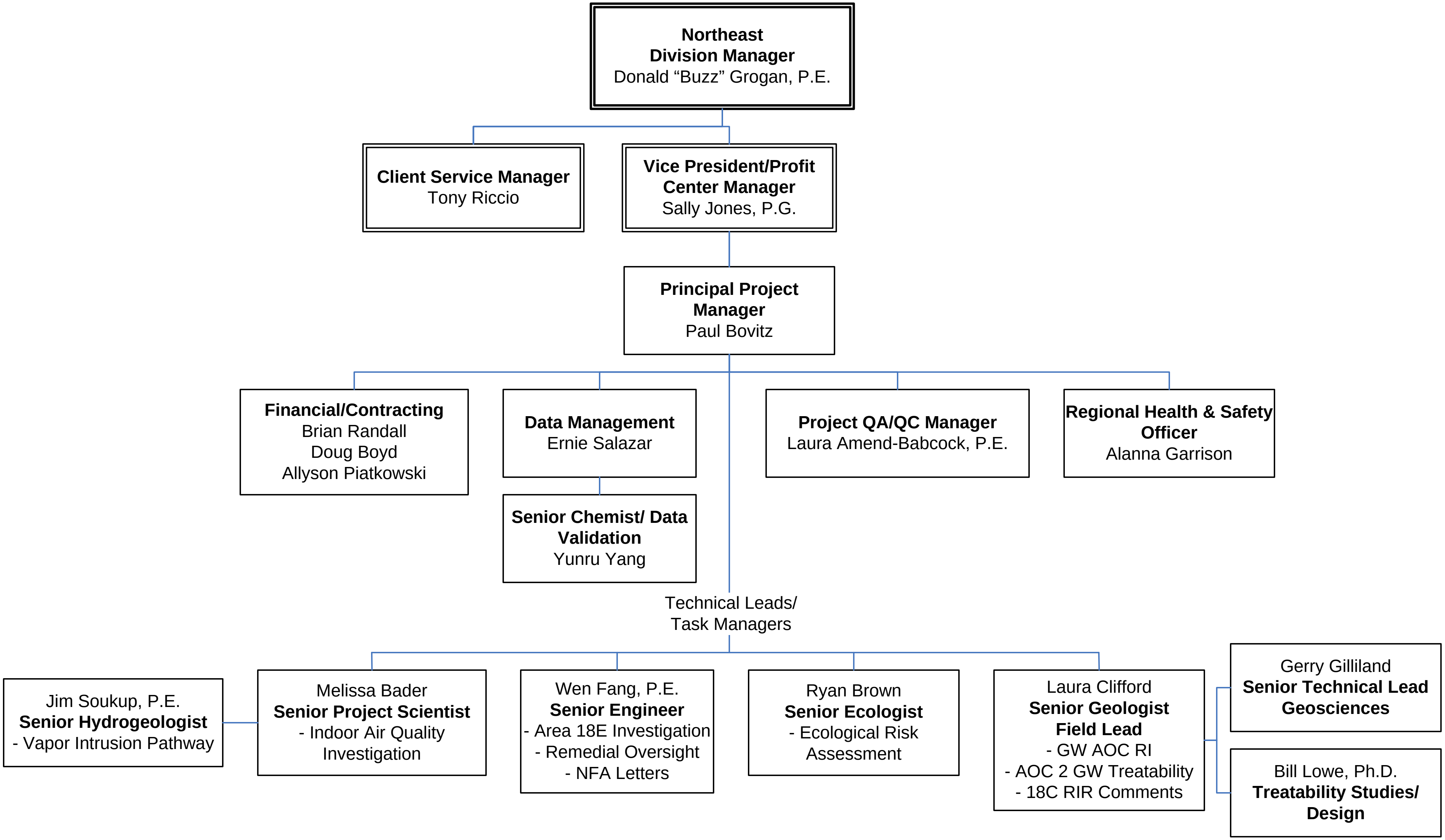
4.2.5 FIELD TEAM AND SUBCONTRACTORS

Weston's field team and subcontractors are responsible for complying with the requirements of the site-specific EHS program. All are encouraged to notify Site Management or SSHO in the event safety or health issues not identified in the site-specific EHS program are encountered.

4.3 ORGANIZATION

All personnel having the potential for exposure to site hazards are subject to the requirements of this APP and associated SSHP. An Organizational Chart, included as Figure 4.1, indicates the chain of command at the Weston team level and personnel assigned to the following key positions.

WESTON SOLUTIONS, INC.
RARITAN ARSENAL ORGANIZATION CHART



Northeast Division Manager
Donald "Buzz" Grogan, P.E.

Client Service Manager
Tony Riccio

Vice President/Profit Center Manager
Sally Jones, P.G.

Principal Project Manager
Paul Bovitz

Financial/Contracting
Brian Randall
Doug Boyd
Allyson Piatkowski

Data Management
Ernie Salazar

Senior Chemist/ Data Validation
Yunru Yang

Project QA/QC Manager
Laura Amend-Babcock, P.E.

Regional Health & Safety Officer
Alanna Garrison

Technical Leads/
Task Managers

Jim Soukup, P.E.
Senior Hydrogeologist
- Vapor Intrusion Pathway

Melissa Bader
Senior Project Scientist
- Indoor Air Quality Investigation

Wen Fang, P.E.
Senior Engineer
- Area 18E Investigation
- Remedial Oversight
- NFA Letters

Ryan Brown
Senior Ecologist
- Ecological Risk Assessment

Laura Clifford
Senior Geologist
Field Lead
- GW AOC RI
- AOC 2 GW Treatability
- 18C RIR Comments

Gerry Gilliland
Senior Technical Lead
Geosciences

Bill Lowe, Ph.D.
Treatability Studies/ Design

Last Updated
9 March 2005

SECTION 5.0

SUBCONTRACTORS AND SUPPLIERS

5.0 SUBCONTRACTORS AND SUPPLIERS

Weston will provide oversight and coordinate on-site/field activities to ensure the successful execution of tasks described within this APP. Each subcontractor is responsible for providing supervision of its employees [as defined by 29 Code of Federal Regulations (CFR) 1904] and will provide qualified personnel and/or competent persons as, and where, required by law or regulation. Unless otherwise agreed to and documented in writing, each subcontractor will be responsible for managing and recording any injury or incident involving its employees as required by OSHA or other applicable laws and regulations.

5.1 IDENTIFICATION

This section will be updated as new work begins. Potential subcontractors include drillers, environmental laboratories and surveyors. Contracted work is performed as outlined below.

SUBCONTRACTOR	TASK
East Coast Drilling, Inc.	Geoprobe®, well installation
S2C2	Geoprobe®, MIP
Columbia Technologies	Mobil laboratory for MIP
Arecon Ltd.	Surface water sampling
STL-Edison	Groundwater sampling
T&M Associates	Surveying
French & Parello	Surveying
TrueGreen Land Care	Landscaping
Cycle Chem	Transport and disposal of waste

5.2 SUBCONTRACTOR CONTROL AND RESPONSIBILITIES

All subcontractors will be provided a copy of this APP. Subcontractors will review the APP with their employees and supervisors and each individual is expected to sign the signature sheet identified in Section 1.0, certifying that they understand and will comply with the requirements of this plan. Subcontractors will provide Company-Specific Programs and subcontractor-specific AHAs to the Prime Contractor for inclusion in the APP. Subcontractor personnel are expected to participate in all daily health and safety briefings. In accordance with contract requirements, all subcontractors are expected to comply with necessary plans and procedures. Deviation is cause for dismissal.

5.3 SAFETY RESPONSIBILITIES

Weston requires its subcontractors to work in a responsible and safe manner. Subcontractors for this project are required to adhere to applicable requirements set forth in the USACE Safety and Health Requirements Manual, EM 385-1-1, (3 Nov 03) in their work and safety plans. Joint safety inspections will be performed by Project Manager Mr. Paul Bovitz and the various subcontractor representatives weekly, at a minimum.

SECTION 6.0

TRAINING

6.0 TRAINING

6.1 SITE-SPECIFIC TRAINING

All components of the APP will be discussed with team members during the project safety indoctrination training. Specific concentration will be provided for the following components:

- Vehicular traffic awareness;
- Emergency response/notification;
- Hypothermia/hyperthermia control and prevention;
- Required PPE;
- Regional biological hazards;
- Working will Drilling machinery (as necessary);
- First aid/cardiopulmonary resuscitation (CPR) procedures;
- Client-specific requirements;
- Hazard communication and contaminant information; and
- EHS expectations.

6.2 SITE TRAINING AND CERTIFICATION REQUIREMENTS

All personnel assigned to or regularly entering the project site will have received the required training. In accordance with 29 CFR 1910.120 and other OSHA Regulations, applicable required training for all site workers will be performed as outlined in the following subsections.

6.2.1 Occupational Safety and Health Administration Training

Where necessary and applicable by regulation, all general site workers must have completed the 40-hour Hazardous Waste Operations and Emergency Response (HAZWOPER) training course and three days of field experience under the direct supervision of a trained, experienced supervisor. The SSHO must have an additional 8 hours of specialized safety supervisory training. Additionally, safety personnel will receive either the OSHA-Outreach 10 or 30-Hour Construction course as required. All workers must have annual refresher training. All training will be documented.
Workers on construction sites will receive training as required by 29 CFR 1926.

6.2.2 First Aid and Cardiopulmonary Resuscitation Training

At least two employees per site will be certified in First Aid and CPR. The training will be equivalent to that provided by the American Red Cross.

6.2.3 Bloodborne Pathogen Training

The SSHO will be responsible for administering First Aid in the event of injury or incident. Therefore, the SSHO will receive training in controlling exposures to Bloodborne Pathogens (BBP). All Weston employees receive annual BBP refresher training.

6.2.4 Hearing Conservation Training

All site personnel exposed to noise levels exceeding 85 decibles on the A scale (dBA) 8-hour time-weighted average will be provided with training that addresses the following topics:

- Physical and psychological effects of high noise exposure;
- Noise exposure limits;
- Elements of the Hearing Conservation Program; and
- Selection, use, and limitations of hearing protection devices.

6.2.5 Respiratory Protection Training

In accordance with 29 CFR 1910.134, all site personnel required to use respiratory protection devices will have received medical clearance and equipment-specific training. This training covers the use, limitations, inspection, maintenance, cleaning, and storage of respiratory protection devices required for use under the conditions of this Health and Safety Program. Site-specific briefing/training will reinforce knowledge as necessary.

Weston’s Respiratory Protection Program can be found within the Field Safety Officer’s Manual and in Section 12.0, Attachment E of this APP.

6.2.6 Personal Protective Equipment Training

In accordance with OSHA 29 CFR 1910, Subpart I, all PPE will be provided, used, and maintained in a sanitary and reliable condition. All PPE will be of sufficient construction, design, and material to provide employees protection against known or anticipated hazards. Personal protective equipment will be selected that properly and appropriately fits the employee.

Weston employees have been provided with training in accordance with the PPE standard. Any concerns regarding the use of appropriate PPE will be brought the attention of the SSHO, who is directed to contact the PSM for assistance in evaluation of PPE as necessary.

Weston’s PPE Program can be found within the Field Safety Officer’s Manual and in Attachment 12, Attachment F of this APP.

6.2.7 Buddy System Training

Workers will be instructed that all site work will be performed using the buddy system. Team members will keep in visual contact with each other at all times.

Team members will be made aware of any slip, trip, and lifting hazards along with any potential exposure to chemical substances, heat or cold stress, and general hazards within their work area.

6.2.8 Other

Weston will assure that additional training or certification (required by either Weston or subcontracted employees) is verified. These training topics or certifications may include crane operator, diving, confined space and others. Supplemental training may be required for site-specific contaminants or as required due to changes in site conditions. Supplemental training may include permit-required confined space entry, additional HazCom and OSHA chemical-specific requirements. In the event supplemental training is required, documentation will be noted.

6.3 EMERGENCY RESPONSE TRAINING

All site personnel will be briefed on the site ERCP provided in Section 12.0, Attachment A. Site personnel will be briefed on roles and responsibilities during an emergency, notification, potential emergency situations, rally points, and location of emergency equipment.

6.4 SAFETY MEETINGS

At a minimum, safety briefings (typically prior to start of work for the day) will be given daily by the Task Leader and/or the SSHO. Topics will include proposed work scheduled, any special activities, requirements for PPE and other topics pertinent to the SOW. Daily briefings will be documented as to topic, employees attending, and persons presenting.

At the start of each work period, which is normally Monday, a site-specific safety topic will be selected and discussed in detail.

All Weston, client, and subcontractor personnel are required to attend the training, to be documented by the SSHO. The training will consist of site-specific hazards and/or appropriate safety-related concerns.

6.5 VISITOR COORDINATION AND TRAINING

Site visitors are defined as persons who are not employed at the project site, who do not routinely enter restricted work areas, and whose presence is of short duration (i.e., one to two days at one time or per month). Visitors who do not enter the exclusion zone (EZ) are required to meet the general requirements specified below. These visitors may include client personnel, Weston personnel, commercial vendors, political representatives, and auditors or inspectors from local, district, or federal agencies. Visitors who enter the EZ during site operations will meet the same medical clearance and OSHA training requirements specified for all site personnel.

6.5.1 General Requirements

The following requirements apply to visitors whose purpose is to observe site conditions or field activities without entering the EZ:

- The senior Weston on-site representative and the SSHO will be notified of the nature and duration of the visit before visitors are permitted to enter the Site.

- The visitor's log will be completed, including the individual's name, date, and the name of the company or agency represented.

- A Weston representative will escort the site visitor at all times while in the work area. The SSHO, or designee, will be a member of the escorting party.

- Visitors will comply with specific safety and health requirements described below, as applicable.

6.5.2 Training Requirements

All visitors will receive site-specific training to ensure potential hazards and risks are identified. This training will consist of a safety briefing by the SSHO that will include:

- Location and description of potential hazards and risks;
- Required PPE;
- Areas of the site that are closed to visitors;
- The site evacuation plan and emergency procedures; and
- Other topics as deemed appropriate.

6.5.3 Additional Visitor Requirements (Entry into the Exclusion Zone)

Site visitors wishing to enter the EZ during site operations will be subject to the same medical clearance and OSHA training requirements as assigned site personnel. Documentation of training and medical clearance must be presented to the SSHO prior to entry into the EZ.

SECTION 7.0

SAFETY AND HEALTH INSPECTIONS

7.0 SAFETY AND HEALTH INSPECTIONS

7.1 TASK LOGS AND INSPECTIONS

7.1.1 Safety Log

The Task Manager and SSHO (as designated in Attachment 1 to the APP) will maintain a Safety Log of all safety-related activities. The SSHO is responsible for ensuring that health and safety activities for the day, as well as Safety Meeting minutes, are included within the log or filed appropriately.

7.1.2 Training Log

The SSHO is responsible for ensuring that all training conducted relative to job site activities is documented appropriately.

Documentation of training for all site workers will be available on site.

7.1.3 Visitor Log

A Visitor Log will be maintained at the entrance to all work sites to record visitations to the job site.

7.2 SITE INSPECTION AND FORMS

Daily safety and health inspections will be conducted by the SSHO with the results recorded in the Safety Log or files appropriately. The PSM or designee will conduct safety and health audits (at a minimum monthly) to ensure site personnel are performing the tasks in accordance with the Work Plan, APP and the site-specific EHS program. Excavations will be inspected in accordance with OSHA and EM 385-1-1 requirements by a competent person, should excavation work be required.

Results of inspections will be documented on Weston's Inspection and Deficiency Tracking Form; the tracking form will be posted on site.

7.3 EQUIPMENT INSPECTIONS

Any piece of heavy equipment utilized during field activities will undergo initial inspection by both the operator and the SSHO, and will undergo daily inspections by a competent person prior to commencing work as per EM 385-1-1, Section 16.A.01. All inspections will be documented and records maintained in the project file. Should equipment fail a substantive safety part of the inspection, the unit will be repaired and re-inspected before being returned to service.

7.4 EXTERNAL INSPECTIONS AND CERTIFICATIONS

Not applicable at this time.

7.5 PERSONNEL AND QUALIFICATIONS

The personnel listing and qualifications can be found in Section 12.0, Attachment L.

SECTION 8.0

SAFETY AND HEALTH EXPECTATIONS, INCENTIVE PROGRAM AND COMPLIANCE

8.0 SAFETY AND HEALTH EXPECTATIONS, INCENTIVE PROGRAM AND COMPLIANCE

8.1 GOALS AND OBJECTIVES

In performing its mission, Weston will conduct activities in a manner protecting human health and the environment:

- With commitment to 100% safety and no releases to the environment;
- With commitment to assuring employees and others work safely "every minute of every day";
- With commitment to regulatory compliance and applicable requirements;
- In a manner protective of the worker, the public, and the environment;
- With pollution reduction goals and continual improvement targets;
- Communicating EHS awareness and policy to all personnel;
- Seeking performance improvement input from involved or affected personnel;
- Identifying environmental aspects with potential for significant impact; and
- Prescribing remedies to offset impact potential.

As indicated in Weston's Statement of Safety and Health Policy, our program is established to be proactive in assuring safe work conditions. We fully expect all workers and visitors to comply with the requirements of this APP and all applicable rules, policies, and regulations associated with the site.

8.2 SITE INCENTIVE PROGRAM

Each Weston site is authorized to conduct appropriate incentives programs; however, an incentive program is not a requirement for any site. Safety incentives for the successful completion of site activities may include employee lunches, gift cards and clothing. The appropriateness of any proposed program must be approved by the PSM.

8.3 NON-COMPLIANCE

Weston will maintain procedures to monitor and measure on regular basis key characteristics of its operations and activities. This will include the information to track performance, relevant operational controls, and conformance with the organization’s EHS objectives and milestones.

Management systems audits, surveillance, inspections, and compliance audits will be conducted on an established schedule.

Weston will maintain procedures for defining responsibility and authority for handling and investigating nonconformance, taking action to mitigate impacts, and for initiating and compiling corrective action(s).

Weston typically uses a tiered approach to disciplinary action. This approach utilizes prescriptive measures such as verbal warnings and letters to file for initial infractions. Subsequent measures include removal from the site or employment termination.

8.4 ACCOUNTABILITY

Health and safety is everyone's responsibility. Each Weston employee has been entrusted with the responsibility to ensure that the policies and procedures outlined in our Corporate Health and Safety Program and this APP are followed. Each supervisor is held responsible for the health and safety of those he or she supervises. Additional policy can be found in the *Implementation Plan* within the *FSO Manual*.

SECTION 9.0

ACCIDENT REPORTING

9.0 ACCIDENT REPORTING

9.1 EXPOSURE DATA

The Site Manager and/or PM will provide exposure data in the form of man-hours worked for the previous month to the Contracting Officer's Representative (COR) within five working days of the beginning of each new month or as directed.

9.2 ACCIDENT INVESTIGATIONS, REPORTS AND LOGS

In the event that an accident or incident occurs at the job site, the PSM will be notified immediately (within eight hours). The Weston Notice of Incident (NOI) Form will be completed and forwarded to Weston Management and the COR within 24 hours.

For any incident or near miss, appropriate investigation, documentation, and corrective actions will be completed. As necessary, a report will be made to the COR verbally within 24 hours and a written report of the accident/incident submitted on ENG Form 3394, Accident Investigation Form, within five working days of the incident.

Emergency situations can be minimized through proper implementation of the APP and ERCP. If an emergency situation develops, it will be handled in a calm, deliberate manner so that it is controlled and the health and safety of the site workers and surrounding community are not jeopardized. Should an incident occur resulting in a fatality, $100,000 or more in property damage, three or more persons being hospitalized, or any incident which would result in adverse publicity to the client, the client's Representative will be immediately notified with regulatory (e.g., OSHA) contacts made as necessary.

Specific emergency procedures, phone numbers, personnel, and equipment requirements can be found in the ERCP.

9.3 SERIOUS EVENT NOTIFICATION AND ACTION

Fatalities and other serious incidents will be reported immediately to the COR and Mr. Ted Blackburn, the Program Safety and Health Manager (603-656-5442). Fatalities and serious accident scenes will not be disturbed until Weston and USACE have convened and completed the necessary investigation. Upon investigation completion and USACE approval, activities may be resumed.

SECTION 10.0

MEDICAL SUPPORT

10.0 MEDICAL SUPPORT

For on-site medical support, there will be a portable first aid kit, BBP kit, and emergency eye wash station or bottles available for use. At least two people trained in first aid and CPR will be on site. Any personnel with major injuries requiring emergency care will be transported to the nearest hospital, John F, Kennedy Medical Center, Edison, New Jersey. Refer to the Emergency Response Contingency Plan for emergency contact information, responder and hospital information, including directions to the hospital.

Route to Hospital from Fieldcrest Avenue (written detail):

Start out going NE on Fieldcrest Ave toward Seneca Street. Merge onto CR-514 E/Woodbridge Ave. Take the NJ Turnpike ramp. Merge onto Route I-287 North. Take to Route 1 North. Follow to Parsonage Road and make a right. (Parsonage now becomes James Street). End at 65 James Street, John F. Kennedy Medical Center.

Route to Hospital from Raritan Center Parkway (written detail):

Start out going South on Raritan Center Parkway. Make a U-turn at Clover PL onto Raritan Center Parkway. Merge onto CR-514 E / Woodbridge Ave. Take the NJ Turnpike ramp. Merge onto I-287 North. Take to Route 1 North. Follow to Parsonage Road and make a right (Parsonage becomes James Street). End at 65 James Street, John F. Kennedy Medical Center.

The names and qualifications of personnel are in Section 12.0, Attachment L.

SECTION 11.0

PERSONAL PROTECTIVE EQUIPMENT

11.0 PERSONAL PROTECTIVE EQUIPMENT

All personnel performing operations on site will be required to wear Level D PPE at a minimum. Upgrade to higher levels of protection will be determined by the SSHO.

11.1 LEVEL D PERSONAL PROTECTIVE EQUIPMENT

A hazard assessment of each of the anticipated tasks to be performed during the initial phase of work has been completed. Level D PPE will be worn during Site Tasks which include UXO survey and screening, soil sampling, Geoprobe® groundwater sampling, monitoring well installation, groundwater sampling, surveying, sediment sampling, surfacewater sampling, benthic bioassay, fish sampling, frog sampling, fiddler crab sampling, plant sampling, earthworm sampling, small mammal sampling, indoor air sampling, subslab soil gas sampling, and subslab soil sampling activities.

Level D PPE consists of the following:

- Work clothes, e.g., long pants and sleeved shirts for physical and thermal protection;
- Work gloves - leather or cotton as necessary for physical hazards;
- Boots (American National Standards Institute [ANSI] approved);
- Safety glasses (ANSI approved); and
- Hard hat (ANSI approved).

Additional PPE for site activities may be found in the SSHP in the *FSO Manual*. The PPE Program is included in Section 120, Attachment F.

11.2 MODIFIED LEVEL D

An upgrade to Modified Level D may be required at the determination of the SSHO or PSM. Modified Level D PPP consists of standard Level D PPE (listed above) and the following:

- Tyvek suit;
- Disposable booties or overboots; and
- Nitrile gloves.

SECTION 12.0

PLANS, PROGRAMS, OR INFORMATION REQUIRED

12.0 PLANS, PROGRAMS OR INFORMATION REQUIRED

The plans and programs identified within this section can be found as either attachments to the APP, within Weston's Field Safety Officer Manual, or within other listed and indicated sources.

A) Emergency Response Contingency Plan
B) Contaminant Information Sheets
C) Material Safety Data Sheets (MSDS) for Chemicals/Preservatives
D) Severe Weather Field Operating Procedure
E) Respiratory Protection Plan (see FSO Manual)
F) Personal Protective Equipment Program (see FSO Manual)
G) Site Specific Hazard Communications Program/Checklist
H) Drug and Alcohol Program
I) UXO Information
J) Drilling Safety
K) Boating
L) Personnel and Qualifications
M) Biological Hazards
N) Site Specific Health and Safety Plan

Refer to the ECRP and Weston's FSO Manual for information regarding Fire Prevention and Control. The attached AHAs in Section 14.0 of the APP provide Health Hazard Control Plan information.

ATTACHMENT A

EMERGENCY RESPONSE CONTINGENCY PLAN

U.S. ARMY CORPS OF ENGINEERS

FORMER RARITAN ARSENAL PROJECT
EMERGENCY RESPONSE AND CONTINGENCY PLAN

New England Contract No. DACA41-92-D-8002/0015-0017
Baltimore Contract No. DACA31-00-D-0023/050, 056, and 069
Baltimore Contract No. W912DR-05-D-0022-0001

April 2006

Prepared for:

U.S. ARMY CORPS OF ENGINEERS

Prepared by:

WESTON SOLUTIONS, INC.
205 Campus Drive
Edison, New Jersey 08837

1.0 INTRODUCTION

This Emergency Response and Contingency Plan (ERCP) has been prepared by Weston Solutions, Inc. (WESTON$^{®}$) to describe actions that will be taken by WESTON site personnel in the event of an emergency situation.

The purpose of this plan is to:

- Anticipate events to ensure proper planning and preparation.
- Act as a guide in the event of an emergency situation.
- Minimize hazards to human health and the environment from anticipated emergency events.
- Familiarize response personnel with equipment and procedures.

This plan is determined to comply with the requirements of Occupational Safety and Health Administration (OSHA) [including emergency action planning, Process Safety Management (PSM) and Hazardous Waste Operations and Emergency Response (HAZWOPER)], Department of Transportation (reporting and response actions), and U.S. Environmental Protection Agency (EPA) [including Spill Prevention, Containment, Countermeasure, Resource Conservation and Recovery Act (RCRA) and Risk Management Plan].

2.0 PRE-EMERGENCY PLANNING

In order to handle emergencies properly and effectively, planning and training is essential. Pre-emergency planning procedures must be in place to immediately respond to emergency situations. Site personnel must be knowledgeable of their roles and responsibilities and act within their abilities and training. WESTON will prohibit its employees from responding to emergency situations that would require them to be exposed to hazards beyond their degree of training. As necessary (by regulation) and prior to site activities, the Site Safety and Health Officer (SSHO) or project staff will communicate with outside response agencies (e.g., fire, police, ambulance, and medical) to coordinate response efforts. Contacts with each response agency will be informed of any changing site conditions that may affect emergency response.

Copies of this ERCP will be made available to any agency [e.g., police, fire, hospital, State Emergency Response Commission, and Local Emergency Planning Commission] required to hold a copy. A complete list of emergency contacts can be found in Attachment 1.

3.0 ROLES AND RESPONSIBILITIES

The Site Health and Safety Coordinator (SHSC) aka SSHO will be the primary Emergency Response Coordinator (ERC) or Incident Commander as termed through Uniform Incident Command. The SHSC or designated alternate will contact the appropriate personnel or authorities as determined by the type and nature of incident. Attachment 1 lists emergency contacts and serves as documentation of this site-specific chain-of-command. Attachment 3 includes checklists for use during emergency incidents.

This chain-of-command is established to minimize confusion and to leave no doubt as to whom has decision-making authority in the event of an emergency situation.

3.1 Emergency Response Coordinator Role

Emergency Response Coordinator responsibilities during emergency situations are as follows:

- Evaluate emergency situation and special needs.
- Direct all emergency efforts, including evacuation of personnel and assignment of personnel to response roles.
- Notify and interact with emergency response agencies.
- Oversee medical and decontamination procedures.
- Serve as the point of contact for local fire department(s) and/or hazardous material team(s).

Emergency Response Coordinator responsibilities (after the emergency phase is complete) include:

- Supervise cleanup efforts; ensure proper recovery, disposal, and accounting of any hazardous material/waste.
- Ensure all emergency equipment and supplies are cleaned and/or made available for future use.
- Document incident, advise management, and initiate debriefing.

The ERC will delegate, as necessary, specific roles and duties outlined above.

3.2 Alternate EMERGENCY Response Coordinator's Role

- The Project Manager is the primary backup to the ERC.

3.3 Regional Safety Manager Role

- Provide technical assistance and lead post-event investigations.

3.4 Regional Safety Officer Role

- Receive reports from the ERC.

- Provide information to appropriate management and track reports.
- Workers compensation liaison.
- Focal point for medical return to work.
- Incident investigation as necessary.

3.4 Project Manager Role

- Assure funding as necessary for emergency operations.
- Report and interact with regulatory agencies and client as necessary.
- Media Contact * (note that all media contacts will be governed by applicable contract provisions. WESTON's Marketing Department will be consulted in the event of a media contract or as necessary).

3.5 Emergency Response Teams

Emergency Response Teams will be comprised of all personnel on-site, cross-trained to actions necessary (e.g., spills, confined space rescue). Attachment 1 indicates roles and responsibilities for this site.

4.0 EMERGENCY RECOGNITION, PREVENTION AND TRAINING

All WESTON personnel will be instructed on a daily basis to be constantly alert for potentially hazardous situations or conditions. Immediate recognition with necessary corrective actions of potential hazardous conditions can avert an emergency. Emergency response discussions will be incorporated into regular safety meetings and will include such topics as:

- Tasks to be performed.
- Hazards that may be encountered, along with their effects and how to recognize symptoms.
- Emergency procedures, including evacuation.

Training required to be given (initially and periodically) to all site workers includes the following:

- Site topography, site layout, and prevailing weather conditions.
- Procedures for reporting incidents.
- Roles and procedures in the event response may include local, state, or federal responders.
- Alarm systems and all applicable aspects of this ERCP.

4.1 If Site is Regulated Under 29 Code of Federal Regulations 1910.120 (HAZWOPER)

In addition to the above requirements, all WESTON site personnel shall have a minimum of the following safety training:

- 40-hour HAZWOPER.
- 8-hour Annual Refresher Course.
- Site specific Training.
- At least (1) member of the WESTON team shall have First Aid/cardiopulmonary resuscitation (CPR) training.
- At least (1) member (SSHO) shall have 8-hour SHSC Training.

4.2 If Site is Non-HAZWOPER

In addition to the above requirements, all WESTON personnel shall have a minimum of the following safety training:

- Hazard Communication Training.
- Site-Specific Training.
- At least one person shall have First Aid/CPR training.

5.0 COMMUNICATION

Daily environmental health and safety briefings will be used to remind personnel of their roles, responsibilities, and emergency procedures. A record of the safety briefings will be completed and maintained on-site.

Emergency communications will be voice, audible horn/alarm, or site telephone. See Attachment 2 for site-specific requirements. Emergency telephone numbers will be kept in the site office. Personnel will be instructed to immediately contact the SHSC or Site Manager if an emergency situation arises.

A backup emergency notification system will also be used during all site activities (e.g., air horns located at each work location). In the case of an emergency, the signal for personnel to evacuate the area will be a series of long blasts. The assembly/gathering point for individual work locations will be provided during the daily safety briefing. After a head count has been taken, further evacuation may be required based on wind direction and weather conditions. Five short blasts of the air horn will signal all clear, workers may than return to designated work areas.

Each type of communication will be tested to insure that site personnel can identify the signals above background noise, as well as to check for system efficacy and accuracy. In the event that air horns prove to be inefficient, alternative methods (e.g., 2-way radios) will be implemented and tested to prove efficient use.

In the event of an emergency requiring outside assistance, the ERC or designated alternate will contact outside help using the nearest telephone or other pre-established means.

6.0 SUPPORT AREAS, EVACUATION PROCEDURES, AND PERSONNEL ACCOUNTING

The primary support area for all work at the site will be in the vicinity of the site field vehicle.

In the event of a severe fire or chemical release, the work area may have to be evacuated. The SSHO shall evaluate the work area on a daily basis and shall determine the best route of evacuation for that day's specific work activities and site-specific location. Due to the nature and size of the site, and variability in work location from a day-to-day basis, an evacuation route map is not provided in this ERCP. During the daily morning safety briefing, the SSHO shall indicate the primary and secondary routes of evacuation for the day's activities.

The evacuation signal will be a series of three long blasts from an air horn and will be initiated by the SSHO. Workers will be instructed to check the wind direction, and leave the site by the shortest route preferably upwind or cross-wind and without crossing any plume or smoke cloud. A safe meeting area will be designated during the daily safety meeting, where workers will assemble and check in with the SSHO. The location of the assembly area will vary daily based on the work locations. The assembly zone location will be addressed each day at the daily safety briefing. The SSHO will check off the workers using the sign-in sheet to confirm all personnel have evacuated.

Based on the type of emergency, the proper federal, state, and local authorities will be notified, as described in the sections above, immediately upon evacuation of the site. In the event of a serious emergency, evacuation of the local community will be the responsibility of the local authorities. The SSHO will meet with state and local emergency responders upon their arrival, update the status of the situation, and help to coordinate community evacuation activities as appropriate.

7.0 EMERGENCY PROCEDURES

7.1 General

During an emergency, the following actions will be taken, with some actions conducted concurrently. No one will attempt an emergency response/rescue until the situation has been assessed and the appropriate response outlined by the ERC or local responders.

It will be determined prior to work initiation, whether any tasks on site are critical operations requiring one or more persons to shut down sensitive equipment in a time-critical manner. No critical operations have been identified at this time that would require specific emergency or shut-down procedures.

General guidelines for rescue/response include the following:

- Assessment: Assess the type and extent of the emergency, then determine and verify existing and potential hazards to site personnel and the off-site population. Determine, based on the type and extent of the emergency, the following:

  - Whether and how to respond.
  - The extent of any injuries and/or damage.
  - The need for evacuation of site personnel and off-site population.
  - The resources needed for evacuation and response.

- Evacuate:

  - Move site personnel to a safe distance upwind of the incident.
  - Monitor the incident for significant changes. The hazards may diminish, permitting personnel to re-enter the site, or hazards may increase and require public evacuation.

    ***Note**: Should site personnel or visitors be handicapped to the point of needing assistance during an evacuation, the ERC will ensure that appropriate numbers of site workers are trained to provide any needed assistance.*

    ***Note**: Work sites with potential hazards that could involve adverse community risk, and require evacuation of the local community must be discussed and coordinated with the client and local fire and police agencies before fieldwork begins.*

- Enforcing the buddy system: Allow no one (including rescuers) to enter a contaminated area or hazardous area without a partner or without appropriate communications means and proper personal protective equipment (PPE). At the time of the incident, one person will be designated to record the names, time of entry, and time of exit for all personnel entering the exclusion zone (EZ). At all times, personnel in the EZ should be in line-of-sight or communications contact with the ERC or his designee.

- Survey casualties:
  - Locate all victims and assess their condition.
  - Determine resources needed for stabilization and transport.

- Request aid: Contact the required off-site/on-site personnel or agencies (such as the ambulance, fire department, police, etc). Ensure that previous communications and understanding or response actions to be conducted by the off-site resources have been accomplished. In certain cases (e.g., confined space rescue), the off-site responder(s) must be brought to the site before work is initiated so that an evaluation of and training on the confined spaces is accomplished.

- Allocate resources: Allocate appropriately qualified on-site personnel and equipment to the rescue and initiate incident response operations.

- Remove or assist victims from the area using appropriate equipment and procedures.

- Control measures, including containment: Assist in bringing the hazardous situation under complete or temporary controls and use measures to prevent any escalation of the emergency.

- Decontaminate: Use established procedures to decontaminate personnel in the decontamination area. If the emergency makes this area unsafe, establish a new decontamination area at an appropriate distance. Decontaminate victims before or after stabilization as their medical condition indicates. Decontamination may be delayed if the injuries suffered by the victim pose an immediate threat to the victim's life or health. Instead, the victim should be placed on a tarp, sheet of plastic or non-absorbent backboard to allow handling of the victim without the threat of contaminating support personnel until the victim is stabilized.

- Stabilize: Administer any medical procedures that are necessary before the victim can be moved. Stabilize or permanently remediate the hazardous condition. Address the cause of the emergency and anything that was damaged or endangered by the emergency (e.g., drums, and tanks).

- Transport: No one will be transported without being decontaminated or protected from contaminating others. Measures will be taken to minimize chemical contamination of the transport vehicle, ambulance, and hospital personnel.

- Casualty Logging: Record the names(s) of the victim(s), the time, the destination, and their condition upon transport.

- Casualty Tracking: Record the disposition, condition, and location of the casualties.

- Media Reporting: Media contacts should be named (see Attachment A) and utilized whenever contact with reporters is necessary. The Site Manager will be the immediate media contact. The Project Manager (PM) is listed as the media contact for most sites.

7.2 Security Issues

Both routine and emergency response actions dictate the need for prevention of unauthorized access and for the protection of vital records and equipment. Site size, location, political or social environment, and equipment needs are criteria necessary to evaluate whether security (private or public) is needed.

- Local Police Departments should be notified of site activities conducted, personnel on site, site hazards and risks, and regulatory issues before work begins. Notifications will assist in coordination of efforts should police present be required.

In the event of unauthorized access, personnel should avoid confrontation (verbal or physical). Attempts must be made to explain site hazards, and Corporate and client expectations for a safe worksite. Continued presence by unauthorized persons will require a team member to notify the local police force. Site activities may need to be halted in the event unauthorized persons create an adverse risk to themselves, to WESTON personnel, or to subcontractor personnel.

7.3 Severe Weather/Natural Disasters

In the event of adverse weather conditions occurring on-site such as lightning, high winds, tornado, hurricane or extreme heat, the SSHO will instruct the workers to discontinue or modify field operations. These natural phenomena complicate work activities and add or increase risk to all site personnel. The following actions should be evaluated or taken in the event of severe weather:

- Stop work.
- Secure all loose materials, toolboxes, plywood, and trashcans. etc.
- Bring all workers to safe areas indoors when lightning or severe weather is in the immediate area.
- Verify that all buildings and trailer doors are locked and windows closed.
- Shut down and disconnect all non-critical electrical equipment to protect the equipment from electrical surges and abrupt power loss.

7.4 Injury or Illness

In the event of injury or illness, site personnel will take the following action:

- Evaluate the scene for safe entry.
- Notify SSHO and Site Manager.
- Assess the type and extent of injury.

- Provide initial First Aid to injured person.
- Decontaminate the injured personnel, if or as necessary.
- If required and injury or illness not potentially life-threatening, transport to local medical facility.
- If injury or illness potentially life-threatening notify emergency medical services of need for transportation.
- Notify Regional Safety Officer (RSO) and PM.

7.5 Extrication

In the event a person becomes trapped and requires extrication site personnel will take the following action:

- Notify SSHO and Site Manager.
- Evaluate the scene for safe entry.
- Contact the local Fire Department or Rescue Service.
- Provide First Aid as necessary.
- Notify RSO and PM.

7.6 Chemical Exposure

In the event of chemical exposure site personnel will take the following action:

- Evaluate the scene for safe entry.
- Notify SSHO and Site Manager.
- Provide assistance with emergency shower, eyewash, or other initial First Aid, as required.
- Decontaminate exposed personnel.
- Notify emergency medical services of need for transportation as necessary.
- Notify RSO and PM.

7.7 Small Fire

A small fire is defined as a fire that can be extinguished with a 4A:20BC type fire extinguisher or incipient stage fires, which can safely be extinguished with material readily at hand. In the event of a small fire, site personnel will take the following actions:

- Evacuate all unnecessary personal from the area, if possible, to an upwind location.
- Notify SSHO and Site Manager.
- Attempt to extinguish fire using portable fire extinguishers or by smothering from an upwind location.
- Request emergency response assistance as appropriate.
- Notify the RSO and PM.

7.8 Large Fire

In the event of a large fire, or a small fire, which cannot be extinguished, the following actions will be taken:

- Sound alarm.
- Evacuate all unnecessary personnel from the area, if possible, to an upwind location.
- Notify local fire department; request other emergency response services (police, ambulance, and hospital) as needed.
- Notify SSHO, Site Manager and RSO and other appropriate personnel or agencies.

7.9 Explosion

In the event of an explosion, all nonessential personnel will evacuate the site. Required support equipment, services, and personnel will be requested. Response will follow steps identified under the Chemical Exposure section. Notification action as indicated in the Large Fires section will be followed.

7.10 Small Spill

In the event of a small spill, appropriate actions will be taken to prevent the spill from reaching groundwater, surface water or drains.
Actions include:

- Verification of spilled material, volume and hazards.
- Determine appropriate response procedures including PPE [see Material Safety Data Sheets (MSDS) or Chemical Data Sheet].
- Assess quantity and size of the spill to determine the level of response to contain and clean it up.
- Confine or contain spill with booms, pads, or berm.
- Neutralize spill with appropriate agents (if safe/possible).
- Notify SSHO, RSO and Site Manager.
- WESTON will collect spilled material including absorbent material and place in appropriate containers. All Hazmat shall be disposed of in accordance with all applicable hazardous waste regulations and client requirements.

WESTON will keep all records related to the spill of hazardous waste for a period of at least 3 years after the spill has been cleaned up or such longer period of time as required in any unresolved enforcement action.

Note: Material Safety Data Sheet's for materials on-site with potential to spill (e.g., gasoline, diesel, acids, solvents) will be provided as Attachment C to Section 12.0 of the APP. Procedures and requirements for spill response will follow criteria outlined in the MSDS.

7.11 Large Spill

A volume equal to or greater than state or federal reportable quantity and/or those beyond the capabilities and resources of on-site personnel defines large spills. Appropriate remedial actions will be conducted according to state and federal regulations.

General procedures as follows:

- Verification of spilled material, volume, and hazards.
- As safe to do so, confine the spill to the smallest area possible using booms, pads, berms or any other effective material.
- Assess type and extent of damages and injuries to personnel; take appropriate First Aid steps if necessary.
- Notify RSO and Site Manager.
- In the event the additional emergency clean-up assistance is needed, WESTON will request assistance from off-site response contractors.
- WESTON will collect all hazardous waste including contaminated booms and absorbent material. All hazardous clean-up residues shall be disposed of in accordance with all applicable hazardous waste regulations.
- All emergency equipment will be decontaminated prior to being put back into service. Expendable or damaged supplies will be immediately replaced.

WESTON will keep all records related to the spill of hazardous waste for a period of at least 3 years after the spill has been cleaned up or such longer period of time as required in any unresolved enforcement action.

In the event of a spill or a release requiring agency reporting, the PM will notify the client and appropriate regulatory agencies (see Attachment 1).

8.0 CRITIQUES AND CORRECTIVE ACTIONS

Post-emergency response activities include documentation, investigation, and appropriate corrective actions to avoid future problems. The PSM, operations safety staff, the RSO or the SSHO will lead the post-incident critique to assure worker knowledge of actions taken and proposals for changes as necessary.

The SSHO and the RSO are responsible for documenting incident reports and providing communication to management. The PSM and/or operations safety staff is responsible for providing direction and assistance. Corrective actions necessary based upon appropriate review and investigation of the incident are required prior to assumption of work. In the event corrective actions cannot be made on an immediate basis, documented plans and schedules will be formulated.

ATTACHMENT 1

EMERGENCY CONTACTS LIST

Weston Program Manager

Roberto Rico	(603) 656-5421

Weston Project Manager

Paul Bovitz	(732) 417-5815

Weston Program Safety Manager

Ted Blackburn, CSP, CET	(603) 656-5442

Weston Regional Safety Officer

Alanna Garrison	(732) 417-5893

Weston Site Managers

Ryan Brown (Eco Assessment)	(732) 417-5850
Melissa Bader (Air)	(732) 417-5891

Weston Site Safety and Health Officers

Thomas Brownell (Soil and Groundwater)	(732) 417-5892
Ryan Brown (Eco)	(732) 417-5850
George Molnar (Eco)	(732) 417-5817
Melissa Bader (Air)	(732) 417-5891

USACE Contact

James Moore, USACE Project Manger	(732) 435-0079

Edison Emergency Contacts

Fire Department	911
Police Department	911
Emergency Medical Services	911
Regional HazMat Team (Middlesex)	911
Edison Health Department	(732) 745-3100

ATTACHMENT 2

EMERGENCY EQUIPMENT LIST

The following is a list of potentially available emergency equipment on site, to be maintained in the field vehicle or work area:

- First aid kit
- Bloodborne pathogens kit
- Fire extinguisher
- Site telephone (cell phone)
- Absorbent material (vermiculite)
- Spill kits (small spill)
- Eye wash (portable of 15-minute)
- Two-way radio (dependent upon location)
- Overpacks (dependent upon task)
- Berm materials (dependent upon tasks)
- Horn or other audible hand-held alarm

ATTACHMENT 3

EMERGENCY INCIDENT CHECKLIST

ATTACHMENT 3
FORMS (E.G., INCIDENT REPORT, INVESTIGATION REPORT, CLIENT REPORT FORM)

Indicate forms to be used:

- ☐ Forms are attached
- ☐ Forms will be provided in Site Safety and Health Officer file

Minimum forms required on-site include:

- ☐ Notice of Incident (NOI)
- ☐ Incident Report Log (e.g., OSHA 200 Log)
- ☐ Incident Investigation Form
- ☐ Corps of Engineers Accident Report Form 3394 (if CoE Site)
- ☐ Spill Report Form (see Attachment D)
- ☐ Emergency Response Coordinator (ERC) Incident Checklists
- ☐ General
- ☐ HazMat
- ☐ Fire
- ☐ Safety and Research
- ☐ Incident Termination
- ☐ Safety Observation/Suggestion Form
- ☐ Investigators Interview Preparation Form
- ☐ Incident Observation Form
- ☐ Other

EMERGENCY RESPONSE COORDINATOR
INCIDENT CHECKLIST

Nature of Incident

- ☐ Hazardous Material Release
- ☐ Medical
- ☐ Fire
- ☐ Technical Rescue
- ☐ Other

Checklist

- ☐ Date and Time
- ☐ Command Established
- ☐ Command Post Location
- ☐ ERC (name) ____________________
- ☐ Safety and Research Support Officer (name) ______________________
- ☐ Decontamination Officer (name) _________________________
- ☐ Entry Team (names) ____
- ☐ Extent of Incident Identified
- ☐ Site Secured
- ☐ Evacuation Determined/Initiated
- ☐ Decontamination Setup (where necessary)
- ☐ Personnel Accounted For
- ☐ Emergency Response Teams Activated
- ☐ Internal
- ☐ External
- ☐ Medical Treatment Determined/Provided
- ☐ Control and Containment Determined/Initiated
- ☐ Release from Emergency Condition (date/time) _______________________
- ☐ Cleanup and Return to Normal Condition (date/time) _____________________
- ☐ Critique and Follow-up (date/time) ______________________________

EMERGENCY RESPONSE COORDINATOR
HAZMAT INCIDENT CHECKLIST

Situation

- ☐ Spill
- ☐ Air
- ☐ Land
- ☐ Water
- ☐ Contained Within Structure
- ☐ Fire
- ☐ Leak
- ☐ Reaction
- ☐ Chemical(s) Involved
- ☐ Amount and Concentrations Estimated
- ☐ Container Types

Involving

- ☐ Fixed Location
- ☐ Transportation
- ☐ Piping
- ☐ Other
- ☐ Monitoring and Readings from Entry Team

Notifications

- ☐ Fire Department
- ☐ HazMat Response
- ☐ Police
- ☐ U.S. Coast Guard
- ☐ State
- ☐ Local
- ☐ National Response Center
- ☐ Client
- ☐ WESTON
- ☐ Other

Key Steps:

- ☐ Identify Chemical(s), Hazards and Risk
- ☐ Determine Objectives (evacuation, external response or internal control)
- ☐ Establish Command Structure
- ☐ Establish Control Zones
- ☐ Ensure Response Teams Activated
- ☐ Ensure Personnel Accounted For
- ☐ Ensure Appropriate Medical Treatment as necessary
- ☐ Ensure Proper Equipment/personal protective equipment where necessary
- ☐ Ensure Decontamination Established where necessary
- ☐ Ensure Objectives for Entry Established
- ☐ Ensure Briefing Prior to Entry
- ☐ Ensure Debriefing of Entry Team

EMERGENCY RESPONSE COORDINATOR
FIRE INCIDENT CHECKLIST

Location:

Type of Fire:

- ☐ Building/Structure
- ☐ Vehicle
- ☐ Other

Extent of Fire:

Building and Location Information:

- ☐ Type of Construction
- ☐ Sprinkler System
- ☐ Age of Structure
- ☐ Occupancy
- ☐ Contents
- ☐ Hazardous Materials

Shut-Offs and Utilities:

- ☐ Gas
- ☐ Electric
- ☐ Steam
- ☐ Pits/Sumps
- ☐ Shafts/Elevators

Water Supply (type and location)

SAFETY AND RESEARCH OFFICER
HAZMAT INCIDENT RESPONSE CHECKLIST
AND RISK ASSESSMENT GUIDE

Establish Control Zones

Research:

- ☐ Chemical(s) Identified
- ☐ Chemical Data Sheets Available
- ☐ Chemical Hazards Determined
- ☐ Major Hazards
- ☐ Physical
- ☐ Flammable
- ☐ Toxic
- ☐ Corrosive
- ☐ Reactive
- ☐ Specific Medical Treatment(s)

Amount of Chemical(s) Released or Potential for Release:

Container Types and Volumes:

Containers Stressed:

- ☐ Fire
- ☐ Reaction
- ☐ Corrosion
- ☐ Other

Exposures

- ☐ Workers
- ☐ Public
- ☐ Environmental

Protective Clothing and Equipment Required:

Decontamination Established:

Objectives Identified and Briefing Conducted

Entry Team Established (names/roles)

Level of Protection Established

Entry Controlled and Timed

EMERGENCY RESPONSE COORDINATOR TERMINATION CHECKLIST

Type Incident, Incident Number and Date:

On-Site Debriefing:

- ☐ Personnel Exposures/Health Effects
- ☐ Equipment Needs/Restocking Requirements
- ☐ Operations Review
- ☐ Need for Crisis Intervention Services
- ☐ Identify Contact Person for any Additional Concerns

Forms and Reports Initiated

Location of Forms and Reports

Date and Time for Debrief and Critique

Assignments for Follow-up

Investigation for Cause Initiated

Regulatory Criteria (notifications/reports) Complete

SPILL REPORT FORM

This form is to be used to report to regulatory agencies and others in the event of a release or spill. Use this form to assist in the initial report phase of an incident. Have the following information available (to the extent possible) before the call. Do not wait for information that would put you at risk of not reporting in a timely manner and in accordance with applicable regulations.

Name, Address, Telephone Number of Person Reporting.

The identity (chemical name), location and nature of the release, including its source, quantity and duration.

Whether the release is to air, ground, or water.

Whether any injuries or property damage.

What are the weather conditions?

What types of corrective actions are underway (e.g., containment, evacuation, etc.)?

ATTACHMENT B

CONTAMINANT INFORMATION SHEETS

Attachment B
List of Contents

Material Safety Data Sheets for:

- Arsenic
- Barium
- Beryllium
- Copper
- Lead
- Mercury
- Nickel
- Selenium
- Thallium
- Polychlorinated Biphenyls
- 4,4-DDT
- Aldrin
- Dieldrin
- 2,4-Dinitrotoluene
- 2,6-Dinitrotoluene
- Anthracene
- Benzo(a)anthracene
- Benzo(b)fluoranthene
- Benzo(k)fluoranthene
- Chloroform
- Dibenz(a,h)anthracene
- Flouranthene
- Methylene chloride
- Pentachlorophenol
- Tetrachloroethylene
- Trichloroethylene
- Vinyl Chloride
- Xylenes

International Chemical Safety Cards

ARSENIC

ICSC: 0013

ARSENIC
Grey arsenic
Metallic arsenic
As
Atomic mass: 74.9

CAS # 7440-38-2
RTECS # CG0525000
ICSC # 0013
UN # 1558
EC # 033-001-00-X

TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/ SYMPTOMS	PREVENTION	FIRST AID/ FIRE FIGHTING
FIRE	Combustible. Gives off irritating or toxic fumes (or gases) in a fire.	NO open flames. NO contact with strong oxidizers. NO contact with hot surfaces.	Powder, water spray, foam, carbon dioxide.
EXPLOSION	Risk of fire and explosion is slight if in the form of fine powder or dust when exposed to hot surfaces or flames.	Prevent deposition of dust; closed system, dust explosion-proof electrical equipment and lighting.	
EXPOSURE		AVOID ALL CONTACT!	IN ALL CASES CONSULT A DOCTOR!
• **INHALATION**	Cough. Diarrhoea. Shortness of breath. Sore throat. Vomiting. Weakness. Grey skin.	Closed system and ventilation.	Fresh air, rest. Artificial respiration if indicated. Refer for medical attention.
• **SKIN**	Redness.	Protective gloves. Protective clothing.	Remove contaminated clothes. Rinse skin with plenty of water or shower.
• **EYES**	Redness.	or eye protection in combination with breathing protection if powder.	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor.
• **INGESTION**	Diarrhoea. Nausea. Sore throat. Unconsciousness. Vomiting (further see Inhalation).	Do not eat, drink, or smoke during work. Wash hands before eating.	Rinse mouth. Induce vomiting (ONLY IN CONSCIOUS PERSONS!). Refer for medical attention.

SPILLAGE DISPOSAL	STORAGE	PACKAGING & LABELLING
Evacuate danger area! Sweep spilled substance into sealable containers. Carefully collect remainder, then remove to safe place. Do NOT let this chemical enter the environment (extra personal protection: complete protective clothing including self-contained breathing apparatus).	Provision to contain effluent from fire extinguishing. Separated from strong oxidants, acids, halogens, food and feedstuffs. Well closed. Keep in a well-ventilated room.	Do not transport with food and feedstuffs. T symbol R: 23/25 S: (1/2-)20/21-28-45 UN Hazard Class: 6.1 UN Packing Group: II Marine pollutant.

SEE IMPORTANT INFORMATION ON BACK

ICSC: 0013

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International Chemical Safety Cards

ARSENIC

ICSC: 0013

IMPORTANT DATA

PHYSICAL STATE; APPEARANCE:
ODOURLESS, BRITTLE, GREY, METALLIC-LOOKING CRYSTALS.

PHYSICAL DANGERS:

CHEMICAL DANGERS:
Upon heating, toxic fumes are formed. Reacts violently with strong oxidants and halogens causing fire and explosion hazard. Reacts with nitric acid, hot sulfuric acid. Toxic arsine gas may be formed in contact with acid or acidic substances and certain metals, such as galvanized or light metals.

OCCUPATIONAL EXPOSURE LIMITS (OELs):
TLV: ppm; 0.01 mg/m^3 (as TWA) A1 (ACGIH 1994-1995).

ROUTES OF EXPOSURE:
The substance can be absorbed into the body by inhalation of its aerosol, through the skin and by ingestion.

INHALATION RISK:
Evaporation at 20°C is negligible; a harmful concentration of airborne particles can, however, be reached quickly.

EFFECTS OF SHORT-TERM EXPOSURE:
The substance irritates the eyes, the skin and the respiratory tract. The substance may cause effects on the circulatory system, nervous system, kidneys and gastrointestinal tract , resulting in convulsions, kidney impairment, severe hemorrhage, losses of fluids, and electrolytes, shock and death. Exposure may result in death. The effects may be delayed. Medical observation is indicated.

EFFECTS OF LONG-TERM OR REPEATED EXPOSURE:
Repeated or prolonged contact with skin may cause dermatitis. Repeated or prolonged contact may cause skin sensitization. The substance may have effects on the mucous membranes, skin, kidneys, liver , resulting in neuropathy, pigmentation disorders, perforation of nasal septum and tissue lesions. This substance is carcinogenic to humans.

PHYSICAL PROPERTIES

Sublimation point: 613°C
Relative density (water = 1): 5.7
Solubility in water: none

ENVIRONMENTAL DATA

The substance is toxic to aquatic organisms. It is strongly advised not to let the chemical enter into the environment because it persists in the environment.

NOTES

The substance is combustible but no flash point is available in literature. Depending on the degree of exposure, periodic medical examination is indicated. Do NOT take working clothes home. Refer also to cards for specific arsenic compounds, e.g., Arsenic pentoxide (ICSC # 0377), Arsenic trichloride (ICSC # 0221), Arsenic trioxide (ICSC # 0378), Arsine (ICSC # 0222).

ADDITIONAL INFORMATION

ICSC: 0013 **ARSENIC**

International Chemical Safety Cards

BARIUM

ICSC: 1052

BARIUM
Ba
Atomic mass: 137.3

CAS # 7440-39-3
RTECS # CQ8370000
ICSC # 1052
UN # 1400

TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/ SYMPTOMS	PREVENTION	FIRST AID/ FIRE FIGHTING
FIRE	Flammable.	NO open flames.	Special powder, dry sand, NO hydrous agents, NO water.
EXPLOSION	Finely dispersed particles form explosive mixtures in air.	Prevent deposition of dust; closed system, dust explosion-proof electrical equipment and lighting.	
EXPOSURE		PREVENT DISPERSION OF DUST! STRICT HYGIENE!	
• **INHALATION**	Cough. Sore throat.	Local exhaust or breathing protection.	Fresh air, rest. Refer for medical attention.
• **SKIN**	Redness.	Protective gloves.	Remove contaminated clothes. Rinse skin with plenty of water or shower. Refer for medical attention.
• **EYES**	Redness. Pain.	Safety goggles.	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor.
• **INGESTION**		Do not eat, drink, or smoke during work.	Rinse mouth. Refer for medical attention.

SPILLAGE DISPOSAL	STORAGE	PACKAGING & LABELLING
Sweep spilled substance into containers. Carefully collect remainder, then remove to safe place (extra personal protection: complete protective clothing including self-contained breathing apparatus).	Separated from halogenated solvents, strong oxidants, acids. Dry. Keep under inert gas, petroleum or oxygen-free liquid.	UN Hazard Class: 4.3 UN Packing Group: II

SEE IMPORTANT INFORMATION ON BACK

ICSC: 1052

Prepared in the context of cooperation between the International Programme on Chemical Safety & the Commission of the European Communities

International Chemical Safety Cards

BARIUM

ICSC: 1052

IMPORTANT DATA

PHYSICAL STATE; APPEARANCE:
YELLOWISH TO WHITE LUSTROUS SOLID IN VARIOUS FORMS.

PHYSICAL DANGERS:

CHEMICAL DANGERS:
The substance may spontaneously ignite on contact with air (if in powder form). The substance is a strong reducing agent and reacts violently with oxidants and acids. Reacts with water, forming combustible gas (hydrogen - see ICSC # 0001) and barium hydroxide. Reacts violently with halogenated solvents causing fire and explosion hazard.

OCCUPATIONAL EXPOSURE LIMITS (OELs):
TLV: ppm; 0.5 mg/m^3 (as TWA) (ACGIH 1992-1993).

ROUTES OF EXPOSURE:
The substance can be absorbed into the body by ingestion.

INHALATION RISK:

EFFECTS OF SHORT-TERM EXPOSURE:
The substance irritates the eyes, the skin, and the respiratory tract.

EFFECTS OF LONG-TERM OR REPEATED EXPOSURE:

PHYSICAL PROPERTIES

Boiling point: 1640°C
Melting point: 725°C
Relative density (water = 1): 3.6

Solubility in water: reaction
Vapour pressure, kPa at 1049°C: 1.3

ENVIRONMENTAL DATA

NOTES

Reacts violently with fire extinguishing agents such as water, bicarbonate, powder, foam, and carbon dioxide. Rinse contaminated clothes (fire hazard) with plenty of water.

Transport Emergency Card: TEC (R)-43G14

ADDITIONAL INFORMATION

ICSC: 1052 **BARIUM**

IMPORTANT LEGAL NOTICE:

Neither the CEC or the IPCS nor any person acting on behalf of the CEC or the IPCS is responsible for the use which might be made of this information. This card contains the collective views of the IPCS Peer Review Committee and may not reflect in all cases all the detailed requirements included in national legislation on the subject. The user should verify compliance of the cards with the relevant legislation in the country of use.

International Chemical Safety Cards

BERYLLIUM

ICSC: 0226

BERYLLIUM
Glucinium
(powder)
Be
Atomic mass: 9.0

CAS # 7440-41-7
RTECS # DS1750000
ICSC # 0226
UN # 1567
EC # 004-001-00-7

TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/ SYMPTOMS	PREVENTION	FIRST AID/ FIRE FIGHTING
FIRE	Combustible.	NO open flames.	Special powder, dry sand, NO other agents.
EXPLOSION	Finely dispersed particles form explosive mixtures in air.	Prevent deposition of dust; closed system, dust explosion-proof electrical equipment and lighting.	
EXPOSURE		PREVENT DISPERSION OF DUST! AVOID ALL CONTACT!	IN ALL CASES CONSULT A DOCTOR!
• **INHALATION**	Cough. Shortness of breath. Sore throat. Weakness. Symptoms may be delayed (see Notes).	Local exhaust. Breathing protection.	Fresh air, rest. Refer for medical attention.
• **SKIN**	Redness.	Protective gloves. Protective clothing.	Remove contaminated clothes. Rinse skin with plenty of water or shower.
• **EYES**	Redness. Pain.	Face shield or eye protection in combination with breathing protection if powder.	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor.
• **INGESTION**		Do not eat, drink, or smoke during work. Wash hands before eating.	Rinse mouth. Do NOT induce vomiting. Refer for medical attention.

SPILLAGE DISPOSAL	STORAGE	PACKAGING & LABELLING
Evacuate danger area! Consult an expert! Carefully collect the spilled substance into containers; if appropriate moisten first, then remove to safe place. Do NOT let this chemical enter the environment (extra personal protection: complete protective clothing including self-contained	Separated from strong acids, bases, chlorinated solvents, food and feedstuffs.	Unbreakable packaging; put breakable packaging into closed unbreakable container. Do not transport with food and feedstuffs. T+ symbol R: 49-25-26-36/37/38-43-48/23 S: 53-45 Note: E

breathing apparatus).		UN Hazard Class: 6.1 UN Subsidiary Risks: 4.1 UN Packing Group: II

SEE IMPORTANT INFORMATION ON BACK

ICSC: 0226

International Chemical Safety Cards

BERYLLIUM

ICSC: 0226

IMPORTANT DATA	**PHYSICAL STATE; APPEARANCE:** GREY TO WHITE METAL OR POWDER. **PHYSICAL DANGERS:** Dust explosion possible if in powder or granular form, mixed with air. **CHEMICAL DANGERS:** Reacts with strong acids and strong bases forming combustible gas (HYDROGEN - see ICSC # 0001). Forms shock sensitive mixtures with some chlorinated solvents, such as carbon tetrachloride and trichloroethylene. **OCCUPATIONAL EXPOSURE LIMITS (OELs):** TLV (as TWA): ppm; 0.002 mg/m^3 A2 (Suspected Human Carcinogen) (ACGIH 1994-1995).	**ROUTES OF EXPOSURE:** The substance can be absorbed into the body by inhalation of its aerosol and by ingestion. **INHALATION RISK:** Evaporation at 20°C is negligible; a harmful concentration of airborne particles can, however, be reached quickly when dispersed. **EFFECTS OF SHORT-TERM EXPOSURE:** The aerosol of this substance irritates the respiratory tract. Inhalation of dust or fumes may cause chemical pneumonitis. Exposure may result in death. The effects may be delayed. Medical observation is indicated. **EFFECTS OF LONG-TERM OR REPEATED EXPOSURE:** Repeated or prolonged contact may cause skin sensitization. Lungs may be affected by repeated or prolonged exposure to dust particles , resulting in chronic beryllium disease (cough, weight loss, weakness). This substance is carcinogenic to humans.
PHYSICAL PROPERTIES	Boiling point: above 2500°C Melting point: 1287°C	Relative density (water = 1): 1.9 Solubility in water: none
ENVIRONMENTAL DATA	The substance is very toxic to aquatic organisms.	

NOTES

Depending on the degree of exposure, periodic medical examination is indicated.

Transport Emergency Card: TEC (R)-61G10
NFPA Code: H3; F1; R0

ADDITIONAL INFORMATION

ICSC: 0226 **BERYLLIUM**

International Chemical Safety Cards

COPPER

ICSC: 0240

COPPER
(powder)
Cu
Atomic mass: 63.5

CAS # 7440-50-8
RTECS # GL5325000
ICSC # 0240

TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/ SYMPTOMS	PREVENTION	FIRST AID/ FIRE FIGHTING
FIRE	Combustible.	NO open flames.	Special powder, dry sand, NO other agents.
EXPLOSION			
EXPOSURE		PREVENT DISPERSION OF DUST!	
• **INHALATION**	Cough. Headache. Shortness of breath. Sore throat.	Local exhaust or breathing protection.	Fresh air, rest. Refer for medical attention.
• **SKIN**	Redness.	Protective gloves.	Remove contaminated clothes. Rinse and then wash skin with water and soap.
• **EYES**	Redness. Pain.	Safety goggles.	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor.
• **INGESTION**	Abdominal pain. Nausea. Vomiting.	Do not eat, drink, or smoke during work.	Rinse mouth. Refer for medical attention.

SPILLAGE DISPOSAL	STORAGE	PACKAGING & LABELLING
Sweep spilled substance into containers. Carefully collect remainder. Then remove to safe place (extra personal protection: P2 filter respirator for harmful particles).	Separated from: see Chemical Dangers.	

SEE IMPORTANT INFORMATION ON BACK

ICSC: 0240

International Chemical Safety Cards

COPPER

ICSC: 0240

	PHYSICAL STATE; APPEARANCE:	**ROUTES OF EXPOSURE:**

IMPORTANT DATA	RED POWDER, TURNS GREEN ON EXPOSURE TO MOIST AIR. **PHYSICAL DANGERS:** **CHEMICAL DANGERS:** Shock-sensitive compounds are formed with acetylenic compounds, ethylene oxides and azides. Reacts with strong oxidants like chlorates, bromates and iodates, causing explosion hazard. **OCCUPATIONAL EXPOSURE LIMITS (OELs):** TLV: ppm; 0.2 mg/m^3 fume (ACGIH 1992-1993). TLV (as Cu, dusts & mists): ppm; 1 mg/m^3 (ACGIH 1992-1993).	The substance can be absorbed into the body by inhalation and by ingestion. **INHALATION RISK:** Evaporation at 20°C is negligible; a harmful concentration of airborne particles can, however, be reached quickly when dispersed. **EFFECTS OF SHORT-TERM EXPOSURE:** Inhalation of fume may cause metal fever (see Notes). **EFFECTS OF LONG-TERM OR REPEATED EXPOSURE:** Repeated or prolonged contact may cause skin sensitization.
PHYSICAL PROPERTIES	Boiling point: 2595°C Melting point: 1083°C	Relative density (water = 1): 8.9 Solubility in water: none
ENVIRONMENTAL DATA		

NOTES

The symptoms of metal fume fever do not become manifest until several hours.

ADDITIONAL INFORMATION

ICSC: 0240 **COPPER**

IMPORTANT LEGAL NOTICE:	Neither the CEC or the IPCS nor any person acting on behalf of the CEC or the IPCS is responsible for the use which might be made of this information. This card contains the collective views of the IPCS Peer Review Committee and may not reflect in all cases all the detailed requirements included in national legislation on the subject. The user should verify compliance of the cards with the relevant legislation in the country of use.

International Chemical Safety Cards

LEAD

ICSC: 0052

LEAD
Lead metal
Plumbum
(powder)
Pb
Atomic mass: 207.2

CAS # 7439-92-1
RTECS # OF7525000
ICSC # 0052

TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/ SYMPTOMS	PREVENTION	FIRST AID/ FIRE FIGHTING
FIRE	Not combustible. Finely divided lead powder is flammable. Gives off irritating or toxic fumes (or gases) in a fire.	NO open flames, NO sparks, and NO smoking (if in powder form).	In case of fire in the surroundings: all extinguishing agents allowed.
EXPLOSION	Finely dispersed particles form explosive mixtures in air.	Prevent deposition of dust; closed system, dust explosion-proof electrical equipment and lighting.	
EXPOSURE		PREVENT DISPERSION OF DUST! STRICT HYGIENE! AVOID EXPOSURE OF (PREGNANT) WOMEN! AVOID EXPOSURE OF ADOLESCENTS AND CHILDREN!	IN ALL CASES CONSULT A DOCTOR!
• INHALATION	Abdominal cramps. Drowsiness. Headache. Nausea. Vomiting. Weakness. Wheezing. Pallor. Hemoglobinuria. Collapse.	Ventilation (not if powder). Avoid inhalation of fine dust and mist. Local exhaust or breathing protection.	Fresh air, rest. Refer for medical attention.
• SKIN			
• EYES			
• INGESTION	Abdominal cramps (further see Inhalation).	Do not eat, drink, or smoke during work. Wash hands before eating.	Rinse mouth. Induce vomiting (ONLY IN CONSCIOUS PERSONS!). Refer for medical attention.

SPILLAGE DISPOSAL	STORAGE	PACKAGING & LABELLING
Sweep spilled substance into containers; if appropriate, moisten first to prevent dusting. Carefully collect	Separated from strong oxidants, strong bases, strong acids, food and feedstuffs.	

remainder, then remove to safe place. Do NOT let this chemical enter the environment (extra personal protection: P2 filter respirator for harmful particles).		

SEE IMPORTANT INFORMATION ON BACK

ICSC: 0052 Prepared in the context of cooperation between the International Programme on Chemical Safety & the Commission of the European Communities © IPCS CEC 1993

International Chemical Safety Cards

LEAD

ICSC: 0052

IMPORTANT DATA	**PHYSICAL STATE; APPEARANCE:** BLUISH-WHITE OR SILVERY-GREY SOLID IN VARIOUS FORMS. TURNS TARNISHED ON EXPOSURE TO AIR. **PHYSICAL DANGERS:** Dust explosion possible if in powder or granular form, mixed with air. **CHEMICAL DANGERS:** Upon heating, toxic fumes are formed. Reacts with hot concentrated nitric acid, boiling concentrated hydrochloric and sulfuric acids. Attacked by pure water and by weak organic acids in the presence of oxygen. **OCCUPATIONAL EXPOSURE LIMITS (OELs):** TLV: ppm; 0.15 mg/m^3 (as TWA) (ACGIH 1993-1994).	**ROUTES OF EXPOSURE:** The substance can be absorbed into the body by inhalation of its aerosol and by ingestion. **INHALATION RISK:** Evaporation at 20°C is negligible; a harmful concentration of airborne particles can, however, be reached quickly. **EFFECTS OF SHORT-TERM EXPOSURE:** The substance may cause effects on the gastrointestinal tract, blood, central nervous system and kidneys , resulting in colics, shock, anemia, kidney damage and encephalopathy. Exposure may result in death. The effects may be delayed. Medical observation is indicated. **EFFECTS OF LONG-TERM OR REPEATED EXPOSURE:** The substance may have effects on the gastrointestinal tract, nervous system, blood, kidneys and immune system , resulting in severe lead colics, paralysis of muscle groups of the upper extremities (forearm, wrist and fingers), anemia, mood and personality changes, retarded mental development, and irreversible nephropathy. May cause retarded development of the new-born. Danger of cumulative effect.
PHYSICAL PROPERTIES	Boiling point: 1740°C Melting point: 327.5°C	Relative density (water = 1): 11.34 Solubility in water: none
ENVIRONMENTAL DATA	This substance may be hazardous to the environment; special attention should be given to air and water. In the food chain important to humans, bioaccumulation takes place, specifically in plants and water organisms, especially shellfish.	

NOTES

Explosive limits are unknown in literature. Use of alcoholic beverages enhances the harmful effect. Depending on the degree of exposure, periodic medical examination is indicated. Do NOT take working clothes home. Refer also to cards for specific lead compounds, e.g., lead chromate (ICSC # 0003), lead(II) oxide (ICSC # 0288).

Transport Emergency Card: TEC (R)-61G12b

ADDITIONAL INFORMATION

ICSC: 0052	**LEAD**

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International Chemical Safety Cards

MERCURY

ICSC: 0056

MERCURY
Quicksilver
Liquid silver
Hydrargyrum
Hg
Atomic mass: 200.6

CAS # 7439-97-6
RTECS # OV4550000
ICSC # 0056
UN # 2809
EC # 080-001-00-0

TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/ SYMPTOMS	PREVENTION	FIRST AID/ FIRE FIGHTING
FIRE	Not combustible. Gives off irritating or toxic fumes (or gases) in a fire.	NO contact with flammable substances.	In case of fire in the surroundings: all extinguishing agents allowed.
EXPLOSION	Risk of fire and explosion on contact with incompatible substances (see Chemical Dangers).		In case of fire: keep drums, etc., cool by spraying with water.
EXPOSURE		STRICT HYGIENE! AVOID EXPOSURE OF (PREGNANT) WOMEN! AVOID EXPOSURE OF ADOLESCENTS AND CHILDREN!	IN ALL CASES CONSULT A DOCTOR!
• **INHALATION**	Abdominal pain. Cough. Diarrhoea. Shortness of breath. Vomiting.	Local exhaust or breathing protection.	Fresh air, rest. Artificial respiration if indicated. Refer for medical attention.
• **SKIN**	MAY BE ABSORBED!	Protective gloves. Protective clothing.	Remove contaminated clothes. Rinse and then wash skin with water and soap. Refer for medical attention.
• **EYES**		Face shield, or eye protection in combination with breathing protection.	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor.
• **INGESTION**		Do not eat, drink, or smoke during work. Wash hands before eating.	Refer for medical attention.

SPILLAGE DISPOSAL	STORAGE	PACKAGING & LABELLING
Evacuate danger area! Consult an expert! Ventilation. Collect leaking and spilled liquid in sealable non-metallic containers as far as possible. Do NOT	Provision to contain effluent from fire extinguishing. Separated from azides, acetylene, ammonia, food and feedstuffs. Well closed. Ventilation	Special material. Do not transport with food and feedstuffs. T symbol R: 23-33

wash away into sewer. Do NOT let this chemical enter the environment (extra personal protection: complete protective clothing including self-contained breathing apparatus).	along the floor.	S: (1/2-)7-45 UN Hazard Class: 8 UN Packing Group: III

SEE IMPORTANT INFORMATION ON BACK

ICSC: 0056 Prepared in the context of cooperation between the International Programme on Chemical Safety & the Commission of the European Communities © IPCS CEC 1993

International Chemical Safety Cards

MERCURY

ICSC: 0056

IMPORTANT DATA	**PHYSICAL STATE; APPEARANCE:** ODOURLESS, HEAVY AND MOBILE SILVERY LIQUID METAL. **CHEMICAL DANGERS:** Upon heating, toxic fumes are formed. Reacts violently with alkali metals, acetylene, azides, ammonia gas, chlorine, chlorine dioxide, sodium carbide and ethylene oxide. Attacks copper and many other metals forming amalgams. **OCCUPATIONAL EXPOSURE LIMITS (OELs):** TLV: ppm; 0.025 mg/m^3 (as TWA) (skin) (ACGIH 1994-1995). MAK: 0.01 ppm; 0.1 mg/m^3; (1992).	**ROUTES OF EXPOSURE:** The substance can be absorbed into the body by inhalation and through the skin , also as a vapour! **INHALATION RISK:** A harmful contamination of the air can be reached very quickly on evaporation of this substance at 20°C. **EFFECTS OF SHORT-TERM EXPOSURE:** Inhalation of the vapours may cause pneumonitis. The substance may cause effects on the kidneys and the central nervous system. The effects may be delayed. Medical observation is indicated. **EFFECTS OF LONG-TERM OR REPEATED EXPOSURE:** The substance may have effects on the central nervous system and kidneys , resulting in emotional and psychic instability, tremor mercurialis, cognitive disturbances, speech disorders. Danger of cumulative effects. Animal tests show that this substance possibly causes toxic effects upon human reproduction.
PHYSICAL PROPERTIES	Boiling point: 357°C Melting point: -39°C Relative density (water = 1): 13.5 Solubility in water: none	Vapour pressure, Pa at 20°C: 0.26 Relative vapour density (air = 1): 6.93 Relative density of the vapour/air-mixture at 20°C (air = 1): 1.009
ENVIRONMENTAL DATA	The substance is very toxic to aquatic organisms. In the food chain important to humans, bioaccumulation takes place, specifically in fish.	

NOTES

Depending on the degree of exposure, periodic medical examination is indicated. No odour warning if toxic concentrations are present. Do NOT take working clothes home.

ADDITIONAL INFORMATION

ICSC: 0056	**MERCURY**

IMPORTANT LEGAL NOTICE:	Neither the CEC or the IPCS nor any person acting on behalf of the CEC or the IPCS is responsible for the use which might be made of this information. This card contains the collective views of the IPCS Peer Review Committee and may not reflect in all cases all the detailed requirements included in national legislation on the subject. The user should verify compliance of the cards with the relevant legislation in the country of use.

International Chemical Safety Cards

NICKEL

ICSC: 0062

NICKEL
(powder)
Ni
Molecular mass: 58.7

CAS # 7440-02-0
RTECS # QR5950000
ICSC # 0062
EC # 028-002-00-7

TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/ SYMPTOMS	PREVENTION	FIRST AID/ FIRE FIGHTING
FIRE	Flammable as dust. Toxic fumes may be released in a fire.		Water in large amounts, foam, dry sand, NO carbon dioxide.
EXPLOSION	Finely dispersed particles form explosive mixtures in air.	Prevent deposition of dust; closed system, dust explosion-proof electrical equipment and lighting.	
EXPOSURE		PREVENT DISPERSION OF DUST! STRICT HYGIENE!	
• **INHALATION**		Local exhaust or breathing protection.	Fresh air, rest.
• **SKIN**		Protective gloves. Protective clothing.	Remove contaminated clothes. Rinse and then wash skin with water and soap.
• **EYES**		Safety spectacles or eye protection in combination with breathing protection.	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor.
• **INGESTION**		Do not eat, drink, or smoke during work.	

SPILLAGE DISPOSAL	STORAGE	PACKAGING & LABELLING
Vacuum spilled material. Carefully collect remainder, then remove to safe place (extra personal protection: P2 filter respirator for harmful particles).	Separated from strong acids.	Xn symbol R: 40-43 S: (2-)22-36

SEE IMPORTANT INFORMATION ON BACK

ICSC: 0062

International Chemical Safety Cards

NICKEL

ICSC: 0062

IMPORTANT DATA

PHYSICAL STATE; APPEARANCE:
ODOURLESS SILVERY METALLIC SOLID IN VARIOUS FORMS.

PHYSICAL DANGERS:
Dust explosion possible if in powder or granular form, mixed with air.

CHEMICAL DANGERS:
Reacts violently, in powder form, with titanium powder and potassium perchlorate, and oxidants such as ammonium nitrate, causing fire and explosion hazard. Reacts slowly with non-oxidizing acids and more rapidly with oxidizing acids. Toxic gases and vapours (such as nickel carbonyl) may be released in a fire involving nickel.

OCCUPATIONAL EXPOSURE LIMITS (OELs):
TLV: ppm; 1 mg/m^3 (as TWA) (ACGIH 1993-1994).

ROUTES OF EXPOSURE:
The substance can be absorbed into the body by inhalation of the dust and by ingestion.

INHALATION RISK:
Evaporation at 20°C is negligible; a harmful concentration of airborne particles can, however, be reached quickly when dispersed.

EFFECTS OF SHORT-TERM EXPOSURE:
Inhalation of the fumes may cause pneumonitis.

EFFECTS OF LONG-TERM OR REPEATED EXPOSURE:
Repeated or prolonged contact with skin may cause dermatitis. Repeated or prolonged contact may cause skin sensitization. Repeated or prolonged inhalation exposure may cause asthma. Lungs may be affected by repeated or prolonged exposure. The substance may have effects on the nasal sinuses , resulting in inflammation and ulceration.

PHYSICAL PROPERTIES	Boiling point: 2730°C Melting point: 1455°C	Relative density (water = 1): 8.9 Solubility in water: none
ENVIRONMENTAL DATA		

NOTES

Depending on the degree of exposure, periodic medical examination is indicated. The symptoms of asthma often do not become manifest until a few hours have passed and they are aggravated by physical effort. Rest and medical observation are therefore essential. Anyone who has shown symptoms of asthma due to this substance should avoid all further contact with this substance.

ADDITIONAL INFORMATION

ICSC: 0062 **NICKEL**

IMPORTANT LEGAL NOTICE:

Neither the CEC or the IPCS nor any person acting on behalf of the CEC or the IPCS is responsible for the use which might be made of this information. This card contains the collective views of the IPCS Peer Review Committee and may not reflect in all cases all the detailed requirements included in national legislation on the subject. The user should verify compliance of the cards with the relevant legislation in the country of use.

International Chemical Safety Cards

SELENIUM

ICSC: 0072

SELENIUM
(powder)
Se
Atomic mass: 79.0

CAS # 7782-49-2
RTECS # VS7700000
ICSC # 0072
UN # 2658 (powder)
EC # 034-001-00-2

TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/ SYMPTOMS	PREVENTION	FIRST AID/ FIRE FIGHTING
FIRE	Combustible. Gives off irritating or toxic fumes (or gases) in a fire.	NO open flames. NO contact with oxidants.	Powder, AFFF, foam, carbon dioxide.
EXPLOSION	Risk of fire and explosion with oxidants.		Use extinguishing media appropriate to surrounding fire conditions. NO contact with water.
EXPOSURE		PREVENT DISPERSION OF DUST! STRICT HYGIENE!	
• **INHALATION**	Irritation of nose. Cough. Dizziness. Headache. Laboured breathing. Nausea. Sore throat. Vomiting. Weakness. Symptoms may be delayed (see Notes).	Ventilation, local exhaust, or breathing protection.	Fresh air, rest. Refer for medical attention.
• **SKIN**	Redness. Skin burns. Pain. Discolouration.	Protective gloves. Protective clothing.	Rinse skin with plenty of water or shower. Refer for medical attention. Remove and isolate contaminated clothes.
• **EYES**	Redness. Pain. Blurred vision.	Safety spectacles or eye protection in combination with breathing protection.	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor.
• **INGESTION**	Metallic taste. Diarrhoea. Chills. Fever (further see Inhalation).	Do not eat, drink, or smoke during work.	Rinse mouth. Induce vomiting (ONLY IN CONSCIOUS PERSONS!). Refer for medical attention.

SPILLAGE DISPOSAL	STORAGE	PACKAGING & LABELLING
Do NOT wash away into sewer. Sweep spilled substance into containers; if appropriate, moisten first to prevent dusting. Carefully collect remainder, then remove to safe place (extra personal protection: P3 filter respirator	Fireproof. Separated from strong oxidants, strong acids, food and feedstuffs. Dry.	Airtight. Do not transport with food and feedstuffs. T symbol R: 23/25-33 S: (1/2-)20/21-28-45 UN Hazard Class: 6.1

for toxic particles).		UN Packing Group: III

SEE IMPORTANT INFORMATION ON BACK

ICSC: 0072

International Chemical Safety Cards

SELENIUM

ICSC: 0072

I M P O R T A N T D A T A

PHYSICAL STATE; APPEARANCE:
ODOURLESS SOLID IN VARIOUS FORMS. DARK RED-BROWN TO BLUISH-BLACK AMORPHOUS SOLID OR RED TRANSPARENT CRYSTALS OR METALLIC GREY TO BLACK CRYSTALS.

PHYSICAL DANGERS:

CHEMICAL DANGERS:
Upon heating, toxic fumes are formed. Reacts violently with oxidants and strong acids. Reacts with water at 50°C forming flammable hydrogen (see ICSC # 0001) and selenious acids. Reacts with incandescence on gentle heating with phosphorous and metals such as nickel, zinc, sodium, potassium, platinum.

OCCUPATIONAL EXPOSURE LIMITS (OELs):
TLV: ppm; 0.2 mg/m^3 as TWA (ACGIH 1991-1992).

ROUTES OF EXPOSURE:
The substance can be absorbed into the body by inhalation, through the skin and by ingestion.

INHALATION RISK:
Evaporation at 20°C is negligible; a harmful concentration of airborne particles can, however, be reached quickly by dispersion.

EFFECTS OF SHORT-TERM EXPOSURE:
The substance irritates the eyes and the respiratory tract. Inhalation of dust may cause lung oedema (see Notes). Inhalation of fume may cause symptoms of asphyxiation, chills and fever and bronchitis. The effects may be delayed.

EFFECTS OF LONG-TERM OR REPEATED EXPOSURE:
Repeated or prolonged contact with skin may cause dermatitis. The substance may have effects on the respiratory tract, gastrointestinal tract, and skin , resulting in nausea, vomiting, cough, yellowish skin discolouration, loss of nails, garlic breath and bad teeth.

PHYSICAL PROPERTIES	Boiling point: 685°C Melting point: 170-217°C Relative density (water = 1): 4.8	Solubility in water: none Vapour pressure, Pa at 20°C: 0.1
ENVIRONMENTAL DATA		

NOTES

Do NOT take working clothes home.

ADDITIONAL INFORMATION

ICSC: 0072 **SELENIUM**

IMPORTANT LEGAL NOTICE:	for the use which might be made of this information. This card contains the collective views of the IPCS Peer Review Committee and may not reflect in all cases all the detailed requirements included in national legislation on the subject. The user should verify compliance of the cards with the relevant legislation in the country of use.

International Chemical Safety Cards

THALLIUM

ICSC: 0077

THALLIUM
Ramor
Thallium (metal)
Tl
Atomic mass: 204.4

CAS # 7440-28-0
RTECS # XG3425000
ICSC # 0077

EC # 081-001-00-3

TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/ SYMPTOMS	PREVENTION	FIRST AID/ FIRE FIGHTING
FIRE	Gives off irritating or toxic fumes (or gases) in a fire.		In case of fire in the surroundings: all extinguishing agents allowed.
EXPLOSION			
EXPOSURE		PREVENT DISPERSION OF DUST! AVOID ALL CONTACT! AVOID EXPOSURE OF (PREGNANT) WOMEN!	IN ALL CASES CONSULT A DOCTOR!
• **INHALATION**	Abdominal pain. Diarrhoea. Nausea. Vomiting. Loss of hair, pain in legs and chest, and dry skin. Symptoms may be delayed (see Notes).	Local exhaust or breathing protection.	Fresh air, rest. Artificial respiration if indicated. Refer for medical attention.
• **SKIN**	(Further see Inhalation).	Protective gloves. Protective clothing.	Remove contaminated clothes. Rinse and then wash skin with water and soap. Refer for medical attention.
• **EYES**		Safety goggles, or eye protection in combination with breathing protection if powder.	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor.
• **INGESTION**	Loss of vision, polyneuritis, psychic disturbances, delirium, convulsions, respiratory paralysis, coma, cardiac disturbances (further see Inhalation).	Do not eat, drink, or smoke during work. Wash hands before eating.	Rinse mouth. Give a slurry of activated charcoal in water to drink. Induce vomiting (ONLY IN CONSCIOUS PERSONS!). Refer for medical attention.

SPILLAGE DISPOSAL	STORAGE	PACKAGING & LABELLING
Sweep spilled substance into sealable containers. Carefully collect remainder, then remove to safe place.	Separated from strong acids, fluorine, other halogens, food and feedstuffs.	Do not transport with food and feedstuffs. T+ symbol

		R: 26/28-33 S: (1/2-)13-28-45

SEE IMPORTANT INFORMATION ON BACK

ICSC: 0077	Prepared in the context of cooperation between the International Programme on Chemical Safety & the Commission of the European Communities © IPCS CEC 1993

International Chemical Safety Cards

THALLIUM

ICSC: 0077

IMPORTANT DATA	**PHYSICAL STATE; APPEARANCE:** BLUISH-WHITE, VERY SOFT METAL. TURNS GREY ON EXPOSURE TO AIR. **PHYSICAL DANGERS:** **CHEMICAL DANGERS:** Reacts violently with fluorine. Reacts with other halogens at room temperature. **OCCUPATIONAL EXPOSURE LIMITS (OELs):** TLV (as Tl (soluble compounds)): ppm; 0.1 mg/m^3 (as TWA) (skin) (ACGIH 1994-1995). MAK not established.	**ROUTES OF EXPOSURE:** The substance can be absorbed into the body by inhalation of its aerosol, through the skin and by ingestion. **INHALATION RISK:** Evaporation at 20°C is negligible; a harmful concentration of airborne particles can, however, be reached quickly especially if powdered. **EFFECTS OF SHORT-TERM EXPOSURE:** The substance may cause effects on the peripheral and the central nervous system, liver and kidneys, the gastrointestinal tract, skin (hair) and the cardiovascular system , resulting in polyneuritis, optic nerve atrophy, encephalopathy, cardiac disturbances, liver and kidney damage, alopecia. Exposure may result in death. The effects may be delayed. Medical observation is indicated. **EFFECTS OF LONG-TERM OR REPEATED EXPOSURE:** The substance may have effects on the vision, nervous system, skin (hair), heart, gastrointestinal tract. Animal tests show that this substance possibly causes toxic effects upon human reproduction.
PHYSICAL PROPERTIES	Boiling point: 1457°C Melting point: 304°C	Relative density (water = 1): 11.9 Solubility in water: none
ENVIRONMENTAL DATA	The substance is toxic to aquatic organisms. This substance may be hazardous to the environment; special attention should be given to plants. It is strongly advised not to let the chemical enter into the environment because it persists in the environment.	

NOTES

Depending on the degree of exposure, periodic medical examination is indicated. The symptoms of acute thallium poisoning (except for gastrointestinal symptoms) do not become manifest until 12 hours to 4 days after exposure. Do NOT take working clothes home. Refer to cards for specific thallium compounds (e.g., thallous sulfate - see ICSC # 0336).

ADDITIONAL INFORMATION

ICSC: 0077	**THALLIUM**

International Chemical Safety Cards

POLYCHLORINATED BIPHENYL (AROCLOR 1254)

ICSC: 0939

POLYCHLORINATED BIPHENYL (AROCLOR 1254)
Chlorobiphenyl (54% chlorine)
Chlorodiphenyl (54% chlorine)
PCB
Molecular mass: 327 (average)

CAS # 11097-69-1
RTECS # TQ1360000
ICSC # 0939
UN # 2315
EC # 602-039-00-4

TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/ SYMPTOMS	PREVENTION	FIRST AID/ FIRE FIGHTING
FIRE	Not combustible. Irritating and toxic gases may be generated in a fire.		Powder, carbon dioxide.
EXPLOSION			
EXPOSURE		PREVENT GENERATION OF MISTS! STRICT HYGIENE!	
• **INHALATION**		Ventilation.	Fresh air, rest. Refer for medical attention.
• **SKIN**	MAY BE ABSORBED! Dry skin. Redness. Chloracne (further see Inhalation).	Protective gloves. Protective clothing.	Remove contaminated clothes. Rinse and then wash skin with water and soap. Refer for medical attention.
• **EYES**	Redness. Pain.	Safety goggles, face shield.	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor.
• **INGESTION**	Headache. Numbness. Fever.	Do not eat, drink, or smoke during work.	Rest. Refer for medical attention.

SPILLAGE DISPOSAL	STORAGE	PACKAGING & LABELLING
Consult an expert! Collect leaking liquid in sealable containers. Absorb remaining liquid in sand or inert absorbent and remove to safe place. Do NOT let this chemical enter the environment (extra personal protection: complete protective clothing including self-contained breathing apparatus).	Separated from food and feedstuffs. Cool. Dry. Keep in a well-ventilated room.	Unbreakable packaging; put breakable packaging into closed unbreakable container. Do not transport with food and feedstuffs. Xn symbol R: 33 S: 35 Note: C UN Hazard Class: 9 UN Packing Group: II

SEE IMPORTANT INFORMATION ON BACK

ICSC: 0939	Prepared in the context of cooperation between the International Programme on Chemical Safety & the Commission of the European Communities © IPCS CEC 1993

International Chemical Safety Cards

POLYCHLORINATED BIPHENYL (AROCLOR 1254)

ICSC: 0939

IMPORTANT DATA	**PHYSICAL STATE; APPEARANCE:** LIGHT YELLOW VISCOUS LIQUID. **PHYSICAL DANGERS:** **CHEMICAL DANGERS:** The substance decomposes in a fire producing irritating and toxic gases. **OCCUPATIONAL EXPOSURE LIMITS (OELs):** TLV: ppm; 0.5 mg/m^3 (skin) (ACGIH 1991-1992).	**ROUTES OF EXPOSURE:** The substance can be absorbed into the body by inhalation of its aerosol, through the skin and by ingestion. **INHALATION RISK:** A harmful contamination of the air will be reached rather slowly on evaporation of this substance at 20°C. **EFFECTS OF SHORT-TERM EXPOSURE:** The substance irritates the eyes (see Notes). **EFFECTS OF LONG-TERM OR REPEATED EXPOSURE:** Repeated or prolonged contact with skin may cause dermatitis chloracne. The substance may have effects on the liver. Animal tests show that this substance possibly causes toxic effects upon human reproduction.
PHYSICAL PROPERTIES	Relative density (water = 1): 1.5 Solubility in water: none	Vapour pressure, Pa at 25°C: 0.01 Octanol/water partition coefficient as log Pow: 6.30 (estimated)
ENVIRONMENTAL DATA	In the food chain important to humans, bioaccumulation takes place, specifically in water organisms. It is strongly advised not to let the chemical enter into the environment.	

NOTES

Changes into a resinous state (pour point) at 10°C. Distillation range: 365°-390°C. No open cup flash point to boiling. The symptoms other than the chloracne and liver effects may be in part due to contaminants of the PCB.

Transport Emergency Card: TEC (R)-914

ADDITIONAL INFORMATION

ICSC: 0939 **POLYCHLORINATED BIPHENYL (AROCLOR 1254)**

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International Chemical Safety Cards

DDT

ICSC: 0034

DDT
Dichlorodiphenyltrichloroethane
1,1,1-Trichloro-2,2-bis(p-chlorophenyl)ethane
2,2-bis(p-Chlorophenyl)-1,1,1-trichloroethane
$C_{14}H_9Cl_5$
Molecular mass: 354.5

CAS # 50-29-3
RTECS # KJ3325000
ICSC # 0034
UN # 2761
EC # 602-045-00-7

TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/ SYMPTOMS	PREVENTION	FIRST AID/ FIRE FIGHTING
FIRE	Combustible. Liquid formulations containing organic solvents may be flammable. Gives off irritating or toxic fumes (or gases) in a fire.	NO open flames.	Powder, water spray, foam, carbon dioxide.
EXPLOSION	Risk of fire and explosion if formulations contain flammable/explosive solvents.		In case of fire: keep drums, etc., cool by spraying with water.
EXPOSURE		PREVENT DISPERSION OF DUST! STRICT HYGIENE!	IN ALL CASES CONSULT A DOCTOR!
• **INHALATION**	Cough.	Avoid inhalation of fine dust and mist. Local exhaust or breathing protection.	Fresh air, rest. Artificial respiration if indicated. Refer for medical attention.
• **SKIN**		Protective gloves.	Remove contaminated clothes. Rinse and then wash skin with water and soap.
• **EYES**		Safety goggles, or eye protection in combination with breathing protection if powder.	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor.
• **INGESTION**	Tremors. Convulsions. Diarrhoea. Dizziness. Vomiting. Numbness. Paresthesias. Hyperexcitability.	Do not eat, drink, or smoke during work.	Rinse mouth. Give a slurry of activated charcoal in water to drink. Induce vomiting (ONLY IN CONSCIOUS PERSONS!). Rest. Refer for medical attention.

SPILLAGE DISPOSAL	STORAGE	PACKAGING & LABELLING
Do NOT wash away into sewer. Sweep spilled substance into sealable non-	Provision to contain effluent from fire extinguishing. Separated from strong	Do not transport with food and feedstuffs. Do NOT keep in iron or

metallic containers; if appropriate, moisten first to prevent dusting. Carefully collect remainder, then remove to safe place (extra personal protection: P3 filter respirator for toxic particles).	bases, iron, aluminum and its salts, food and feedstuffs.	aluminum containers. T symbol N symbol R: 25-40-48/25-50/53 S: (1/2-)22-36/37-45-60-61 UN Hazard Class: 6.1 UN Packing Group: III Severe marine pollutant.

SEE IMPORTANT INFORMATION ON BACK

ICSC: 0034

International Chemical Safety Cards

DDT

ICSC: 0034

IMPORTANT DATA	**PHYSICAL STATE; APPEARANCE:** COLOURLESS CRYSTALS OR WHITE POWDER. **PHYSICAL DANGERS:** **CHEMICAL DANGERS:** On combustion, forms toxic and corrosive fumes including hydrogen chloride. Reacts with organic and inorganic bases, aluminum, iron. **OCCUPATIONAL EXPOSURE LIMITS (OELs):** TLV: ppm; 1 mg/m^3 (as TWA) (ACGIH 1993-1994).	**ROUTES OF EXPOSURE:** The substance can be absorbed into the body by inhalation and through the skin, and by ingestion. **INHALATION RISK:** Evaporation at 20°C is negligible; a harmful concentration of airborne particles can, however, be reached quickly especially if powdered. **EFFECTS OF SHORT-TERM EXPOSURE:** The substance irritates the eyes, the skin and the respiratory tract. The substance may cause effects on the central nervous system , resulting in convulsions and respiratory failure. Exposure may result in death. Medical observation is indicated. **EFFECTS OF LONG-TERM OR REPEATED EXPOSURE:** The substance may have effects on the central nervous system, liver. This substance is possibly carcinogenic to humans. Animal tests show that this substance possibly causes toxic effects upon human reproduction.
PHYSICAL PROPERTIES	Boiling point: 260°C Melting point: 109°C Relative density (water = 1): 1.5	Solubility in water: none Octanol/water partition coefficient as log Pow: 6.36-6.38
ENVIRONMENTAL DATA	The substance is very toxic to aquatic organisms. This substance may be hazardous to the environment; special attention should be given to birds. In the food chain important to humans, bioaccumulation takes place, specifically in milk and aquatic organisms.	

NOTES

Explosive limits are unknown in literature. Depending on the degree of exposure, periodic medical examination is indicated. Carrier solvents used in commercial formulations may change physical and toxicological properties. Do NOT take working clothes home. Agritan, Azotox, Anofex, Ixodex, Gesapon, Gesarex, Gesarol, Guesapon, and Neocid are trade names.

Transport Emergency Card: TEC (R)-61G53b

ADDITIONAL INFORMATION

ICSC: 0034 **DDT**

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International Chemical Safety Cards

ALDRIN

ICSC: 0774

ALDRIN
HHDN
1,2,3,4,10,10-Hexachloro-1,4,4a,5,8,8a-hexahydro,endo,exo-1,4:5.8-dimethanonaphthalene
$C_{12}H_8Cl_6$
Molecular mass: 364.9

CAS # 309-00-2
RTECS # IO2100000
ICSC # 0774
UN # 2761
EC # 602-048-00-3

TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/ SYMPTOMS	PREVENTION	FIRST AID/ FIRE FIGHTING
FIRE	Not combustible. Liquid formulations containing organic solvents may be flammable.		In case of fire in the surroundings: all extinguishing agents allowed.
EXPLOSION	Explosion hazard will depend on the solvent used or on the characteristics of the dust.		
EXPOSURE		PREVENT DISPERSION OF DUST! STRICT HYGIENE! AVOID EXPOSURE OF (PREGNANT) WOMEN!	
• INHALATION	(see Ingestion).	Ventilation (not if powder).	Fresh air, rest. Artificial respiration if indicated. Refer for medical attention.
• SKIN	MAY BE ABSORBED! See Ingestion.	Protective gloves. Protective clothing.	Remove contaminated clothes. Rinse and then wash skin with water and soap.
• EYES		Safety goggles or face shield.	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor.
• INGESTION	Dizziness. Headache. Nausea. Vomiting. Weakness. Muscle twitching.	Do not eat, drink, or smoke during work.	Do NOT induce vomiting. Rest. Refer for medical attention.

SPILLAGE DISPOSAL	STORAGE	PACKAGING & LABELLING
Sweep spilled substance into containers. Carefully collect remainder, then remove to safe place. Do not let this chemical enter water courses or sewers (extra personal protection: complete protective clothing including self-contained breathing apparatus).	Separated from food and feedstuffs. Cool. Dry.	Do not transport with food and feedstuffs. T symbol R: 24/25-40-48 S: 22-36/37-44 UN Hazard Class: 6.1 Severe marine pollutant.

SEE IMPORTANT INFORMATION ON BACK

ICSC: 0774

International Chemical Safety Cards

ALDRIN

ICSC: 0774

IMPORTANT DATA

PHYSICAL STATE; APPEARANCE:
COLOURLESS CRYSTALS.

PHYSICAL DANGERS:

CHEMICAL DANGERS:
The substance decomposes on heating producing toxic and corrosive fumes (chlorine fumes, hydrogen chloride.) Reacts with acids, oxidants, active metals, phenols, acid catalysts. Can be corrosive due to the slow evolution of hydrogen chloride in storage.

OCCUPATIONAL EXPOSURE LIMITS (OELs):
TLV : ppm; 0.25 mg/m^3 (as TWA) (skin) (ACGIH 1991-1992).

ROUTES OF EXPOSURE:
The substance can be absorbed into the body through the skin and by ingestion.

INHALATION RISK:
Evaporation at 20°C is negligible; a harmful concentration of airborne particles can, however, be reached quickly on spraying.

EFFECTS OF SHORT-TERM EXPOSURE:
The substance may cause effects on the central nervous system , resulting in convulsions.

EFFECTS OF LONG-TERM OR REPEATED EXPOSURE:
The substance accumulates in the human body. Aldrin may be present in human placental tissues and blood.

PHYSICAL PROPERTIES

Boiling point at 0.267 kPa: 145°C
Melting point: 104°C
Relative density (water = 1): 1.54
Solubility in water: none
Vapour pressure, Pa at 20°C: 0.0086
Octanol/water partition coefficient as log Pow: 7.4

ENVIRONMENTAL DATA

Aldrin persists in soils: 50% disappear after 4 to 7 years. This substance may be hazardous to the environment; special attention should be given to fish and birds. In the food chain important to humans, bioaccumulation takes place, specifically in aquatic organisms.

NOTES

Other melting points: 40-60°C (technical grade). Technical aldrin is a tan to dark brown waxy solid. Carrier solvents used in commercial formulations may change physical and toxicological properties. Do NOT take working clothes home. The recommendations on this Card also apply to ICSC # 0787 (dieldrin). Aldrine, Aldrex, Aldrite, Aldrosol, Drinox, Seedrin, Octalene are trade names.

Transport Emergency Card: TEC (R)-61G53b
NFPA Code: H2; F0; R0;

ADDITIONAL INFORMATION

ICSC: 0774 **ALDRIN**

IMPORTANT LEGAL NOTICE:

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	relevant legislation in the country of use.

International Chemical Safety Cards

DIELDRIN

ICSC: 0787

DIELDRIN
HEOD
1,2,3,4,10,10-Hexachloro-6,7-epoxy-1,4,4a,5,6,7,8,8a-octahydro,endo,exo-1,4:5,8-dimethanonaphthalene
$C_{12}H_8Cl_6O$
Molecular mass: 381

CAS # 60-57-1
RTECS # IO1750000
ICSC # 0787
UN # 2761
EC # 602-049-00-9

TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/ SYMPTOMS	PREVENTION	FIRST AID/ FIRE FIGHTING
FIRE	Not combustible. Liquid formulations containing organic solvents may be flammable.		In case of fire in the surroundings: all extinguishing agents allowed.
EXPLOSION	Explosion hazard will depend on the solvent used or on the characteristics of the dust.		
EXPOSURE		PREVENT DISPERSION OF DUST! STRICT HYGIENE! AVOID EXPOSURE OF (PREGNANT) WOMEN!	
• **INHALATION**	(see Ingestion).	Ventilation (not if powder).	Fresh air, rest. Refer for medical attention.
• **SKIN**	MAY BE ABSORBED! See Ingestion.	Protective gloves. Rubber boots.	Remove contaminated clothes. Rinse and then wash skin with water and soap.
• **EYES**	Redness.	Safety goggles or face shield.	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor.
• **INGESTION**	Convulsions. Dizziness. Headache. Nausea. Vomiting. Weakness.	Do not eat, drink, or smoke during work.	Do NOT induce vomiting. Rest. Refer for medical attention.

SPILLAGE DISPOSAL	STORAGE	PACKAGING & LABELLING
Sweep spilled substance into sealable containers. Carefully collect remainder, then remove to safe place. Do NOT let this chemical enter the environment (extra personal protection: complete protective clothing including self-contained breathing apparatus).	Separated from food and feedstuffs. Cool. Dry.	Do not transport with food and feedstuffs. T+ symbol R: 25-27-40-48 S: 22-36/37-45 UN Hazard Class: 6.1 UN Packing Group: I

		Marine pollutant.

SEE IMPORTANT INFORMATION ON BACK

ICSC: 0787	Prepared in the context of cooperation between the International Programme on Chemical Safety & the Commission of the European Communities © IPCS CEC 1993

International Chemical Safety Cards

DIELDRIN

ICSC: 0787

IMPORTANT DATA	**PHYSICAL STATE; APPEARANCE:** COLOURLESS CRYSTALS. **PHYSICAL DANGERS:** **CHEMICAL DANGERS:** The substance decomposes on heating producing toxic and corrosive fumes (chlorine fumes, hydrogen chloride). Reacts with oxidants, concentrated mineral acids, acid acatalysts, metals (copper, iron). Attacks metal due to the slow formation of hydrogen chloride in storage. **OCCUPATIONAL EXPOSURE LIMITS (OELs):** TLV (as TWA): ppm; 0.25 mg/m^3 (skin) (ACGIH 1991-1992).	**ROUTES OF EXPOSURE:** The substance can be absorbed into the body through the skin and by ingestion. **INHALATION RISK:** Evaporation at 20°C is negligible; a harmful concentration of airborne particles can, however, be reached quickly on spraying. **EFFECTS OF SHORT-TERM EXPOSURE:** The substance may cause effects on the central nervous system , resulting in convulsions. Medical observation is indicated. **EFFECTS OF LONG-TERM OR REPEATED EXPOSURE:** The substance may be found in the human placenta.
PHYSICAL PROPERTIES	Melting point: 175-176°C Relative density (water = 1): 1.62 Solubility in water: None	Vapour pressure, Pa at 20°C: 0.0004 Octanol/water partition coefficient as log Pow: 6.2
ENVIRONMENTAL DATA	Dieldrin persists in the environment: 50% disappear after 4 to 7 years. This substance may be hazardous to the environment; special attention should be given to birds and water organisms. In the food chain important to humans, bioaccumulation takes place, specifically in aquatic organisms.	

NOTES

Technical dieldrin (95%) consists of light tan flakes with a mild odour. Carrier solvents used in commercial formulations may change physical and toxicological properties. Do NOT take working clothes home. The recommendations on this Card also apply to ICSC # 0774 (aldrin). Alvit, Octalox, Quintox, Illoxol, Panoram D-31, Dieldrite, Dorytox, Compound 497 are trade names.

Transport Emergency Card: TEC (R)-61G53b

ADDITIONAL INFORMATION

ICSC: 0787 **DIELDRIN**

IMPORTANT LEGAL	Neither the CEC or the IPCS nor any person acting on behalf of the CEC or the IPCS is responsible for the use which might be made of this information. This card contains the collective views of the IPCS Peer Review Committee and may not reflect in all cases all the detailed requirements included

NOTICE:	in national legislation on the subject. The user should verify compliance of the cards with the relevant legislation in the country of use.

International Chemical Safety Cards

2,4-DINITROTOLUENE

ICSC: 0727

2,4-DINITROTOLUENE
1-Methyl-2,4-dinitrobenzene
2,4-DNT
$C_7H_6N_2O_4$ / $C_6H_3CH_3(NO_2)_2$
Molecular mass: 182.1

CAS # 121-14-2
RTECS # XT1575000
ICSC # 0727
UN # 2038
EC # 609-007-00-9

TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/ SYMPTOMS	PREVENTION	FIRST AID/ FIRE FIGHTING
FIRE	Combustible. Gives off irritating or toxic fumes (or gases) in a fire.	NO open flames.	Powder, water spray, foam, carbon dioxide.
EXPLOSION	Finely dispersed particles form explosive mixtures in air.	Prevent deposition of dust; closed system, dust explosion-proof electrical equipment and lighting.	In case of fire: keep drums, etc., cool by spraying with water. Combat fire from a sheltered position.
EXPOSURE		PREVENT DISPERSION OF DUST! STRICT HYGIENE! AVOID ALL CONTACT!	
• **INHALATION**	Blue lips or finger nails. Blue skin. Headache. Dizziness. Nausea. Confusion. Convulsions. Unconsciousness.	Local exhaust or breathing protection.	Fresh air, rest. Artificial respiration if indicated. Refer for medical attention.
• **SKIN**	MAY BE ABSORBED! (see Inhalation).	Protective gloves.	Remove contaminated clothes. Rinse and then wash skin with water and soap. Refer for medical attention.
• **EYES**	Redness.	Face shield.	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor.
• **INGESTION**	(Further see Inhalation).	Do not eat, drink, or smoke during work. Wash hands before eating.	Rinse mouth. Induce vomiting (ONLY IN CONSCIOUS PERSONS!). Refer for medical attention.

SPILLAGE DISPOSAL	STORAGE	PACKAGING & LABELLING
Consult an expert! Ventilation. Do NOT wash away into sewer. Sweep spilled substance into containers; if	Separated from strong bases, food and feedstuffs, oxidants, reducing agents. Well closed. Keep in a well-ventilated	Do not transport with food and feedstuffs. T symbol

appropriate, moisten first to prevent dusting. Carefully collect remainder, then remove to safe place (extra personal protection: chemical protection suit including self-contained breathing apparatus).	room.	R: 23/24/25-33 S: (1/2-)28-37-45 Note: C UN Hazard Class: 6.1 UN Packing Group: II

SEE IMPORTANT INFORMATION ON BACK

ICSC: 0727

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International Chemical Safety Cards

2,4-DINITROTOLUENE

ICSC: 0727

IMPORTANT DATA	**PHYSICAL STATE; APPEARANCE:** YELLOW CRYSTALS , WITH CHARACTERISTIC ODOUR. **PHYSICAL DANGERS:** Dust explosion possible if in powder or granular form, mixed with air. **CHEMICAL DANGERS:** May explode on heating. The substance decomposes on heating producing toxic and corrosive fumes including nitrogen oxides even in absence of air. Reacts with strong bases, oxidants and reducing agents. **OCCUPATIONAL EXPOSURE LIMITS (OELs):** TLV: ppm; 1.5 mg/m^3 (as TWA) (skin) (ACGIH 1996).	**ROUTES OF EXPOSURE:** The substance can be absorbed into the body by inhalation, through the skin and by ingestion. **INHALATION RISK:** Evaporation at 20°C is negligible; a harmful concentration of airborne particles can, however, be reached quickly. **EFFECTS OF SHORT-TERM EXPOSURE:** The substance irritates the eyes and the skin. The substance may cause effects on the central nervous system, cardiovascular system, and the blood , resulting in the formation of methaemoglobin. The effects may be delayed. **EFFECTS OF LONG-TERM OR REPEATED EXPOSURE:** The substance may have effects on the central nervous system, cardiovascular system and blood , resulting in formation of methaemoglobin.
PHYSICAL PROPERTIES	Boiling point: 300°C Melting point: 71°C Solubility in water: none Vapour pressure, kPa at 103°C: 0.13	Relative vapour density (air = 1): 6.28 Flash point: 207°C c.c. Octanol/water partition coefficient as log Pow: 1.98
ENVIRONMENTAL DATA	The substance is very toxic to aquatic organisms.	

NOTES

Use of alcoholic beverages enhances the harmful effect. Depending on the degree of exposure, periodic medical examination is indicated. Specific treatment is necessary in case of poisoning with this substance; the appropriate means with instructions must be available. Also consult ICSC # 0465.

Transport Emergency Card: TEC (R)-61G12b

NFPA Code: H3; F1; R3;

ADDITIONAL INFORMATION	

ICSC: 0727 **2,4-DINITROTOLUENE**

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International Chemical Safety Cards

2,6-DINITROTOLUENE

ICSC: 0728

2,6-DINITROTOLUENE
1-Methyl-2,6-dinitrobenzene
2,6-DNT
$C_7H_6N_2O_4$ / $C_6H_3CH_3(NO_2)_2$
Molecular mass: 182.1

CAS # 606-20-2
RTECS # XT1925000
ICSC # 0728
UN # 2038
EC # 609-007-00-9

TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/ SYMPTOMS	PREVENTION	FIRST AID/ FIRE FIGHTING
FIRE	Combustible. Gives off irritating or toxic fumes (or gases) in a fire.	NO open flames.	Powder, water spray, foam, carbon dioxide.
EXPLOSION	Finely dispersed particles form explosive mixtures in air.	Prevent deposition of dust; closed system, dust explosion-proof electrical equipment and lighting.	In case of fire: keep drums, etc., cool by spraying with water. Combat fire from a sheltered position.
EXPOSURE		PREVENT DISPERSION OF DUST! STRICT HYGIENE! AVOID ALL CONTACT!	
• **INHALATION**	Blue lips or finger nails. Blue skin. Headache. Dizziness. Nausea. Confusion. Convulsions. Unconsciousness.	Local exhaust or breathing protection.	Fresh air, rest. Artificial respiration if indicated. Refer for medical attention.
• **SKIN**	MAY BE ABSORBED! (see Inhalation).	Protective gloves. Protective clothing.	Remove contaminated clothes. Rinse and then wash skin with water and soap. Refer for medical attention.
• **EYES**		Face shield.	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor.
• **INGESTION**	(See Inhalation).	Do not eat, drink, or smoke during work. Wash hands before eating.	Rinse mouth. Induce vomiting (ONLY IN CONSCIOUS PERSONS!). Refer for medical attention.

SPILLAGE DISPOSAL	STORAGE	PACKAGING & LABELLING
Consult an expert! Ventilation. Sweep spilled substance into containers; if appropriate, moisten first to prevent	Separated from strong bases, oxidants, reducing agents and food and feedstuffs. Well closed. Keep in a well-	Do not transport with food and feedstuffs. T symbol

dusting. Carefully collect remainder, then remove to safe place (extra personal protection: chemical protection suit including self-contained breathing apparatus).	ventilated room.	R: 23/24/25-33 S: (1/2-)28-37-45 Note: C UN Hazard Class: 6.1 UN Packing Group: II

SEE IMPORTANT INFORMATION ON BACK

ICSC: 0728

Prepared in the context of cooperation between the International Programme on Chemical Safety & the Commission of the European Communities

International Chemical Safety Cards

2,6-DINITROTOLUENE

ICSC: 0728

IMPORTANT DATA	**PHYSICAL STATE; APPEARANCE:** YELLOW, BROWN TO RED CRYSTALS , WITH CHARACTERISTIC ODOUR. **PHYSICAL DANGERS:** Dust explosion possible if in powder or granular form, mixed with air. **CHEMICAL DANGERS:** May explode on heating. The substance decomposes on heating producing toxic and corrosive fumes including nitrogen oxides even in absence of air. Reacts with strong bases, oxidants and reducing agents. **OCCUPATIONAL EXPOSURE LIMITS (OELs):** TLV: ppm; 1.5 mg/m^3 (as TWA) (skin) (ACGIH 1996).	**ROUTES OF EXPOSURE:** The substance can be absorbed into the body by inhalation, through the skin and by ingestion. **INHALATION RISK:** Evaporation at 20°C is negligible; a harmful concentration of airborne particles can, however, be reached quickly. **EFFECTS OF SHORT-TERM EXPOSURE:** The substance may cause effects on the blood , resulting in the formation of methaemoglobin. The effects may be delayed. **EFFECTS OF LONG-TERM OR REPEATED EXPOSURE:** The substance may have effects on the central nervous system, cardiovascular system and blood , resulting in formation of methaemoglobin.
PHYSICAL PROPERTIES	Boiling point: 285°C Melting point: 66°C Relative density (water = 1): 1.283 (liquid) Vapour pressure, Pa at 20°C: 2.4	Relative vapour density (air = 1): 6.28 Flash point: 207°C (c.c.)°C Octanol/water partition coefficient as log Pow: 2.050
ENVIRONMENTAL DATA		

NOTES

Use of alcoholic beverages enhances the harmful effect. Depending on the degree of exposure, periodic medical examination is indicated. Specific treatment is necessary in case of poisoning with this substance; the appropriate means with instructions must be available. Also consult ICSC # 0465 on the isomer mixture.

Transport Emergency Card: TEC (R)-61G12b
NFPA Code: H3; F1; R3;

ADDITIONAL INFORMATION	

ICSC: 0728 **2,6-DINITROTOLUENE**

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International Chemical Safety Cards

ANTHRACENE

ICSC: 0825

ANTHRACENE
Anthracin
Paranaphthalene
Molecular mass: 178.2

CAS # 120-12-7
RTECS # CA9350000
ICSC # 0825

TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/ SYMPTOMS	PREVENTION	FIRST AID/ FIRE FIGHTING
FIRE	Combustible.	NO open flames.	Powder, water spray, foam, carbon dioxide.
EXPLOSION	Finely dispersed particles form explosive mixtures in air.	Prevent deposition of dust; closed system, dust explosion-proof electrical equipment and lighting.	In case of fire: keep drums, etc., cool by spraying with water.
EXPOSURE		PREVENT DISPERSION OF DUST! STRICT HYGIENE!	
• **INHALATION**	Cough. Laboured breathing. Sore throat.	Local exhaust or breathing protection.	Fresh air, rest. Artificial respiration if indicated. Refer for medical attention.
• **SKIN**	MAY BE ABSORBED! Redness.	Protective gloves. Protective clothing.	Remove contaminated clothes. Rinse and then wash skin with water and soap. Refer for medical attention.
• **EYES**	Redness. Pain.	Safety goggles, or eye protection in combination with breathing protection if powder.	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor.
• **INGESTION**	Abdominal pain.	Do not eat, drink, or smoke during work.	Rinse mouth. Refer for medical attention.

SPILLAGE DISPOSAL	STORAGE	PACKAGING & LABELLING
Sweep spilled substance into containers. Carefully collect remainder, then remove to safe place (extra personal protection: P2 filter respirator for harmful particles).	Separated from strong oxidants, strong acids. Tightly closed. Cool.	

SEE IMPORTANT INFORMATION ON BACK

ICSC: 0825

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International Chemical Safety Cards

ANTHRACENE

ICSC: 0825

IMPORTANT DATA

PHYSICAL STATE; APPEARANCE:
WHITE CRYSTALS OR FLAKES.

PHYSICAL DANGERS:
Dust explosion possible if in powder or granular form, mixed with air.

CHEMICAL DANGERS:
The substance decomposes on heating, on contact with sunlight, under influence of strong oxidants producing acrid, toxic fume , causing fire and explosion hazard.

OCCUPATIONAL EXPOSURE LIMITS (OELs):
TLV not established.
PDK not established.

ROUTES OF EXPOSURE:
The substance can be absorbed into the body by inhalation, through the skin and by ingestion.

INHALATION RISK:
Evaporation at 20°C is negligible; a harmful concentration of airborne particles can, however, be reached quickly.

EFFECTS OF SHORT-TERM EXPOSURE:
The substance irritates the eyes, the skin, the respiratory tract and the gastrointestinal tract.

EFFECTS OF LONG-TERM OR REPEATED EXPOSURE:
Repeated or prolonged contact may cause skin sensitization.

PHYSICAL PROPERTIES

Boiling point: 342°C
Melting point: 218°C
Relative density (water = 1): 1.25
Solubility in water: none
Relative vapour density (air = 1): 6.15
Flash point: 121°C
Auto-ignition temperature: 538°C
Explosive limits, vol% in air: 0.6-?
Octanol/water partition coefficient as log Pow: 4.5 (calculated)

ENVIRONMENTAL DATA

This substance may be hazardous to the environment; special attention should be given to soil and air. In the food chain important to humans, bioaccumulation takes place, specifically in aquatic organisms and plants.

NOTES

Do NOT take working clothes home. Green oil, Tetraolive are trade names.

NFPA Code: H0; F1; R;

ADDITIONAL INFORMATION

ICSC: 0825 **ANTHRACENE**

IMPORTANT LEGAL NOTICE:

International Chemical Safety Cards

BENZ(a)ANTHRACENE

ICSC: 0385

BENZ(a)ANTHRACENE
1,2-Benzoanthracene
Benzo(a)anthracene
2,3-Benzphenanthrene
Naphthanthracene
$C_{18}H_{12}$
Molecular mass: 228.3

CAS # 56-55-3
RTECS # CV9275000
ICSC # 0385
EC # 601-033-00-9

TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/ SYMPTOMS	PREVENTION	FIRST AID/ FIRE FIGHTING
FIRE	Combustible.		Water spray, powder. In case of fire in the surroundings: all extinguishing agents allowed.
EXPLOSION	Finely dispersed particles form explosive mixtures in air.	Prevent deposition of dust; closed system, dust explosion-proof electrical equipment and lighting.	
EXPOSURE		AVOID ALL CONTACT!	
• **INHALATION**		Local exhaust or breathing protection.	Fresh air, rest.
• **SKIN**		Protective gloves. Protective clothing.	Remove contaminated clothes. Rinse and then wash skin with water and soap.
• **EYES**		Safety goggles, face shield, or eye protection in combination with breathing protection.	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor.
• **INGESTION**		Do not eat, drink, or smoke during work. Wash hands before eating.	Rinse mouth.

SPILLAGE DISPOSAL	STORAGE	PACKAGING & LABELLING
Sweep spilled substance into sealable containers; if appropriate, moisten first to prevent dusting. Carefully collect remainder, then remove to safe place (extra personal protection: complete protective clothing including self-contained breathing apparatus).	Well closed.	T symbol R: 45 S: 53-45

SEE IMPORTANT INFORMATION ON BACK

ICSC: 0385

International Chemical Safety Cards

BENZ(a)ANTHRACENE

ICSC: 0385

IMPORTANT DATA	**PHYSICAL STATE; APPEARANCE:** COLOURLESS TO YELLOW-BROWN FLUORESCENT FLAKES OR POWDER. **PHYSICAL DANGERS:** Dust explosion possible if in powder or granular form, mixed with air. **CHEMICAL DANGERS:** **OCCUPATIONAL EXPOSURE LIMITS (OELs):** TLV not established.	**ROUTES OF EXPOSURE:** The substance can be absorbed into the body by inhalation, through the skin and by ingestion. **INHALATION RISK:** Evaporation at 20°C is negligible; a harmful concentration of airborne particles can, however, be reached quickly. **EFFECTS OF SHORT-TERM EXPOSURE:** **EFFECTS OF LONG-TERM OR REPEATED EXPOSURE:** This substance is probably carcinogenic to humans.
PHYSICAL PROPERTIES	Sublimation point: 435°C Melting point: 162°C Relative density (water = 1): 1.274	Solubility in water: none Vapour pressure, Pa at 20°C: 292 Octanol/water partition coefficient as log Pow: 5.61
ENVIRONMENTAL DATA	In the food chain important to humans, bioaccumulation takes place, specifically in seafood.	

NOTES

This substance is one of many polycyclic aromatic hydrocarbons - standards are usually established for them as mixtures, e.g., coal tar pitch volatiles. However, it may be encountered as a laboratory chemical in its pure form. Insufficient data are available on the effect of this substance on human health, therefore utmost care must be taken. Do NOT take working clothes home. Tetraphene is a common name.

ADDITIONAL INFORMATION

ICSC: 0385 **BENZ(a)ANTHRACENE**

International Chemical Safety Cards

BENZO(B)FLUORANTHENE

ICSC: 0720

BENZO(B)FLUORANTHENE
Benzo(e)acephenanthrylene
2,3-Benzofluoroanthene
$C_{20}H_{12}$
Molecular mass: 252.3

CAS # 205-99-2
RTECS # CU1400000
ICSC # 0720

TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/ SYMPTOMS	PREVENTION	FIRST AID/ FIRE FIGHTING
FIRE	Combustible.	NO open flames.	Water spray, powder.
EXPLOSION			
EXPOSURE		PREVENT DISPERSION OF DUST! STRICT HYGIENE! AVOID ALL CONTACT!	IN ALL CASES CONSULT A DOCTOR!
• INHALATION		Local exhaust or breathing protection.	Fresh air, rest.
• SKIN	MAY BE ABSORBED!	Protective gloves. Protective clothing.	Remove contaminated clothes. Rinse and then wash skin with water and soap. Refer for medical attention. Wear protective gloves when administering first aid.
• EYES		Safety goggles or eye protection in combination with breathing protection.	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor.
• INGESTION		Do not eat, drink, or smoke during work.	Wear protective gloves when inducing vomiting. Induce vomiting (ONLY IN CONSCIOUS PERSONS!). Refer for medical attention.

SPILLAGE DISPOSAL	STORAGE	PACKAGING & LABELLING
Sweep spilled substance into containers. Carefully collect remainder, then remove to safe place. Do NOT let this chemical enter the environment.	Provision to contain effluent from fire extinguishing. Tightly closed.	Unbreakable packaging; put breakable packaging into closed unbreakable container.

SEE IMPORTANT INFORMATION ON BACK

ICSC: 0720

International Chemical Safety Cards

BENZO(B)FLUORANTHENE

ICSC: 0720

IMPORTANT DATA	**PHYSICAL STATE; APPEARANCE:** COLOURLESS TO YELLOW CRYSTALS. **PHYSICAL DANGERS:** **CHEMICAL DANGERS:** Upon heating, toxic fumes are formed. **OCCUPATIONAL EXPOSURE LIMITS (OELs):** TLV not established.	**ROUTES OF EXPOSURE:** The substance can be absorbed into the body by inhalation of its aerosol and through the skin. **INHALATION RISK:** Evaporation at 20°C is negligible; a harmful concentration of airborne particles can, however, be reached quickly. **EFFECTS OF SHORT-TERM EXPOSURE:** **EFFECTS OF LONG-TERM OR REPEATED EXPOSURE:** This substance is possibly carcinogenic to humans.
PHYSICAL PROPERTIES	Melting point: 168°C Solubility in water: none	Vapour pressure, Pa at 20°C: <10 Octanol/water partition coefficient as log Pow: 6.04
ENVIRONMENTAL DATA	This substance may be hazardous to the environment; special attention should be given to the total environment. In the food chain important to humans, bioaccumulation takes place, specifically in oils and fats.	

NOTES

Depending on the degree of exposure, periodic medical examination is indicated. Data are insufficiently available on the effect of this substance on human health, therefore utmost care must be taken. Do NOT take working clothes home.

ADDITIONAL INFORMATION

ICSC: 0720 **BENZO(B)FLUORANTHENE**

IMPORTANT LEGAL NOTICE:	Neither the CEC or the IPCS nor any person acting on behalf of the CEC or the IPCS is responsible for the use which might be made of this information. This card contains the collective views of the IPCS Peer Review Committee and may not reflect in all cases all the detailed requirements included in national legislation on the subject. The user should verify compliance of the cards with the relevant legislation in the country of use.

International Chemical Safety Cards

BENZO(K)FLUORANTHENE

ICSC: 0721

BENZO(K)FLUOROANTHENE
11,12-Benzofluoroanthene
Dibenzo(b,j,k)fluorene
$C_{20}H_{12}$
Molecular mass: 252.3

CAS # 207-08-9
RTECS # DF6350000
ICSC # 0721

TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/ SYMPTOMS	PREVENTION	FIRST AID/ FIRE FIGHTING
FIRE	Combustible.	NO open flames.	Water spray, powder.
EXPLOSION			
EXPOSURE		PREVENT DISPERSION OF DUST! STRICT HYGIENE! AVOID ALL CONTACT!	IN ALL CASES CONSULT A DOCTOR!
• **INHALATION**		Local exhaust or breathing protection.	Fresh air, rest. Refer for medical attention.
• **SKIN**	MAY BE ABSORBED!	Protective gloves. Protective clothing.	Remove contaminated clothes. Rinse and then wash skin with water and soap. Refer for medical attention. Wear protective gloves when administering first aid.
• **EYES**		Safety goggles or eye protection in combination with breathing protection if powder.	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor.
• **INGESTION**		Do not eat, drink, or smoke during work.	Wear protective gloves when inducing vomiting. Induce vomiting (ONLY IN CONSCIOUS PERSONS!). Refer for medical attention.

SPILLAGE DISPOSAL	STORAGE	PACKAGING & LABELLING
Sweep spilled substance into containers. Carefully collect remainder, then remove to safe place. Do NOT let this chemical enter the environment.	Provision to contain effluent from fire extinguishing. Separated from strong oxidants. Tightly closed.	

SEE IMPORTANT INFORMATION ON BACK

ICSC: 0721

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International Chemical Safety Cards

BENZO(K)FLUORANTHENE

ICSC: 0721

IMPORTANT DATA	**PHYSICAL STATE; APPEARANCE:** YELLOW CRYSTALS. **PHYSICAL DANGERS:** **CHEMICAL DANGERS:** Upon heating, toxic fumes are formed. Reacts with strong oxidants. **OCCUPATIONAL EXPOSURE LIMITS (OELs):** TLV not established.	**ROUTES OF EXPOSURE:** The substance can be absorbed into the body by inhalation of its aerosol and through the skin. **INHALATION RISK:** Evaporation at 20°C is negligible; a harmful concentration of airborne particles can, however, be reached quickly. **EFFECTS OF SHORT-TERM EXPOSURE:** **EFFECTS OF LONG-TERM OR REPEATED EXPOSURE:** This substance is possibly carcinogenic to humans.
PHYSICAL PROPERTIES	Boiling point: 480°C Melting point: 215.7°C	Solubility in water: none Octanol/water partition coefficient as log Pow: 6.84
ENVIRONMENTAL DATA	This substance may be hazardous to the environment; special attention should be given to the total environment. In the food chain important to humans, bioaccumulation takes place, specifically in oils and fats.	

NOTES

Data are insufficiently available on the effect of this substance on human health, therefore utmost care must be taken. Do NOT take working clothes home.

ADDITIONAL INFORMATION

ICSC: 0721 **BENZO(K)FLUORANTHENE**

IMPORTANT LEGAL NOTICE:	Neither the CEC or the IPCS nor any person acting on behalf of the CEC or the IPCS is responsible for the use which might be made of this information. This card contains the collective views of the IPCS Peer Review Committee and may not reflect in all cases all the detailed requirements included in national legislation on the subject. The user should verify compliance of the cards with the relevant legislation in the country of use.

International Chemical Safety Cards

CHLOROFORM

ICSC: 0027

CHLOROFORM
Trichloromethane
Methane trichloride
Formyl chloride
$CHCl_3$
Molecular mass: 119.4

CAS # 67-66-3
RTECS # FS9100000
ICSC # 0027
UN # 1888
EC # 602-006-00-4

TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/ SYMPTOMS	PREVENTION	FIRST AID/ FIRE FIGHTING
FIRE	Not combustible. See Notes. Gives off irritating or toxic fumes (or gases) in a fire.		In case of fire in the surroundings: all extinguishing agents allowed.
EXPLOSION	Risk of fire and explosion (see Chemical Dangers).		In case of fire: keep drums, etc., cool by spraying with water.
EXPOSURE		STRICT HYGIENE! AVOID EXPOSURE OF ADOLESCENTS AND CHILDREN!	
• **INHALATION**	Cough. Drowsiness. Headache. Nausea.	Ventilation, local exhaust, or breathing protection.	Fresh air, rest. Artificial respiration if indicated. Refer for medical attention.
• **SKIN**	MAY BE ABSORBED! Redness. Pain.	Protective gloves. Protective clothing.	Remove contaminated clothes. Rinse skin with plenty of water or shower. Refer for medical attention.
• **EYES**	Redness. Pain.	Face shield or eye protection in combination with breathing protection.	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor.
• **INGESTION**	Abdominal pain. Vomiting (further see Inhalation).	Do not eat, drink, or smoke during work.	Rinse mouth. Give plenty of water to drink. Rest. Refer for medical attention.

SPILLAGE DISPOSAL	STORAGE	PACKAGING & LABELLING
Evacuate danger area! Consult an expert! Collect leaking and spilled liquid in sealable containers as far as possible. Absorb remaining liquid in sand or inert absorbent and remove to	Separated from strong oxidants, strong bases, metals, acetone, food and feedstuffs. Keep in the dark. Ventilation along the floor.	Unbreakable packaging; put breakable packaging into closed unbreakable container. Do not transport with food and feedstuffs. Xn symbol

safe place. Do NOT let this chemical enter the environment (extra personal protection: self-contained breathing apparatus).		R: 22-38-40-48/20/22 S: 36/37 UN Hazard Class: 6.1 UN Packing Group: III Marine pollutant.

SEE IMPORTANT INFORMATION ON BACK

ICSC: 0027

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International Chemical Safety Cards

CHLOROFORM

ICSC: 0027

IMPORTANT DATA	**PHYSICAL STATE; APPEARANCE:** VOLATILE COLOURLESS LIQUID , WITH CHARACTERISTIC ODOUR. **PHYSICAL DANGERS:** The vapour is heavier than air. **CHEMICAL DANGERS:** On contact with hot surfaces or flames this substance decomposes forming irritating and toxic fumes (hydrogen chloride, ICSC # 0163; phosgene, ICSC # 0007; chlorine, ICSC # 0126). The substance decomposes slowly under influence of air and light. Reacts violently with strong bases, strong oxidants, some metals, such as aluminium, lithium, magnesium, potassium, sodium and acetone, causing fire and explosion hazard. Attacks plastic, rubber and coatings. **OCCUPATIONAL EXPOSURE LIMITS (OELs):** TLV (as TWA): 10 ppm; 50 mg/m^3 (ACGIH 1992-1993). MAK: 10 ppm; 50 mg/m^3; II,1, B (1992). MAK: class III B (1992).	**ROUTES OF EXPOSURE:** The substance can be absorbed into the body by inhalation, through the skin and by ingestion. **INHALATION RISK:** A harmful contamination of the air can be reached very quickly on evaporation of this substance at 20°C. **EFFECTS OF SHORT-TERM EXPOSURE:** The substance irritates the eyes. The substance may cause effects on the heart, liver, kidneys and the central nervous system , resulting in unconsciousness. The effects may be delayed. Medical observation is indicated. **EFFECTS OF LONG-TERM OR REPEATED EXPOSURE:** Repeated or prolonged contact with skin may cause dermatitis. This substance is possibly carcinogenic to humans.
PHYSICAL PROPERTIES	Boiling point: 62°C Melting point: -64°C Relative density (water = 1): 1.48 Solubility in water, g/100 ml at 20°C: 0.8	Vapour pressure, kPa at 20°C: 21.2 Relative vapour density (air = 1): 4.12 Relative density of the vapour/air-mixture at 20°C (air = 1): 1.7 Octanol/water partition coefficient as log Pow: 1.97
ENVIRONMENTAL DATA	This substance may be hazardous to the environment; special attention should be given to water.	

NOTES

Turns combustible on addition of small amounts of a flammable substance or an increase in the oxygen content of the air. Use of alcoholic beverages enhances the harmful effect. Depending on the degree of exposure, periodic medical examination is indicated. The odour warning when the exposure limit value is exceeded is insufficient. Do NOT use in the vicinity of a fire or a hot surface, or during welding.

Transport Emergency Card: TEC (R)-146
NFPA Code: H 2; F 0; R 0;

ADDITIONAL INFORMATION

ICSC: 0027 **CHLOROFORM**

IMPORTANT LEGAL NOTICE:	Neither the CEC or the IPCS nor any person acting on behalf of the CEC or the IPCS is responsible for the use which might be made of this information. This card contains the collective views of the IPCS Peer Review Committee and may not reflect in all cases all the detailed requirements included in national legislation on the subject. The user should verify compliance of the cards with the relevant legislation in the country of use.

International Chemical Safety Cards

DIBENZ(a,h)ANTHRACENE

ICSC: 0431

DIBENZO(a,h)ANTHRACENE
1,2:5,6-Dibenzanthracene
$C_{22}H_{14}$
Molecular mass: 278.4

CAS # 53-70-3
RTECS # HN2625000
ICSC # 0431
EC # 601-041-00-2

TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/ SYMPTOMS	PREVENTION	FIRST AID/ FIRE FIGHTING
FIRE	Combustible.	NO open flames.	Water spray, powder.
EXPLOSION			
EXPOSURE		AVOID ALL CONTACT!	
• **INHALATION**		Local exhaust or breathing protection.	Fresh air, rest.
• **SKIN**	Redness. Swelling. Itching.	Protective gloves. Protective clothing.	Remove contaminated clothes. Rinse and then wash skin with water and soap.
• **EYES**	Redness.	Face shield, or eye protection in combination with breathing protection.	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor.
• **INGESTION**		Do not eat, drink, or smoke during work. Wash hands before eating.	Rinse mouth.

SPILLAGE DISPOSAL	STORAGE	PACKAGING & LABELLING
Sweep spilled substance into sealable containers; if appropriate, moisten first to prevent dusting. Carefully collect remainder, then remove to safe place (extra personal protection: P3 filter respirator for toxic particles).	Well closed.	T symbol R: 45 S: 53-45

SEE IMPORTANT INFORMATION ON BACK

ICSC: 0431

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International Chemical Safety Cards

DIBENZ(a,h)ANTHRACENE

ICSC: 0431

I M P O R T A N T D A T A	**PHYSICAL STATE; APPEARANCE:** COLOURLESS CRYSTALLINE POWDER. **PHYSICAL DANGERS:** **CHEMICAL DANGERS:** **OCCUPATIONAL EXPOSURE LIMITS (OELs):** TLV not established.	**ROUTES OF EXPOSURE:** The substance can be absorbed into the body by inhalation, through the skin and by ingestion. **INHALATION RISK:** Evaporation at 20°C is negligible; a harmful concentration of airborne particles can, however, be reached quickly. **EFFECTS OF SHORT-TERM EXPOSURE:** **EFFECTS OF LONG-TERM OR REPEATED EXPOSURE:** The substance may have effects on the skin , resulting in photosensitization. This substance is probably carcinogenic to humans.
PHYSICAL PROPERTIES	Boiling point: 524°C Melting point: 267°C Relative density (water = 1): 1.28	Solubility in water: none Octanol/water partition coefficient as log Pow: 6.5
ENVIRONMENTAL DATA	In the food chain important to humans, bioaccumulation takes place, specifically in seafood.	

NOTES

This is one of many polycyclic aromatic hydrocarbons - standards are usually established for them as mixtures, e.g., coal tar pitch volatiles. However, it may be encountered as a laboratory chemical in its pure form. Insufficient data are available on the effect of this substance on human health, therefore utmost care must be taken. Do NOT take working clothes home. DBA is a commonly used name. This substance is one of many polycyclic aromatic hydrocarbons (PAH).

ADDITIONAL INFORMATION

ICSC: 0431 **DIBENZ(a,h)ANTHRACENE**

IMPORTANT LEGAL NOTICE:	Neither the CEC or the IPCS nor any person acting on behalf of the CEC or the IPCS is responsible for the use which might be made of this information. This card contains the collective views of the IPCS Peer Review Committee and may not reflect in all cases all the detailed requirements included in national legislation on the subject. The user should verify compliance of the cards with the relevant legislation in the country of use.

International Chemical Safety Cards

VINYLIDENE CHLORIDE

ICSC: 0083

VINYLIDENE CHLORIDE
1,1-Dichloroethene
1,1-Dichloroethylene
VDC
$C_2H_2Cl_2/H_2C{=}CCl_2$
Molecular mass: 97

CAS # 75-35-4
RTECS # KV9275000
ICSC # 0083
UN # 1303 (inhibited)
EC # 602-025-00-8

TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/ SYMPTOMS	PREVENTION	FIRST AID/ FIRE FIGHTING
FIRE	Extremely flammable. Gives off irritating or toxic fumes (or gases) in a fire.	NO open flames, NO sparks, and NO smoking.	Powder, water spray, foam, carbon dioxide.
EXPLOSION	Vapour/air mixtures are explosive. Vinyl chloride monomer vapours are uninhibited and may form polymers in vents or flame arresters of storage tanks, resulting in blockage of vents.	Closed system, ventilation, explosion-proof electrical equipment and lighting. Use non-sparking handtools.	In case of fire: keep drums, etc., cool by spraying with water. Combat fire from a sheltered position.
EXPOSURE		STRICT HYGIENE!	
• **INHALATION**	Dizziness. Drowsiness. Unconsciousness.	Ventilation, local exhaust, or breathing protection.	Fresh air, rest. Artificial respiration if indicated. Refer for medical attention.
• **SKIN**	Redness. Skin burns.	Protective gloves. Protective clothing.	Remove contaminated clothes. Rinse and then wash skin with water and soap.
• **EYES**	Redness. Pain.	Safety goggles, or eye protection in combination with breathing protection.	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor.
• **INGESTION**	Abdominal pain. Sore throat (further see Inhalation).	Do not eat, drink, or smoke during work. Wash hands before eating.	Rinse mouth. Do NOT induce vomiting. Give plenty of water to drink. Rest.

SPILLAGE DISPOSAL	STORAGE	PACKAGING & LABELLING
Evacuate danger area! Consult an expert! Collect leaking and spilled liquid in sealable containers as far as possible. Absorb remaining liquid in sand or inert absorbent and remove to	Fireproof. Separated from incompatible materials (see Chemical Dangers). Cool. Keep in the dark. Store only if stabilized.	Airtight. Unbreakable packaging; put breakable packaging into closed unbreakable container. IMO: Marine Pollutant F+ symbol

safe place (extra personal protection: complete protective clothing including self-contained breathing apparatus).		Xn symbol R: 12-20-40 S: 7-16-29 Note: D UN Hazard Class: 3 UN Packing Group: I

SEE IMPORTANT INFORMATION ON BACK

ICSC: 0083

International Chemical Safety Cards

VINYLIDENE CHLORIDE

ICSC: 0083

IMPORTANT DATA	**PHYSICAL STATE; APPEARANCE:** VOLATILE COLOURLESS LIQUID , WITH CHARACTERISTIC ODOUR. **PHYSICAL DANGERS:** The vapour is heavier than air and may travel along the ground; distant ignition possible. **CHEMICAL DANGERS:** The substance can readily form explosive peroxides. The substance will polymerize readily due to heating or under the influence of oxygen, sunlight, copper or aluminium, with fire or explosion hazard. May explode on heating or on contact with flames. The substance decomposes on burning producing toxic and corrosive fumes (hydrogen chloride, phosgene and chlorine). Reacts violently with oxidants. **OCCUPATIONAL EXPOSURE LIMITS (OELs):** TLV: 5 ppm; 20 mg/m^3 (STEL): 20 ppm; 79 mg/m^3 (ACGIH 1992-1993).	**ROUTES OF EXPOSURE:** The substance can be absorbed into the body by inhalation, through the skin and by ingestion. **INHALATION RISK:** A harmful contamination of the air can be reached very quickly on evaporation of this substance at 20°C. **EFFECTS OF SHORT-TERM EXPOSURE:** The substance irritates the eyes, the skin and the respiratory tract. Swallowing the liquid may cause aspiration into the lungs with the risk of chemical pneumonitis. The substance may cause effects on the central nervous system. **EFFECTS OF LONG-TERM OR REPEATED EXPOSURE:** Repeated or prolonged contact with skin may cause dermatitis. The substance may have effects on the liver and kidneys.
PHYSICAL PROPERTIES	Boiling point: 32°C Melting point: -122°C Relative density (water = 1): 1.2 Solubility in water, g/100 ml at 25°C: 0.25 Vapour pressure, kPa at 20°C: 66.5 Relative vapour density (air = 1): 3.3	Relative density of the vapour/air-mixture at 20°C (air = 1): 2.5 Flash point: 5.6°C Auto-ignition temperature: 570°C Explosive limits, vol% in air: 5.6-16 Octanol/water partition coefficient as log Pow: 1.32
ENVIRONMENTAL DATA	This substance may be hazardous to the environment; special attention should be given to water organisms. In the food chain important to humans, bioaccumulation takes place, specifically in plants.	

NOTES

Contains inhibitors (e.g. methoxyphenol). Depending on the degree of exposure, periodic medical examination is indicated. The odour warning when the exposure limit value is exceeded is insufficient. Do NOT use in the vicinity of a fire or a hot surface, or during welding.

Transport Emergency Card: TEC (R)-641
NFPA Code: H2; F4; R2;

ADDITIONAL INFORMATION

ICSC: 0083 **VINYLIDENE CHLORIDE**

IMPORTANT LEGAL NOTICE:	Neither the CEC or the IPCS nor any person acting on behalf of the CEC or the IPCS is responsible for the use which might be made of this information. This card contains the collective views of the IPCS Peer Review Committee and may not reflect in all cases all the detailed requirements included in national legislation on the subject. The user should verify compliance of the cards with the relevant legislation in the country of use.

International Chemical Safety Cards

o-XYLENE

ICSC: 0084

o-XYLENE
ortho-Xylene
1,2-Dimethylbenzene
o-Xylol
$C_6H_4(CH_3)_2/C_8H_{10}$
Molecular mass: 106.2

CAS # 95-47-6
RTECS # ZE2450000
ICSC # 0084
UN # 1307
EC # 601-022-00-9

TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/ SYMPTOMS	PREVENTION	FIRST AID/ FIRE FIGHTING
FIRE	Flammable.	NO open flames, NO sparks, and NO smoking.	Powder, AFFF, foam, carbon dioxide.
EXPLOSION	Above 32°C explosive vapour/air mixtures may be formed.	Above 32°C use a closed system, ventilation, and explosion-proof electrical equipment.	In case of fire: keep drums, etc., cool by spraying with water.
EXPOSURE		STRICT HYGIENE! AVOID EXPOSURE OF (PREGNANT) WOMEN!	
• **INHALATION**	Dizziness. Drowsiness. Headache. Unconsciousness.	Ventilation, local exhaust, or breathing protection.	Fresh air, rest. Artificial respiration if indicated. Refer for medical attention.
• **SKIN**	Dry skin. Redness.	Protective gloves.	Remove contaminated clothes. Rinse and then wash skin with water and soap.
• **EYES**	Redness. Pain.	Safety spectacles.	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor.
• **INGESTION**	Abdominal pain. Burning sensation (further see Inhalation).	Do not eat, drink, or smoke during work.	Rinse mouth. Give a slurry of activated charcoal in water to drink. Do NOT induce vomiting. Refer for medical attention.

SPILLAGE DISPOSAL	STORAGE	PACKAGING & LABELLING
Collect leaking and spilled liquid in sealable containers as far as possible. Absorb remaining liquid in sand or inert absorbent and remove to safe place. Do NOT let this chemical enter the environment.	Fireproof. Separated from strong oxidants.	Xn symbol R: 10-20/21-38 S: (2-)25 Note: C UN Hazard Class: 3

SEE IMPORTANT INFORMATION ON BACK

ICSC: 0084

International Chemical Safety Cards

o-XYLENE

ICSC: 0084

I M P O R T A N T D A T A	**PHYSICAL STATE; APPEARANCE:** COLOURLESS LIQUID , WITH CHARACTERISTIC ODOUR. **PHYSICAL DANGERS:** As a result of flow, agitation, etc., electrostatic charges can be generated. **CHEMICAL DANGERS:** Reacts violently with strong oxidants causing fire and explosion hazard. **OCCUPATIONAL EXPOSURE LIMITS (OELs):** TLV: 100 ppm; 434 mg/m^3 (as TWA) (ACGIH 1993-1994). TLV (as (STEL): 150 ppm; 651 mg/m^3 (ACGIH 1993-1994).	**ROUTES OF EXPOSURE:** The substance can be absorbed into the body by inhalation, through the skin and by ingestion. **INHALATION RISK:** A harmful contamination of the air will be reached rather slowly on evaporation of this substance at 20°C. **EFFECTS OF SHORT-TERM EXPOSURE:** The substance irritates the eyes. Exposure far above the OEL may result in central nervous system depression, unconsciousness and death. **EFFECTS OF LONG-TERM OR REPEATED EXPOSURE:** The liquid defats the skin. The substance may have effects on the central nervous system , resulting in decreased learning ability. Animal tests show that this substance possibly causes toxic effects upon human reproduction.
PHYSICAL PROPERTIES	Boiling point: 144°C Melting point: -25°C Relative density (water = 1): 0.88 Solubility in water: none Vapour pressure, kPa at 20°C: 0.7 Relative vapour density (air = 1): 3.7	Relative density of the vapour/air-mixture at 20°C (air = 1): 1.02 Flash point: 32°C c.c.°C Auto-ignition temperature: 463°C Explosive limits, vol% in air: 0.9-7.0 Octanol/water partition coefficient as log Pow: 3.12
ENVIRONMENTAL DATA	This substance may be hazardous to the environment; special attention should be given to fish and crustacea.	

NOTES

Depending on the degree of exposure, periodic medical examination is indicated. The recommendations on this Card also apply to technical xylene. Also consult ICSC # 0086 p-xylene and 0085 m-xylene.

Transport Emergency Card: TEC (R)-33
NFPA Code: H 2; F 3; R 0;

ADDITIONAL INFORMATION

ICSC: 0084 **o-XYLENE**

International Chemical Safety Cards

m-XYLENE

ICSC: 0085

m-XYLENE
meta-Xylene
1,3-Dimethylbenzene
m-Xylol
$C_6H_4(CH_3)_2/C_8H_{10}$
Molecular mass: 106.2

CAS # 108-38-3
RTECS # ZE2275000
ICSC # 0085
UN # 1307
EC # 601-022-00-9

TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/ SYMPTOMS	PREVENTION	FIRST AID/ FIRE FIGHTING
FIRE	Flammable.	NO open flames, NO sparks, and NO smoking.	Powder, AFFF, foam, carbon dioxide.
EXPLOSION	Above 27°C explosive vapour/air mixtures may be formed.	Above 27°C use a closed system, ventilation, and explosion-proof electrical equipment.	In case of fire: keep drums, etc., cool by spraying with water.
EXPOSURE		STRICT HYGIENE!	
• **INHALATION**	Dizziness. Drowsiness. Headache. Unconsciousness.	Ventilation, local exhaust, or breathing protection.	Fresh air, rest. Artificial respiration if indicated. Refer for medical attention.
• **SKIN**	Dry skin. Redness.	Protective gloves.	Remove contaminated clothes. Rinse and then wash skin with water and soap.
• **EYES**	Redness. Pain.	Safety spectacles.	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor.
• **INGESTION**	Abdominal pain. Burning sensation (further see Inhalation).	Do not eat, drink, or smoke during work.	Rinse mouth. Give a slurry of activated charcoal in water to drink. Do NOT induce vomiting. Refer for medical attention.

SPILLAGE DISPOSAL	STORAGE	PACKAGING & LABELLING
Collect leaking and spilled liquid in sealable containers as far as possible. Absorb remaining liquid in sand or inert absorbent and remove to safe place. Do NOT let this chemical enter the environment.	Fireproof. Separated from strong oxidants.	Xn symbol R: 10-20/21-38 S: (2-)25 Note: C UN Hazard Class: 3

SEE IMPORTANT INFORMATION ON BACK

Prepared in the context of cooperation between the International Programme on Chemical Safety & the

ICSC: 0085

International Chemical Safety Cards

m-XYLENE

ICSC: 0085

IMPORTANT DATA

PHYSICAL STATE; APPEARANCE:
COLOURLESS LIQUID , WITH CHARACTERISTIC ODOUR.

PHYSICAL DANGERS:
As a result of flow, agitation, etc., electrostatic charges can be generated.

CHEMICAL DANGERS:
Reacts violently with strong oxidants such as nitric acid.

OCCUPATIONAL EXPOSURE LIMITS (OELs):
TLV: 100 ppm; 434 mg/m^3 (as TWA) (ACGIH 1993-1994).
TLV (as STEL): 150 ppm; 651 mg/m^3 (ACGIH 1993-1994).

ROUTES OF EXPOSURE:
The substance can be absorbed into the body by inhalation, through the skin and by ingestion.

INHALATION RISK:
A harmful contamination of the air will be reached rather slowly on evaporation of this substance at 20°C.

EFFECTS OF SHORT-TERM EXPOSURE:
The substance irritates the eyes. Exposure far above the OEL may result in central nervous system depression, unconsciousness and death.

EFFECTS OF LONG-TERM OR REPEATED EXPOSURE:
The liquid defats the skin. The substance may have effects on the central nervous system , resulting in decreased learning ability.

PHYSICAL PROPERTIES

Boiling point: 139°C
Melting point: -48°C
Relative density (water = 1): 0.86
Solubility in water: none
Vapour pressure, kPa at 20°C: 0.8
Relative vapour density (air = 1): 3.7
Relative density of the vapour/air-mixture at 20°C (air = 1): 1.02
Flash point: 27°C c.c.°C
Auto-ignition temperature: 527°C
Explosive limits, vol% in air: 1.1-7.0
Octanol/water partition coefficient as log Pow: 3.20

ENVIRONMENTAL DATA

This substance may be hazardous to the environment; special attention should be given to fish and crustacea.

NOTES

Depending on the degree of exposure, periodic medical examination is indicated. The recommendations on this Card also apply to technical xylene. Also consult ICSC # 0084 and 0086 on o- and p-xylene.

NFPA Code: H 2; F 3; R 0;

ADDITIONAL INFORMATION

ICSC: 0085 **m-XYLENE**

International Chemical Safety Cards

p-XYLENE

ICSC: 0086

p-XYLENE
para-Xylene
1,4-Dimethylbenzene
p-Xylol
$C_6H_4(CH_3)_2/C_8H_{10}$
Molecular mass: 106.2

CAS # 106-42-3
RTECS # ZE2625000
ICSC # 0086
UN # 1307
EC # 601-022-00-9

TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/ SYMPTOMS	PREVENTION	FIRST AID/ FIRE FIGHTING
FIRE	Flammable.	NO open flames, NO sparks, and NO smoking.	Powder, AFFF, foam, carbon dioxide.
EXPLOSION	Above 27°C explosive vapour/air mixtures may be formed.	Above 27°C use a closed system, ventilation, and explosion-proof electrical equipment.	In case of fire: keep drums, etc., cool by spraying with water.
EXPOSURE		STRICT HYGIENE! AVOID EXPOSURE OF (PREGNANT) WOMEN!	
• **INHALATION**	Dizziness. Drowsiness. Headache. Unconsciousness.	Ventilation, local exhaust, or breathing protection.	Fresh air, rest. Artificial respiration if indicated. Refer for medical attention.
• **SKIN**	Dry skin. Redness.	Protective gloves.	Remove contaminated clothes. Rinse and then wash skin with water and soap.
• **EYES**	Redness. Pain.	Safety spectacles.	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor.
• **INGESTION**	Abdominal pain. Burning sensation (further see Inhalation).	Do not eat, drink, or smoke during work.	Rinse mouth. Give a slurry of activated charcoal in water to drink. Do NOT induce vomiting. Refer for medical attention.

SPILLAGE DISPOSAL	STORAGE	PACKAGING & LABELLING
Collect leaking and spilled liquid in sealable containers as far as possible. Absorb remaining liquid in sand or inert absorbent and remove to safe place. Do NOT let this chemical enter the environment.	Fireproof. Separated from strong oxidants.	Xn symbol R: 10-20/21-38 S: (2-)25 UN Hazard Class: 3

SEE IMPORTANT INFORMATION ON BACK

ICSC: 0086

International Chemical Safety Cards

p-XYLENE

ICSC: 0086

IMPORTANT DATA	**PHYSICAL STATE; APPEARANCE:** COLOURLESS LIQUID , WITH CHARACTERISTIC ODOUR. **PHYSICAL DANGERS:** As a result of flow, agitation, etc., electrostatic charges can be generated. **CHEMICAL DANGERS:** Reacts violently with strong oxidants such as nitric acid. **OCCUPATIONAL EXPOSURE LIMITS (OELs):** TLV: 100 ppm; 434 mg/m^3 (as TWA) (ACGIH 1993-1994). TLV (as STEL): 150 ppm; 651 mg/m^3 (ACGIH 1993-1994).	**ROUTES OF EXPOSURE:** The substance can be absorbed into the body by inhalation, through the skin and by ingestion. **INHALATION RISK:** A harmful contamination of the air will be reached rather slowly on evaporation of this substance at 20°C. **EFFECTS OF SHORT-TERM EXPOSURE:** The substance irritates the eyes. Exposure far above the OEL may result in central nervous system depression, unconsciousness and death. **EFFECTS OF LONG-TERM OR REPEATED EXPOSURE:** The liquid defats the skin. The substance may have effects on the central nervous system , resulting in decreased learning ability. Animal tests show that this substance possibly causes toxic effects upon human reproduction.
PHYSICAL PROPERTIES	Boiling point: 138°C Melting point: 13°C Relative density (water = 1): 0.86 Solubility in water: none Vapour pressure, kPa at 20°C: 0.9 Relative vapour density (air = 1): 3.7	Relative density of the vapour/air-mixture at 20°C (air = 1): 1.02 Flash point: 27°C c.c.°C Auto-ignition temperature: 528°C Explosive limits, vol% in air: 1.1-7.0 Octanol/water partition coefficient as log Pow: 3.15
ENVIRONMENTAL DATA	This substance may be hazardous to the environment; special attention should be given to fish and crustacea.	

NOTES

Depending on the degree of exposure, periodic medical examination is indicated. The recommendations on this Card also apply to technical xylene. Also consult ICSC # 0084 o-xylene and 0085 m-xylene.

Transport Emergency Card: TEC (R)-33
NFPA Code: H 2; F 3; R 0;

ADDITIONAL INFORMATION

ICSC: 0086 **p-XYLENE**

ATTACHMENT C

MATERIAL SAFETY DATA SHEETS (MSDS) FOR CHEMICALS/PRESERVATIVES

Attachment C
List of Contents

Material Safety Data Sheets for:

- Hydrochloric Acid
- Unleaded Gasoline
- Alconox
- Nitric Acid
- Sulfuric Acid
- Isobutylene calibration gas
- 70% Denatured Alcohol
- 10% Formalin

MATERIAL SAFETY DATA SHEETS

MSDS Number: **H3883** * * * * * *Effective Date: 05/07/03* * * * * * *Supercedes: 11/02/01*

24 Hour Emergency Telephone: 908-859-2151
CHEMTREC: 1-800-424-9300

National Response in Canada
CANUTEC: 613-996-6666

Outside U.S. and Canada
Chemtrec: 703-527-3887

MSDS *Material Safety Data Sheet*

From: Mallinckrodt Baker, Inc.
222 Red School Lane
Phillipsburg, NJ 08865

Mallinckrodt CHEMICALS

J.T.Baker

NOTE: CHEMTREC, CANUTEC and National Response Center emergency numbers to be used only in the event of chemical emergencies involving a spill, leak, fire, exposure or accident involving chemicals.

All non-emergency questions should be directed to Customer Service (1-800-552-2537) for assistance.

HYDROCHLORIC ACID (LESS THAN 10%)

1. Product Identification

Synonyms: Muriatic acid solution; 10:1 Dilute Hydrochloric acid; Hydrochloric acid volumetric solutions (0.2 - 2.0 N)
CAS No.: 7647-01-0
Molecular Weight: 36.46
Chemical Formula: HCl in water
Product Codes:
J.T. Baker: 0325, 0335, 0336, 4655, 5612, 5616, 5620, 5622
Mallinckrodt: 6388, H162, H163, H959, V028, V043

2. Composition/Information on Ingredients

Ingredient	CAS No	Percent	Hazardous
Hydrogen Chloride	7647-01-0	0.7 - 8%	Yes
Water	7732-18-5	92 - 99%	No

3. Hazards Identification

Emergency Overview

DANGER! CORROSIVE. LIQUID AND MIST CAUSE SEVERE BURNS TO ALL

BODY TISSUE. MAY BE FATAL IF SWALLOWED OR INHALED.

J.T. Baker SAF-T-DATA$^{(tm)}$ Ratings (Provided here for your convenience)

Health Rating: 3 - Severe (Poison)
Flammability Rating: 0 - None
Reactivity Rating: 2 - Moderate
Contact Rating: 3 - Severe (Corrosive)
Lab Protective Equip: GOGGLES & SHIELD; LAB COAT & APRON; VENT HOOD; PROPER GLOVES
Storage Color Code: White (Corrosive)

Potential Health Effects

Health hazards given on this data sheet apply to concentrated solutions of hydrochloric acid. Hazards of dilute solutions may be reduced, depending upon the concentration. Degree of hazard for these reduced concentrations is not currently addressed in the available literature.

Inhalation:
Corrosive! Inhalation of vapors can cause coughing, choking, inflammation of the nose, throat, and upper respiratory tract, and in severe cases, pulmonary edema, circulatory failure, and death.
Ingestion:
Corrosive! Swallowing hydrochloric acid can cause immediate pain and burns of the mouth, throat, esophagus and gastrointestinal tract. May cause nausea, vomiting, and diarrhea, and in severe cases, death.
Skin Contact:
Corrosive! Can cause redness, pain, and severe skin burns. Concentrated solutions cause deep ulcers and discolor skin.
Eye Contact:
Corrosive! Vapors are irritating and may cause damage to the eyes. Contact may cause severe burns and permanent eye damage.
Chronic Exposure:
Long-term exposure to concentrated vapors may cause erosion of teeth. Long term exposures seldom occur due to the corrosive properties of the acid.
Aggravation of Pre-existing Conditions:
Persons with pre-existing skin disorders or eye problems or impaired respiratory function may be more susceptible to the effects of the substance.

4. First Aid Measures

First aid procedures given apply to concentrated solutions. Exposures to dilute solutions may not require these extensive first aid procedures.
Inhalation:
Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention immediately.

Ingestion:
If swallowed, DO NOT INDUCE VOMITING. Give large quantities of water. Never give anything by mouth to an unconscious person. Get medical attention immediately.
Skin Contact:
Immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Get medical attention immediately. Wash clothing before reuse. Thoroughly clean shoes before reuse.
Eye Contact:
Immediately flush eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention immediately.

5. Fire Fighting Measures

Fire:
Not considered to be a fire hazard. May react with metals or heat to release flammable hydrogen gas.
Explosion:
Not considered to be an explosion hazard.
Fire Extinguishing Media:
Water or water spray. Neutralize with soda ash or slaked lime.
Special Information:
In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode. Structural firefighter's protective clothing is ineffective for fires involving hydrochloric acid. Stay away from ends of tanks. Cool tanks with water spray until well after fire is out.

6. Accidental Release Measures

Ventilate area of leak or spill. Wear appropriate personal protective equipment as specified in Section 8. Isolate hazard area. Keep unnecessary and unprotected personnel from entering. Contain and recover liquid when possible. Neutralize with alkaline material (soda ash, lime), then absorb with an inert material (e. g., vermiculite, dry sand, earth), and place in a chemical waste container. Do not use combustible materials, such as saw dust. Do not flush to sewer! US Regulations (CERCLA) require reporting spills and releases to soil, water and air in excess of reportable quantities. The toll free number for the US Coast Guard National Response Center is (800) 424-8802.

J. T. Baker NEUTRASORB® or TEAM® 'Low Na+' acid neutralizers are recommended for spills of this product.

7. Handling and Storage

Store in a cool, dry, ventilated storage area with acid resistant floors and good drainage. Protect from physical damage. Keep out of direct sunlight and away from heat and incompatible materials. Do not wash out container and use it for other purposes. When diluting, always add the acid to water; never add water to the acid. When opening metal containers, use non-sparking tools because of the possibility of hydrogen gas being present. Protect from freezing. Containers of this material may be hazardous when empty since they retain product residues (vapors, liquid); observe all warnings and precautions listed for the product.

8. Exposure Controls/Personal Protection

Airborne Exposure Limits:
For Hydrochloric acid:
- OSHA Permissible Exposure Limit (PEL):
5 ppm (Ceiling)
- ACGIH Threshold Limit Value (TLV):
2 ppm (Ceiling), A4 Not classifiable as a human carcinogen

Ventilation System:
A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, *Industrial Ventilation, A Manual of Recommended Practices*, most recent edition, for details.

Personal Respirators (NIOSH Approved):
If the exposure limit is exceeded and engineering controls are not feasible, a full facepiece respirator with an acid gas cartridge may be worn up to 50 times the exposure limit or the maximum use concentration specified by the appropriate regulatory agency or respirator supplier, whichever is lowest. For emergencies or instances where the exposure levels are not known, use a full-facepiece positive-pressure, air-supplied respirator. WARNING: Air purifying respirators do not protect workers in oxygen-deficient atmospheres.

Skin Protection:
Rubber or neoprene gloves and additional protection including impervious boots, apron, or coveralls, as needed in areas of unusual exposure to prevent skin contact.

Eye Protection:
Use chemical safety goggles and/or a full face shield where splashing is possible. Maintain eye wash fountain and quick-drench facilities in work area.

9. Physical and Chemical Properties

Appearance:
Clear, colorless solution.

Odor:
Pungent, hydrochloric acid.

Solubility:
Infinitely soluble.

Specific Gravity:

ca. 1
pH:
For HCL solutions: 0.1 (1.0 N), 1.1 (0.1 N), 2.02 (0.01 N)
% Volatiles by volume @ 21C (70F):
100 (as water and acid)
Boiling Point:
ca. 100C (ca. 212F)
Melting Point:
ca. 0C (ca. 32F)
Vapor Density (Air=1):
Essentially the same as water.
Vapor Pressure (mm Hg):
Essentially the same as water.
Evaporation Rate (BuAc=1):
Essentially the same as water.

10. Stability and Reactivity

Stability:
Stable under ordinary conditions of use and storage.
Hazardous Decomposition Products:
When heated to decomposition, emits toxic hydrogen chloride fumes and will react with water or steam to produce heat and toxic and corrosive fumes. Thermal oxidative decomposition produces toxic chlorine fumes and explosive hydrogen gas.
Hazardous Polymerization:
Will not occur.
Incompatibilities:
A strong mineral acid, concentrated hydrochloric acid is highly reactive with strong bases, metals, metal oxides, hydroxides, amines, carbonates and other alkaline materials. Incompatible with materials such as cyanides, sulfides, sulfites, and formaldehyde.
Conditions to Avoid:
Heat, direct sunlight, incompatibles.

11. Toxicological Information

Hydrochloric acid: Inhalation rat LC50: 3124 ppm/1H; Oral rabbit LD50: 900 mg/kg.
Investigated as a tumorigen, mutagen, reproductive effector.

--------\Cancer Lists\--

Ingredient	---NTP Carcinogen--- Known	 Anticipated	IARC Category
Hydrogen Chloride (7647-01-0)	No	No	3
Water (7732-18-5)	No	No	None

12. Ecological Information

Environmental Fate:
For Hydrochloric Acid (Concentrated Solutions):
When released into the soil, this material is not expected to biodegrade. When released into the soil, this material may leach into groundwater.
Environmental Toxicity:
For Hydrochloric Acid (Concentrated Solutions):
This material may be toxic to aquatic life. LC50 Shrimp: 100-300 ppm/48-hr/salt water; LC100 trout: 10 mg/l/24-hr; TLm mosquito fish: 282 ppm/96-hr.

13. Disposal Considerations

Whatever cannot be saved for recovery or recycling should be handled as hazardous waste and sent to a RCRA approved waste facility. Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal disposal regulations. Dispose of container and unused contents in accordance with federal, state and local requirements.

14. Transport Information

Domestic (Land, D.O.T.)

Proper Shipping Name: HYDROCHLORIC ACID SOLUTION
Hazard Class: 8
UN/NA: UN1789
Packing Group: II
Information reported for product/size: 200L

International (Water, I.M.O.)

Proper Shipping Name: HYDROCHLORIC ACID SOLUTION
Hazard Class: 8
UN/NA: UN1789
Packing Group: II
Information reported for product/size: 200L

15. Regulatory Information

```
--------\Chemical Inventory Status - Part 1\---------------------------------
Ingredient                                      TSCA  EC   Japan  Australia
----------------------------------------------- ----  ---  -----  ---------
Hydrogen Chloride (7647-01-0)                    Yes  Yes   Yes      Yes
Water (7732-18-5)                                Yes  Yes   Yes      Yes
```

--------\Chemical Inventory Status - Part 2\---------------------------------

		--Canada--		
Ingredient	Korea	DSL	NDSL	Phil.
Hydrogen Chloride (7647-01-0)	Yes	Yes	No	Yes
Water (7732-18-5)	Yes	Yes	No	Yes

--------\Federal, State & International Regulations - Part 1\---------------

	-SARA 302-		------SARA 313------	
Ingredient	RQ	TPQ	List	Chemical Catg.
Hydrogen Chloride (7647-01-0)	5000	500*	Yes	No
Water (7732-18-5)	No	No	No	No

--------\Federal, State & International Regulations - Part 2\---------------

		-RCRA-	-TSCA-
Ingredient	CERCLA	261.33	8(d)
Hydrogen Chloride (7647-01-0)	5000	No	No
Water (7732-18-5)	No	No	No

Chemical Weapons Convention: No TSCA 12(b): No CDTA: Yes
SARA 311/312: Acute: Yes Chronic: Yes Fire: No Pressure: No
Reactivity: No (Mixture / Liquid)

Australian Hazchem Code: None allocated.
Poison Schedule: None allocated.
WHMIS:
This MSDS has been prepared according to the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

16. Other Information

NFPA Ratings: Health: **3** Flammability: **0** Reactivity: **0**
Label Hazard Warning:
DANGER! CORROSIVE. LIQUID AND MIST CAUSE SEVERE BURNS TO ALL BODY TISSUE. MAY BE FATAL IF SWALLOWED OR INHALED.
Label Precautions:
Do not get in eyes, on skin, or on clothing.
Do not breathe vapor or mist.
Keep container closed.
Use only with adequate ventilation.
Wash thoroughly after handling.
Label First Aid:
In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before reuse. If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. If swallowed, DO NOT INDUCE VOMITING. Give large quantities of water. Never give anything by mouth to an unconscious person. In all cases get medical attention immediately.

Product Use:
Laboratory Reagent.
Revision Information:
MSDS Section(s) changed since last revision of document include: 8.
Disclaimer:
****

Mallinckrodt Baker, Inc. provides the information contained herein in good faith but makes no representation as to its comprehensiveness or accuracy. This document is intended only as a guide to the appropriate precautionary handling of the material by a properly trained person using this product. Individuals receiving the information must exercise their independent judgment in determining its appropriateness for a particular purpose. MALLINCKRODT BAKER, INC. MAKES NO REPRESENTATIONS OR WARRANTIES, EITHER EXPRESS OR IMPLIED, INCLUDING WITHOUT LIMITATION ANY WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE WITH RESPECT TO THE INFORMATION SET FORTH HEREIN OR THE PRODUCT TO WHICH THE INFORMATION REFERS. ACCORDINGLY, MALLINCKRODT BAKER, INC. WILL NOT BE RESPONSIBLE FOR DAMAGES RESULTING FROM USE OF OR RELIANCE UPON THIS INFORMATION.
****

Prepared by: Environmental Health & Safety
Phone Number: (314) 654-1600 (U.S.A.)

U S OIL AND REFINING CO -- REGULAR UNLEADED GASOLINE -- 9130-00-148-7102

===================== Product Identification =====================

Product ID:REGULAR UNLEADED GASOLINE
MSDS Date:10/01/1985
FSC:9130
NIIN:00-148-7102
MSDS Number: BPHGJ
=== Responsible Party ===
Company Name:U S OIL AND REFINING CO
Address:3001 MARSHALL AVE E
City:TACOMA
State:WA
ZIP:98421-3118
Country:US
Emergency Phone Num:253-383-1651
CAGE:6E780
=== Contractor Identification ===
Company Name:TRUE NORTH ENERGY CO
Address:180 E OCEAN BLVD NO 906
Box:City:LONG BEACH
State:CA
ZIP:90802-4760
Country:US
CAGE:0NFP0
Company Name:U S OIL AND REFINING CO
Address:3001 E MARSHALL AVE
Box:2255
City:TACOMA
State:WA
ZIP:98401-2255
Country:US
Phone:253-383-1651/FAX: 253-383-9970
CAGE:6E780

============= Composition/Information on Ingredients =============

Ingred Name:GASOLINE
CAS:8006-61-9
RTECS #:LX3300000
Fraction by Wt: 100%
Other REC Limits:NONE RECOMMENDED
OSHA PEL:300 PPM/500 STEL
ACGIH TLV:300 PPM/500STEL;9293

===================== Hazards Identification =====================

Routes of Entry: Inhalation:YES Skin:YES Ingestion:YES
Health Hazards Acute and Chronic:ACUTE-INHALATION: PROLONGED EXPOSURE MAY CAUSE SYMPTOMS OF CENTRAL NERVOUS SYSTEM DEPRESSION. EYE: EYE IRRITATION MAY RESULT FROM CONTACT WITH LIQUID. SKIN: SKIN IRRITATION. CHRONIC_EXPOSURE TO HIGH L EVELS OF GASOLINE VAPORS MAY CAUSE ASPHYXIATION, SKIN IRRITATION, CENTRAL NERVOUS SYSTEM DEPRESSION, & CHEMICAL PNEUMONI
Explanation of Carcinogenicity:A LAB STUDY DONE BT API HAS SHOWN THAT RATS & MICE DEVELOPED CANCER AFTER CHRONIC INHALATION TO VAPORS OF UNLEADED GAS.
Effects of Overexposure:INHALATION: DIZZINESS, INCOORDINATION, DROWSINESS, COMA AND DEATH. SKIN: DERMATITIS MAY OCCUR UPON PROLONGED CONTACT DUE TO SKIN DEFATTING.INGESTION: NAUSEA, VOMITING, DIARRJEA AND RESTLESSNESS.
Medical Cond Aggravated by Exposure:NONE SPECIFIED BY MANUFACTURER.

====================== First Aid Measures ======================

First Aid:INHALATION-REMOVE FROM ARE TO FRESH AIR. GIVE OXYGEN OR ADMINISTER CPR, IF NEEDED. OBTAIN PROMPT MEDICAL ATTENTION. EYE-FLUSH WITH CLEAN WATER FOR AT LEST 15 MIN. IF IRRITATION PERSISTS, OBTAIN MEDICA L ATTENTION. SKIN-QUICKLY REMOVE SOILEDCLOTHES. WASH AREA WITH SOAP & WATER. IF IRRITATION PERSISTS, OBTAIN MEDICAL ATTENTION. INGESTUION-DO NOT INDUCE VOMITING. MUST OBTAIN MEDICAL ATTENTION.

==================== Fire Fighting Measures ====================

Flash Point Method:TCC
Flash Point:-45F,-43C
Autoignition Temp:Autoignition Temp Text:>600F
Lower Limits:1.3%
Upper Limits:8.2%
Extinguishing Media:DRY CHEMICAL, FOAM, CARBON DIOXIDE, HALON. WATER FOG OR WATER SPRAY ARE OF VALUE FOR COOLING, BUT MAY NOT EXTINGUISH.
Fire Fighting Procedures:DO NOT ENTER ANY ENCLOSED FIRE SPACE WITHOUT PROPER PROTECTIVE EQUIPMENT, INCLUDING SELF-CONTAINED BREATHING APPARATUS. COOL FIRE EXPOSED CONTAINERS WITH WATER.
Unusual Fire/Explosion Hazard:EXTREMELY FLAMMABLE! THIS MATERIAL RELEASES VAPORS AT OR BELOW AMBIENT TEMPERATURE. WHEN MIXED WITH AIR & EXPOSED TO IGNITION SOURCES VAPORS CAN BURN OR EXPLODE

================= Accidental Release Measures =================

Spill Release Procedures:CONTAIN SPILL. REMOVE ALL IGNITION SOURCES & SAFELY STOP FLOW. IN URBAN AREAS, CLEANUP ASAP; IN NATURAL ENVIRONMENT, SEEK ADVICE FROM ECOLOGIST. EVACUATE ALL PERSONNEL. USE PROPER PROTECTIVE EQUIPMENT . ***CONTINUES IN OTHER PRECAUTIONS***

===================== Handling and Storage =====================

Handling and Storage Precautions:KEEP AWAY FROM HEAT, SPARKS & OPEN FLAMES. KEEP CONTAINERS CLOSED! GROUND ALL DRUMS & TRANSFER VESSELS WHEN HANDLING. KEEP OUT OF REACH OF CHILDREN.
Other Precautions:BALNKET WITH FOAM OR USE WATER FOG TO DISPERSE VAPORS. PADS/ABSORBENT MATERIAL CAN BE USED. GASOLINE WILL FLOAT ON WTAER AND RESULTING RUNOFF MAY CREATE AN EXPLOSION OR FIRE HAZARD. NOTIFY NATIONAL RE SPONSE CENTER (800/424-8802).

============ Exposure Controls/Personal Protection ============

Respiratory Protection:AN APPROVED ORGANIC VAPOR RESPIRATOR, SUPPLIED AIR, OR SELF-CONTAINED BREATHING APPARATUS MUST BE USED WHEN VAPOR CONCENTRATIONS EXCEED THE OCCUPATIONAL EXPOSURE LIMITS.
Ventilation:USE ADEQUATE VENTILATION TO KEEP VAPOR CONCENTRATIONS OF THIS MATERIAL BELOW THE OCCUPATIONAL EXPOSURE LIMITS.
Protective Gloves:CLEAN & IMPERVIOUS GLOVES.
Eye Protection:CHEMICAL TYPE GOGGLES &/OR FACE SHIELD
Other Protective Equipment:WEAR CLEAN & IMPERVIOUS PROTECTIVE CLOTHING SUCH AS GLOVES, APRON, BOOTS AND FACIAL PROTECTION SHOULD BE WORN.
Work Hygienic Practices:USE GOOD PERSONAL HYGIENE PRACTICES. IMMEDIATELY REMOVE SOILED CLOTHING & WASH THOROUGHLY BEFORE REUSE. DISCARD SHOES.
Supplemental Safety and Health
NOTE TO PHYSICIAN: TOXIC SIGNS AND SYMPTOMS MAY FOLLOW CONTACT WITH SKIN OVER LARGE AREAS OF THE BODY, INHALATION OF VAPORS OR INGESTION. PRIMARY HAZARD: INHALATION OF VAPORS. INGESTION, OF LIQUID & A SPIRATION INTO THE LUNGS MAY RESULT IN CHEMICAL

PNEUMONIA.

================= Physical/Chemical Properties =================

HCC:F1
Boiling Pt:=21.1C, 70.F
B.P. Text:70 TO 440F
Melt/Freeze Pt:M.P/F.P Text:N/AP
Decomp Temp:Decomp Text:N/AP
Vapor Pres:8-15 PSIA
Vapor Density:N/AP
Spec Gravity:0.72 TO 0.77
pH:N/AP
Viscosity:N/AP
Evaporation Rate & Reference:SLOWER THAN BUTYL ACETATE
Solubility in Water:SLIGHT.
Appearance and Odor:COLORLESS TO STRAW-COLORED LIQUID; PETROLEUM NAPHTHA ODOR.
Percent Volatiles by Volume:APPREC
Corrosion Rate:N/AP

================= Stability and Reactivity Data =================

Stability Indicator/Materials to Avoid:YES
REACTS WITH STRONG ACIDS AND STRONG OXIDIZING MATERIALS.
Stability Condition to Avoid:HEAT, SPARKS, AND OPEN FLAMES.
Hazardous Decomposition Products:BURNING OR EXCESSIVE HEATING MAY PRODUCE CARBON MONOXIDE AND OTHER HARMFUL GASES AND VAPORS.

=================== Disposal Considerations ===================

Waste Disposal Methods:MAXAMIZE PRODUCT RECOVERY FOR REUSE PRIOR TO DISPOSAL. DISPOSE OF PRODUCT, CONTAMINATED MATERIAL, & STORAGE TANK WATER BOTTOMS AS AN EPA "IGNITABLE HAZARDOUS WASTE" (D001), UNLESS PROVEN OTHERWISE. CO MPLY WITH ALL LAWS.

MSDS Number: A2052 * * * * * *Effective Date: 05/14/03* * * * * * *Supercedes: 02/18/03*

MSDS Material Safety Data Sheet

24 Hour Emergency Telephone: 908-859-2151
CHEMTREC: 1-800-424-9300

National Response in Canada
CANUTEC: 613-996-6666

Outside U.S. And Canada
Chemtrec: 703-527-3887

NOTE: CHEMTREC, CANUTEC and National Response Center emergency numbers to be used only in the event of chemical emergencies involving a spill, leak, fire, exposure or accident involving chemicals.

From: Mallinckrodt Baker, Inc.
222 Red School Lane
Phillipsburg, NJ 08865

J.T.Baker®

All non-emergency questions should be directed to Customer Service (1-800-582-2537) for assistance.

ALCONOX®

1. Product Identification

Synonyms: Proprietary blend of sodium linear alkylaryl sulfonate, alcohol sulfate, phosphates, and carbonates.
CAS No.: Not applicable.
Molecular Weight: Not applicable to mixtures.
Chemical Formula: Not applicable to mixtures.
Product Codes: A461

2. Composition/Information on Ingredients

Ingredient	CAS No	Percent	Hazardous
Alconox® proprietary detergent mixture	N/A	90 - 100%	Yes

3. Hazards Identification

Emergency Overview

CAUTION! MAY BE HARMFUL IF SWALLOWED OR INHALED. MAY CAUSE IRRITATION TO EYES AND RESPIRATORY TRACT.

J.T. Baker SAF-T-DATA$^{(tm)}$ Ratings (Provided here for your convenience)

Health Rating: 1 - Slight
Flammability Rating: 0 - None
Reactivity Rating: 1 - Slight
Contact Rating: 2 - Moderate
Lab Protective Equip: GOGGLES; LAB COAT
Storage Color Code: Orange (General Storage)

Potential Health Effects

Inhalation:
May cause irritation to the respiratory tract. Symptoms may include coughing and shortness of breath.
Ingestion:
May cause irritation to the gastrointestinal tract. Symptoms may include nausea, vomiting and diarrhea.
Skin Contact:
No adverse effects expected.
Eye Contact:
May cause irritation, redness and pain.
Chronic Exposure:
No information found.
Aggravation of Pre-existing Conditions:
No information found.

4. First Aid Measures

Inhalation:
Remove to fresh air. Get medical attention for any breathing difficulty.
Ingestion:
If swallowed, DO NOT INDUCE VOMITING. Give large quantities of water. Never give anything by mouth to an unconscious person. Get medical attention.
Skin Contact:
Wash exposed area with soap and water. Get medical advice if irritation develops.
Eye Contact:
Immediately flush eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention immediately.

5. Fire Fighting Measures

Fire:
Not expected to be a fire hazard.
Explosion:

No information found.

Fire Extinguishing Media:

Dry chemical, foam, water or carbon dioxide.

Special Information:

In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode.

6. Accidental Release Measures

Ventilate area of leak or spill. Wear appropriate personal protective equipment as specified in Section 8. Spills: Pick up and place in a suitable container for reclamation or disposal, using a method that does not generate dust. When mixed with water, material foams profusely. Small amounts of residue may be flushed to sewer with plenty of water.

7. Handling and Storage

Keep in a tightly closed container, stored in a cool, dry, ventilated area. Protect against physical damage. Moisture may cause material to cake. Containers of this material may be hazardous when empty since they retain product residues (dust, solids); observe all warnings and precautions listed for the product.

8. Exposure Controls/Personal Protection

Airborne Exposure Limits:

None established.

Ventilation System:

A system of local and/or general exhaust is recommended to keep employee exposures as low as possible. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, *Industrial Ventilation, A Manual of Recommended Practices*, most recent edition, for details.

Personal Respirators (NIOSH Approved):

For conditions of use where exposure to dust or mist is apparent and engineering controls are not feasible, a particulate respirator (NIOSH type N95 or better filters) may be worn. If oil particles (e.g. lubricants, cutting fluids, glycerine, etc.) are present, use a NIOSH type R or P filter. For emergencies or instances where the exposure levels are not known, use a full-face positive-pressure, air-supplied respirator. WARNING: Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.

Skin Protection:

Wear protective gloves and clean body-covering clothing.

Eye Protection:

Use chemical safety goggles. Maintain eye wash fountain and quick-drench facilities in work area.

9. Physical and Chemical Properties

Appearance:
White powder interspersed with cream colored flakes.
Odor:
No information found.
Solubility:
Moderate (1-10%)
Specific Gravity:
No information found.
pH:
No information found.
% Volatiles by volume @ 21C (70F):
0
Boiling Point:
No information found.
Melting Point:
No information found.
Vapor Density (Air=1):
No information found.
Vapor Pressure (mm Hg):
No information found.
Evaporation Rate (BuAc=1):
No information found.

10. Stability and Reactivity

Stability:
Stable under ordinary conditions of use and storage.
Hazardous Decomposition Products:
Carbon dioxide and carbon monoxide may form when heated to decomposition.
Hazardous Polymerization:
Will not occur.
Incompatibilities:
No information found.
Conditions to Avoid:
No information found.

11. Toxicological Information

No LD50/LC50 information found relating to normal routes of occupational exposure.

--------\Cancer Lists\--

Ingredient	---NTP Carcinogen--- Known	Anticipated	IARC Category
Alconox® proprietary detergent mixture	No	No	None

12. Ecological Information

Environmental Fate:
This product is biodegradable.
Environmental Toxicity:
No information found.

13. Disposal Considerations

Whatever cannot be saved for recovery or recycling should be managed in an appropriate and approved waste disposal facility. Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal disposal regulations. Dispose of container and unused contents in accordance with federal, state and local requirements.

14. Transport Information

Not regulated.

15. Regulatory Information

--------\Chemical Inventory Status - Part 1\---------------------------------

Ingredient	TSCA	EC	Japan	Australia
Alconox® proprietary detergent mixture	Yes	No	No	No

--------\Chemical Inventory Status - Part 2\---------------------------------

Ingredient	Korea	--Canada-- DSL	NDSL	Phil.
Alconox® proprietary detergent mixture	No	No	Yes	No

--------\Federal, State & International Regulations - Part 1\----------------

Ingredient	-SARA 302- RQ	TPQ	------SARA 313------ List	Chemical Catg.
Alconox® proprietary detergent mixture	No	No	No	No

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--------\Federal, State & International Regulations - Part 2\----------------
                                                    -RCRA-    -TSCA-
Ingredient                                  CERCLA  261.33    8(d)
------------------------------------------  ------  ------    ------
Alconox®                                    No      No        No
proprietary detergent mixture


Chemical Weapons Convention:  No     TSCA 12(b):  No     CDTA:  No
SARA 311/312:  Acute: Yes     Chronic: No    Fire: No  Pressure: No
Reactivity: No          (Pure / Solid)
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Australian Hazchem Code: None allocated.
Poison Schedule: None allocated.
WHMIS:
This MSDS has been prepared according to the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

16. Other Information

NFPA Ratings: Health: **0** Flammability: **0** Reactivity: **0**
Label Hazard Warning:
CAUTION! MAY BE HARMFUL IF SWALLOWED OR INHALED. MAY CAUSE IRRITATION TO EYES AND RESPIRATORY TRACT.
Label Precautions:
Avoid contact with eyes.
Keep container closed.
Use with adequate ventilation.
Avoid breathing dust.
Wash thoroughly after handling.
Label First Aid:
If swallowed, DO NOT INDUCE VOMITING. Give large quantities of water. Never give anything by mouth to an unconscious person. If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. In case of eye contact, immediately flush eyes with plenty of water for at least 15 minutes. In all cases, get medical attention.
Product Use:
Laboratory Reagent.
Revision Information:
MSDS Section(s) changed since last revision of document include: 8.
Disclaimer:
**:

Mallinckrodt Baker, Inc. provides the information contained herein in good faith but makes no representation as to its comprehensiveness or accuracy. This document is intended only as a guide to the appropriate precautionary handling of the material by a properly trained person using this product. Individuals receiving the information must exercise their independent judgment in determining its appropriateness for a particular purpose. MALLINCKRODT BAKER, INC. MAKES NO REPRESENTATIONS OR

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Prepared by: Environmental Health & Safety
Phone Number: (314) 654-1600 (U.S.A.)

International Chemical Safety Cards

NITRIC ACID

ICSC: 0183

NITRIC ACID
Concentrated Nitric Acid (70%)
HNO_3
Molecular mass: 63.0

CAS # 7697-37-2
RTECS # QU5775000
ICSC # 0183
UN # 2031
EC # 007-004-00-1

TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/ SYMPTOMS	PREVENTION	FIRST AID/ FIRE FIGHTING
FIRE	Not combustible but enhances combustion of other substances. Gives off irritating or toxic fumes (or gases) in a fire.	NO contact with flammable substances. NO contact with combustibles or organic chemicals.	In case of fire in the surroundings: NO FOAM.
EXPLOSION	Risk of fire and explosion on contact with many common organic compounds.		In case of fire: keep drums, etc., cool by spraying with water.
EXPOSURE		AVOID ALL CONTACT!	
• **INHALATION**	Burning sensation. Cough. Laboured breathing. Unconsciousness. Symptoms may be delayed (see Notes).	Ventilation, local exhaust, or breathing protection.	Fresh air, rest. Half-upright position. Artificial respiration if indicated. Refer for medical attention.
• **SKIN**	Corrosive. Serious skin burns. Pain. Yellow discolouration.	Protective clothing.	Remove contaminated clothes. Rinse skin with plenty of water or shower. Refer for medical attention.
• **EYES**	Corrosive. Redness. Pain. Severe deep burns.	Face shield or eye protection in combination with breathing protection.	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor.
• **INGESTION**	Corrosive. Abdominal pain. Burning sensation. Shock.	Do not eat, drink, or smoke during work. Wash hands before eating.	Do NOT induce vomiting. Give plenty of water to drink. Rest. Refer for medical attention.

SPILLAGE DISPOSAL	STORAGE	PACKAGING & LABELLING
Evacuate danger area! Consult an expert! Ventilation. Collect leaking liquid in sealable containers. Cautiously neutralize remainder with sodium carbonate. Then wash away with plenty of water. Do NOT absorb in saw-dust or other combustible absorbents (extra personal protection: complete protective clothing including self-contained breathing apparatus).	Separated from combustible and reducing substances, bases, food and feedstuffs, organic chemicals. Cool. Dry. Keep in a well-ventilated room.	Unbreakable packaging; put breakable packaging into closed unbreakable container. Do not transport with food and feedstuffs. O symbol C symbol R: 8-35 S: (1/2-)23-26-36-45 Note: B UN Hazard Class: 8

SEE IMPORTANT INFORMATION ON BACK

ICSC: 0183

International Chemical Safety Cards

NITRIC ACID

ICSC: 0183

IMPORTANT DATA

PHYSICAL STATE; APPEARANCE:
COLOURLESS TO YELLOW LIQUID , WITH PUNGENT ODOUR.

CHEMICAL DANGERS:
The substance decomposes on warming producing nitrogen oxides. The substance is a strong oxidant and reacts violently with combustible and reducing materials, e.g., turpentine, charcoal, alcohol. The substance is a strong acid, it reacts violently with bases and is corrosive to metals. Reacts very violently with organic chemicals (e.g., acetone, acetic acid, acetic anhydride), causing fire and explosion hazard. Attacks some plastics.

OCCUPATIONAL EXPOSURE LIMITS (OELs):
TLV: 2 ppm; 5.2 mg/m^3 (as STEL: 4 ppm; 10 mg/m^3) (ACGIH 1993-1994).

ROUTES OF EXPOSURE:
The substance can be absorbed into the body by inhalation of its vapour and by ingestion.

INHALATION RISK:
A harmful contamination of the air can be reached very quickly on evaporation of this substance at 20°C.

EFFECTS OF SHORT-TERM EXPOSURE:
The substance is very corrosive to the eyes, the skin and the respiratory tract. Corrosive on ingestion as well. Inhalation of vapour may cause lung oedema (see Notes).

EFFECTS OF LONG-TERM OR REPEATED EXPOSURE:

PHYSICAL PROPERTIES

Boiling point: 121°C
Melting point: -41.6°C
Relative density (water = 1): 1.4
Solubility in water: miscible
Vapour pressure, kPa at 20°C: 6.4
Relative vapour density (air = 1): 2.2
Relative density of the vapour/air-mixture at 20°C (air = 1): 1.07

ENVIRONMENTAL DATA

NOTES

Depending on the degree of exposure, periodic medical examination is indicated. The symptoms of lung oedema often do not become manifest until a few hours have passed and they are aggravated by physical effort. Rest and medical observation are therefore essential. Rinse contaminated clothes (fire hazard) with plenty of water.

Transport Emergency Card: TEC (R)-9B
NFPA Code: H 3; F 0; R 0;

ADDITIONAL INFORMATION

ICSC: 0183 **NITRIC ACID**

IMPORTANT LEGAL NOTICE: Neither the CEC or the IPCS nor any person acting on behalf of the CEC or the IPCS is responsible for the use which might be made of this information. This card contains the collective views of the IPCS Peer Review Committee and may not reflect in all cases all the detailed requirements included in national legislation on the subject. The user should verify compliance of the cards with the relevant legislation in the country of use.

International Chemical Safety Cards

SULFURIC ACID

ICSC: 0362

SULFURIC ACID
Sulfuric acid 100%
Oil of vitriol
H_2SO_4
Molecular mass: 98.1

CAS # 7664-93-9
RTECS # WS5600000
ICSC # 0362
UN # 1830
EC # 016-020-00-8

TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/ SYMPTOMS	PREVENTION	FIRST AID/ FIRE FIGHTING
FIRE	Not combustible. Many reactions may cause fire or explosion. Gives off irritating or toxic fumes (or gases) in a fire.	NO contact with flammable substances. NO contact with combustibles.	NO water. In case of fire in the surroundings: powder, AFFF, foam, carbon dioxide.
EXPLOSION	Risk of fire and explosion on contact with base(s), combustible substances, oxidants, reducing agents or water.		In case of fire: keep drums, etc., cool by spraying with water but NO direct contact with water.
EXPOSURE		PREVENT GENERATION OF MISTS! AVOID ALL CONTACT!	IN ALL CASES CONSULT A DOCTOR!
• INHALATION	Corrosive. Burning sensation. Cough. Laboured breathing.	Ventilation, local exhaust, or breathing protection.	Fresh air, rest. Half-upright position. Artificial respiration if indicated. Refer for medical attention.
• SKIN	Corrosive. Redness. Serious skin burns. Pain.	Protective gloves. Protective clothing.	Remove contaminated clothes. Rinse skin with plenty of water or shower. Refer for medical attention.
• EYES	Corrosive. Redness. Pain. Severe deep burns.	Face shield or eye protection in combination with breathing protection.	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor.
• INGESTION	Corrosive. Abdominal pain. Burning sensation. Collapse.	Do not eat, drink, or smoke during work.	Rinse mouth. Do NOT induce vomiting. Refer for medical attention.

SPILLAGE DISPOSAL	STORAGE	PACKAGING & LABELLING
Collect leaking liquid in sealable containers. Do NOT absorb in saw-dust or other combustible absorbents (extra personal protection: complete protective clothing including self-contained breathing apparatus).	Separated from combustible and reducing substances, strong oxidants, strong bases, other materials, food and feedstuffs (see Notes). May be stored in stainless steel containers (see Notes).	Unbreakable packaging; put breakable packaging into closed unbreakable container. Do not transport with food and feedstuffs. C symbol R: 35 S: 2-26-30 UN Hazard Class: 8 UN Packing Group: II

SEE IMPORTANT INFORMATION ON BACK

ICSC: 0362

Prepared in the context of cooperation between the International Programme on Chemical Safety & the Commission of the European Communities

International Chemical Safety Cards

SULFURIC ACID

ICSC: 0362

IMPORTANT DATA	**PHYSICAL STATE; APPEARANCE:** COLOURLESS, OILY HYGROSCOPIC LIQUID , WITH NO ODOUR. **PHYSICAL DANGERS:** **CHEMICAL DANGERS:** The substance is a strong oxidant and reacts violently with combustible and reducing materials. The substance is a strong acid, it reacts violently with bases and is corrosive to most common metals forming a flammable/explosive gas (hydrogen see ICSC # 0001). Reacts violently with water and organic materials with evolution of heat (see Notes). Upon heating, irritating or toxic fumes (or gases) (sulfur oxides) are formed. **OCCUPATIONAL EXPOSURE LIMITS (OELs):** TLV: ppm; 1 mg/m^3 (as TWA); 3 mg/m^3 (as STEL) (ACGIH 1993-1994). PDK: 1 mg/m^3 (USSR 1988). MAK: ppm; 1 mg/m^3; respirable fraction of aerosol (1991).	**ROUTES OF EXPOSURE:** The substance can be absorbed into the body by inhalation of its aerosol and by ingestion. **INHALATION RISK:** Evaporation at 20°C is negligible; a harmful concentration of airborne particles can, however, be reached quickly on spraying. **EFFECTS OF SHORT-TERM EXPOSURE:** Corrosive. The substance is very corrosive to the eyes the skin and the respiratory tract. Corrosive on ingestion. Inhalation of an aerosol of this substance may cause lung oedema (see Notes). **EFFECTS OF LONG-TERM OR REPEATED EXPOSURE:** Lungs may be affected by repeated or prolonged exposure to an aerosol of this substance. Risk of tooth erosion upon repeated or prolonged exposure to an aerosol of this substance.
PHYSICAL PROPERTIES	Boiling point (decomposes): 340°C Melting point: 10°C Relative density (water = 1): 1.8	Solubility in water: miscible Vapour pressure, kPa at 146°C: 0.13 Relative vapour density (air = 1): 3.4
ENVIRONMENTAL DATA	This substance may be hazardous to the environment; special attention should be given to water organisms.	

NOTES

The symptoms of lung oedema often do not become manifest until a few hours have passed and they are aggravated by physical effort. Rest and medical observation are therefore essential. NEVER pour water into this substance; when dissolving or diluting always add it slowly to the water. Store in an area having corrosion resistant concrete floor.

Transport Emergency Card: TEC (R)-10B
NFPA Code: H 3; F 0; R 2; W

ADDITIONAL INFORMATION

ICSC: 0362 **SULFURIC ACID**

International Chemical Safety Cards

ISOBUTENE

ICSC: 1027

ISOBUTENE
Isobutylene
2-Methylpropene
(cylinder)
$C_4H_8/CH_2=C(CH_3)_2$
Molecular mass: 56.1

CAS # 115-11-7
RTECS # UD0890000
ICSC # 1027
UN # 1055
EC # 601-012-00-4

TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/ SYMPTOMS	PREVENTION	FIRST AID/ FIRE FIGHTING
FIRE	Extremely flammable.	NO open flames, NO sparks, and NO smoking. NO contact with oxidizing materials.	Shut off supply; if not possible and no risk to surroundings, let the fire burn itself out; in other cases extinguish with sand, powder, carbon dioxide.
EXPLOSION	Gas/air mixtures are explosive. Risk of fire and explosion on contact with oxidants, halogens (see Chemical Dangers).	Closed system, ventilation, explosion-proof electrical equipment and lighting. Prevent build-up of electrostatic charges (e.g., by grounding). Use non-sparking handtools.	In case of fire: keep drums, etc., cool by spraying with water. Combat fire from a sheltered position.
EXPOSURE			
• **INHALATION**	Dizziness. Drowsiness. Dullness. Nausea. Unconsciousness. Vomiting.	Closed system and ventilation.	Fresh air, rest. Artificial respiration if indicated. Refer for medical attention.
• **SKIN**	ON CONTACT WITH LIQUID: FROSTBITE.	Cold-insulating gloves.	ON FROSTBITE: rinse with plenty of water, do NOT remove clothes. Refer for medical attention.
• **EYES**	Frostbite.	Face shield or eye protection in combination with breathing protection.	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor.
• **INGESTION**			

SPILLAGE DISPOSAL	STORAGE	PACKAGING & LABELLING
Evacuate danger area! Consult an expert! Ventilation. Remove all sources of ignition. Do NOT wash away into sewer. NEVER direct water jet on liquid (extra personal protection: self-contained breathing apparatus).	Fireproof. Separated from incompatible substances (see Chemical Dangers). Cool.	F symbol F+ symbol R: 12 S: (2-)9-16-33 Note: C UN Hazard Class: 2.1

SEE IMPORTANT INFORMATION ON BACK

ICSC: 1027

Prepared in the context of cooperation between the International Programme on Chemical Safety & the Commission of the European Communities

International Chemical Safety Cards

ISOBUTENE

ICSC: 1027

IMPORTANT DATA

PHYSICAL STATE; APPEARANCE:
COLOURLESS COMPRESSED LIQUEFIED GAS OR COLOURLESS VOLATILE LIQUID , WITH CHARACTERISTIC ODOUR.

PHYSICAL DANGERS:
The gas is heavier than air and may travel along the ground; distant ignition possible, and may accumulate in low ceiling spaces causing deficiency of oxygen. As a result of flow, agitation, etc., electrostatic charges can be generated.

CHEMICAL DANGERS:
The substance can presumably form explosive peroxides. The substance is able to polymerize with fire or explosion hazard. Reacts violently with oxidants, chlorine, fluorine, nitrogen oxides, hydrogen chloride, hydrogen bromide, causing fire and explosion hazard.

OCCUPATIONAL EXPOSURE LIMITS (OELs):
MAK not established.

ROUTES OF EXPOSURE:
The substance can be absorbed into the body by inhalation.

INHALATION RISK:
On loss of containment this liquid evaporates very quickly causing supersaturation of the air with serious risk of suffocation when in confined areas. A harmful contamination of the air can be reached very quickly on evaporation of this substance at 20°C.

EFFECTS OF SHORT-TERM EXPOSURE:
Rapid evaporation of the liquid may cause frostbite. The substance may cause effects on the central nervous system. Exposure may result in death. Medical observation is indicated.

EFFECTS OF LONG-TERM OR REPEATED EXPOSURE:

PHYSICAL PROPERTIES

Boiling point: -6.9°C
Melting point: -140.3°C
Relative density (water = 1): 0.59
Solubility in water: practically insoluble
Vapour pressure, kPa at 20°C: 1976
Relative vapour density (air = 1): 1.94
Flash point: flammable°C
Auto-ignition temperature: 465°C
Explosive limits, vol% in air: 1.8-9.6%

ENVIRONMENTAL DATA

NOTES

Density of the liquid at boiling point: 0.605 kg/l. High concentrations in the air cause a deficiency of oxygen with the risk of unconsciousness or death. Check oxygen content before entering area. Turn leaking cylinder with the leak up to prevent escape of gas in liquid state.

Transport Emergency Card: TEC (R)-502
NFPA Code: H 1; F 4; R 0;

ADDITIONAL INFORMATION

ICSC: 1027 **ISOBUTENE**

MSDS Number: **D0210** * * * * * *Effective Date:* ***05/07/03*** * * * * * *Supercedes:* ***06/04/01***

MSDS MATERIAL SAFETY DATA SHEET

CHEMTREC: 800-424-9300 (USA)
703-527-3887(Outside USA and Canada)
CANUTEC: 613-996-6666

From: Mallinckrodt Baker, Inc
222 Red School Lane
Phillipsburg, NJ 08865

NOTE: Use CHEMTREC and CANUTEC phone numbers only in the event of a chemical emergency.

Emergency Telephone Number: 908-859-2151

All non-emergency questions should be directed to Customer Service (1-800-582-2537) for assistance.

J. T. BAKER

70% Denatured Ethanol

1. Product Identification

Synonyms: Alcohol spray
CAS No.: Not applicable to mixtures.
Molecular Weight: Not applicable to mixtures.
Chemical Formula: Not applicable to mixtures.
Product Codes: P004, P008

2. Composition/Information on Ingredients

Ingredient	CAS No	Percent	Hazardous
Ethyl Alcohol	64-17-5	63.4%	Yes
Methyl Alcohol	67-56-1	3.2%	Yes
Isopropyl Alcohol	67-63-0	3.4%	Yes
Water	7732-18-5	30%	No

3. Hazards Identification

Emergency Overview

POISON! DANGER! MAY BE FATAL IF SWALLOWED. HARMFUL IF INHALED OR ABSORBED THROUGH SKIN. VAPOR HARMFUL. FLAMMABLE! AFFECTS CENTRAL NERVOUS SYSTEM. MAY CAUSE BLINDNESS. CANNOT BE MADE NONPOISONOUS. CAUSES IRRITATION TO SKIN, EYES AND RESPIRATORY TRACT. MAY AFFECT LIVER, BLOOD, REPRODUCTIVE SYSTEM.

J.T. Baker SAF-T-DATA$^{(tm)}$ Ratings (Provided here for your convenience)

Health Rating: 3 - Severe (Poison)
Flammability Rating: 4 - Extreme (Flammable)
Reactivity Rating: 2 - Moderate
Contact Rating: 2 - Moderate
Lab Protective Equip: GOGGLES & SHIELD; LAB COAT & APRON; VENT HOOD; PROPER GLOVES; CLASS B EXTINGUISHER
Storage Color Code: Red (Flammable)

Potential Health Effects

Inhalation:
Exposure may cause irritation to the mucous membranes of the upper respiratory tract. Prolonged exposures to high concentrations may cause drowsiness, loss of appetite and inability to concentrate.
Ingestion:
Cause headaches, gastritis, intoxication, blindness and, in acute cases, death.
Skin Contact:
Causes skin irritation, cracking or flaking due to dehydration and defatting action.
Eye Contact:
Can cause eye irritation. Splashes may cause temporary pain and blurred vision.
Chronic Exposure:
Prolonged skin contact causes drying and cracking of skin. May affect the nervous system. May affect liver, blood, reproductive system. Continued ingestion of small amounts could result in blindness.
Aggravation of Pre-existing Conditions:
Persons with pre-existing skin disorders or eye problems or impaired liver or kidney function may be more susceptible to the effects of the substance.

---

4. First Aid Measures

Inhalation:
Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Call a physician.
Ingestion:
Induce vomiting immediately as directed by medical personnel. Never give anything by

mouth to an unconscious person.
Skin Contact:
Remove any contaminated clothing. Wash skin with soap or mild detergent and water for at least 15 minutes. Get medical attention if irritation develops or persists.
Eye Contact:
Immediately flush eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention immediately.

5. Fire Fighting Measures

Fire:
Flash point: 25C (77F) OC
Flammable limits in air % by volume:
lel: 3.3; uel: 19
Flammable liquid and vapor!
Dangerous fire hazard when exposed to heat or flame.
Explosion:
Above flash point, vapor-air mixtures are explosive within flammable limits noted above. Vapors can flow along surfaces to distant ignition source and flash back.
Fire Extinguishing Media:
Water spray, dry chemical, alcohol foam, or carbon dioxide. Water may be ineffective.
Special Information:
In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode. Water spray can be used to extinguish fires and cool fire-exposed containers. Water may be used to flush spills away from exposures and to dilute spills to non-flammable mixtures.

6. Accidental Release Measures

Ventilate area of leak or spill. Remove all sources of ignition. Wear appropriate personal protective equipment as specified in Section 8. Isolate hazard area. Keep unnecessary and unprotected personnel from entering. Contain and recover liquid when possible. Use non-sparking tools and equipment. Collect liquid in an appropriate container or absorb with an inert material (e. g., vermiculite, dry sand, earth), and place in a chemical waste container. Do not use combustible materials, such as saw dust. Do not flush to sewer! If a leak or spill has not ignited, use water spray to disperse the vapors, to protect personnel attempting to stop leak, and to flush spills away from exposures. US Regulations (CERCLA) require reporting spills and releases to soil, water and air in excess of reportable quantities. The toll free number for the US Coast Guard National Response Center is (800) 424-8802.

J. T. Baker SOLUSORB® solvent adsorbent is recommended for spills of this product.

7. Handling and Storage

Protect against physical damage. Store in a cool, dry well-ventilated location, away from any area where the fire hazard may be acute. Outside or detached storage is preferred. Separate from incompatibles. Containers should be bonded and grounded for transfers to avoid static sparks. Storage and use areas should be No Smoking areas. Use non-sparking type tools and equipment, including explosion proof ventilation. Containers of this material may be hazardous when empty since they retain product residues (vapors, liquid); observe all warnings and precautions listed for the product.

8. Exposure Controls/Personal Protection

Airborne Exposure Limits:
- OSHA Permissible Exposure Limit (PEL):
1000 ppm (TWA) for ethyl alcohol
400 ppm (TWA) for isopropyl alcohol
200 ppm (TWA) for methyl alcohol
- ACGIH Threshold Limit Value (TLV):
1000 ppm (TWA), A4 - not classifiable as a human carcinogen for ethyl alcohol
200 ppm (TWA), 400 ppm (STEL), A4 - not classifiable as a human carcinogen for isopropyl alcohol
200 ppm (TWA), 250 ppm (STEL) skin, for methyl alcohol

Ventilation System:
A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, *Industrial Ventilation, A Manual of Recommended Practices*, most recent edition, for details.

Personal Respirators (NIOSH Approved):
If the exposure limit is exceeded, wear a supplied air, full-facepiece respirator, airlined hood, or full-facepiece self-contained breathing apparatus.

Skin Protection:
Wear impervious protective clothing, including boots, gloves, lab coat, apron or coveralls, as appropriate, to prevent skin contact.

Eye Protection:
Use chemical safety goggles and/or a full face shield where splashing is possible. Maintain eye wash fountain and quick-drench facilities in work area.

9. Physical and Chemical Properties

Appearance:
Clear, colorless liquid.

Odor:
Alcohol odor.

Solubility:

Miscible in water.
Specific Gravity:
0.882 - 0.896
pH:
No information found.
% Volatiles by volume @ 21C (70F):
70
Boiling Point:
78.3C (172F)
Melting Point:
No information found.
Vapor Density (Air=1):
1.59
Vapor Pressure (mm Hg):
No information found.
Evaporation Rate (BuAc=1):
No information found.

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10. Stability and Reactivity

Stability:
Stable under ordinary conditions of use and storage.
Hazardous Decomposition Products:
Carbon dioxide and carbon monoxide may form when heated to decomposition.
Hazardous Polymerization:
Will not occur.
Incompatibilities:
Strong oxidants, silver salts, acid chlorides, alkali metals, metal hydrides, hydrazine, and many other substances.
Conditions to Avoid:
Heat, flames, ignition sources and incompatibles.

---

11. Toxicological Information

Toxicological Data:
Ethyl alcohol: oral rat LD50: 7060 mg/kg; inhalation rat LC50: 20,000 ppm/10H; Irritation data, eye, rabbit: 500 mg/24H moderate; Investigated as a tumorigen, mutagen, reproductive effector. Methyl alcohol: oral rat LD50: 5628 mg/kg; inhalation rat LC50: 64000 ppm/4H; skin rabbit LD50: 15800 mg/kg; Irritation data,skin,rabbit: 20 mg/24H, Moderate; Investigated as a tumorigen, mutagen, reproductive effector. Isopropyl alcohol: oral rat LD50: 5045 mg/kg; skin rabbit LD50: 12.8 gm/kg; inhalation, rat: 16,000 ppm 8 hr. Investigated as a mutagen, tumorigen, reproductive effector.
Reproductive Toxicity:
Ethanol has been linked to birth defects in humans.
Carcinogenicity:
Ethanol has been linked to cancer in humans. Chronic ethanol ingestion is associated with

liver cancer. Most industrial ethanol contains denaturants that render it undesirable to drink.

--------\Cancer Lists\--

	---NTP Carcinogen---		
Ingredient	Known	Anticipated	IARC Category
Ethyl Alcohol (64-17-5)	No	No	None
Methyl Alcohol (67-56-1)	No	No	None
Isopropyl Alcohol (67-63-0)	No	No	3
Water (7732-18-5)	No	No	None

12. Ecological Information

Environmental Fate:
Following data for ethanol: When released into the soil, this material is expected to readily biodegrade. When released into the soil, this material is expected to leach into groundwater. When released into the soil, this material is expected to quickly evaporate. When released into water, this material is expected to readily biodegrade. When released into water, this material may evaporate to a moderate extent. This material is not expected to significantly bioaccumulate. When released into the air, this material is expected to be readily degraded by reaction with photochemically produced hydroxyl radicals. When released into the air, this material is expected to be readily removed from the atmosphere by dry and wet deposition. When released into the air, this material is expected to have a half-life between 1 and 10 days.

Environmental Toxicity:
This material is not expected to be toxic to aquatic life. The LC50/96-hour values for fish are over 100 mg/l.

13. Disposal Considerations

Whatever cannot be saved for recovery or recycling should be handled as hazardous waste and sent to a RCRA approved incinerator or disposed in a RCRA approved waste facility. Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal disposal regulations. Dispose of container and unused contents in accordance with federal, state and local requirements.

14. Transport Information

Domestic (Land, D.O.T.)

Proper Shipping Name: FLAMMABLE LIQUID, N.O.S. (ETHANOL, ISOPROPANOL, METHANOL)
Hazard Class: 3

UN/NA: UN1993
Packing Group: III
Information reported for product/size: 1GL

International (Water, I.M.O.)

Proper Shipping Name: FLAMMABLE LIQUID, N.O.S. (ETHANOL, ISOPROPANOL, METHANOL)
Hazard Class: 3
UN/NA: UN1993
Packing Group: III
Information reported for product/size: 1GL

International (Air, I.C.A.O.)

Proper Shipping Name: FLAMMABLE LIQUID, N.O.S. (ETHANOL, ISOPROPANOL, METHANOL)
Hazard Class: 3
UN/NA: UN1993
Packing Group: III
Information reported for product/size: 1GL

15. Regulatory Information

--------\Chemical Inventory Status - Part 1\---------------------------------

Ingredient	TSCA	EC	Japan	Australia
Ethyl Alcohol (64-17-5)	Yes	Yes	Yes	Yes
Methyl Alcohol (67-56-1)	Yes	Yes	Yes	Yes
Isopropyl Alcohol (67-63-0)	Yes	Yes	Yes	Yes
Water (7732-18-5)	Yes	Yes	Yes	Yes

--------\Chemical Inventory Status - Part 2\---------------------------------

		--Canada--		
Ingredient	Korea	DSL	NDSL	Phil.
Ethyl Alcohol (64-17-5)	Yes	Yes	No	Yes
Methyl Alcohol (67-56-1)	Yes	Yes	No	Yes
Isopropyl Alcohol (67-63-0)	Yes	Yes	No	Yes
Water (7732-18-5)	Yes	Yes	No	Yes

--------\Federal, State & International Regulations - Part 1\----------------

	-SARA 302-		------SARA 313------	
Ingredient	RQ	TPQ	List	Chemical Catg.
Ethyl Alcohol (64-17-5)	No	No	No	No
Methyl Alcohol (67-56-1)	No	No	Yes	No
Isopropyl Alcohol (67-63-0)	No	No	Yes	No
Water (7732-18-5)	No	No	No	No

--------\Federal, State & International Regulations - Part 2\----------------

		-RCRA-	-TSCA-
Ingredient	CERCLA	261.33	8(d)

Ethyl Alcohol (64-17-5)	No	No	No
Methyl Alcohol (67-56-1)	5000	U154	No
Isopropyl Alcohol (67-63-0)	No	No	No
Water (7732-18-5)	No	No	No

Chemical Weapons Convention: No TSCA 12(b): No CDTA: Yes
SARA 311/312: Acute: Yes Chronic: Yes Fire: Yes Pressure: No
Reactivity: No (Mixture / Liquid)

Australian Hazchem Code: 2[S]E
Poison Schedule: S5
WHMIS:
This MSDS has been prepared according to the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

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16. Other Information

NFPA Ratings: Health: 1 Flammability: 3 Reactivity: 1
Label Hazard Warning:
POISON! DANGER! MAY BE FATAL IF SWALLOWED. HARMFUL IF INHALED OR ABSORBED THROUGH SKIN. VAPOR HARMFUL. FLAMMABLE! AFFECTS CENTRAL NERVOUS SYSTEM. MAY CAUSE BLINDNESS. CANNOT BE MADE NONPOISONOUS. CAUSES IRRITATION TO SKIN, EYES AND RESPIRATORY TRACT. MAY AFFECT LIVER, BLOOD, REPRODUCTIVE SYSTEM.
Label Precautions:
Keep away from heat, sparks and flame.
Do not breathe vapor.
Avoid contact with eyes, skin and clothing.
Keep container closed.
Use only with adequate ventilation.
Wash thoroughly after handling.
Label First Aid:
If swallowed, induce vomiting immediately as directed by medical personnel. Never give anything by mouth to an unconscious person. If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes. In all cases call a physician.
Product Use:
Laboratory Reagent.
Revision Information:
MSDS Section(s) changed since last revision of document include: 8.
Disclaimer:
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Prepared by: Environmental Health & Safety
Phone Number: (314) 654-1600 (U.S.A.)

Material Safety Data Sheet

Section 1. Product and Company Identification

Product Name	Buffered Neutral Formalin 10%	**Product Code**	VW3239
Manufacturer	EMD Chemicals Inc. P.O. Box 70 480 Democrat Road Gibbstown, NJ 08027 Prior to January 1, 2003 EMD Chemicals Inc. was EM Industries, Inc. or EM Science, Division of EM Industries, Inc.	**Effective Date** **Print Date**	**3/27/2003** 5/3/2004

For More Information Call

856-423-6300 Technical Service
Monday-Friday: 8:00 AM - 5:00 PM

In Case of Emergency Call

800-424-9300 CHEMTREC (USA)
613-996-6666 CANUTEC (Canada)
24 Hours/Day: 7 Days/Week

Synonym None.

Material Uses Laboratory Reagent

Chemical Family Mixture.

Section 2. Composition and Information on Ingredients

Component	CAS #	% by Weight
FORMALDEHYDE	50-00-0	4
Methanol	67-56-1	<2
Sodium Phosphate, Dibasic, Anhydrous	7558-79-4	<0.7
Sodium Phosphate, Monobasic, Monohydrate	10049-21-5	<0.5
Water	7732-18-5	>92.8

+Section 3. Hazards Identification

Physical State and Appearance Liquid.

Emergency Overview

WARNING !
CANCER HAZARD
CONTAINS MATERIAL WHICH CAN CAUSE CANCER
HARMFUL IF SWALLOWED.
CAUSES RESPIRATORY TRACT, EYE AND SKIN IRRITATION.
MAY BE HARMFUL IF INHALED OR ABSORBED THROUGH SKIN.
WARNING: This product contains a chemical(s) known to the State of California to cause cancer.

Routes of Entry Absorbed through skin. Dermal contact. Eye contact. Inhalation. Ingestion.

Potential Acute Health Effects

Eyes Hazardous in case of eye contact (irritant). Inflammation of the eye is characterized by redness, watering, and itching.

Skin Hazardous in case of skin contact (irritant). Skin inflammation is characterized by itching, scaling, reddening, or, occasionally, blistering. Non-permeator by skin.

Inhalation Hazardous in case of inhalation (lung irritant). Non-hazardous in case of inhalation.

Ingestion Hazardous in case of ingestion.

Continued on Next Page

Potential Chronic Health Effects

Carcinogenic Effects	Classified + (Proven.) by OSHA [FORMALDEHYDE]. Classified A2 (Suspected for human.) by ACGIH, 2A (Probable for human.) by IARC [FORMALDEHYDE].
	Additional information See Toxicological Information (section 11)
Medical Conditions Aggravated by Overexposure:	Repeated exposure to a highly toxic material may produce general deterioration of health by an accumulation in one or many human organs.

Section 4. First Aid Measures

Eye Contact	Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Cold water may be used. Get medical attention immediately.
Skin Contact	In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Cover the irritated skin with an emollient. Cold water may be used. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention immediately.
Inhalation	If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention immediately.
Ingestion	If swallowed, do not induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. Loosen tight clothing such as a collar, tie, belt or waistband. Get medical attention immediately.

+ Section 5. Fire Fighting Measures

Flammability of the Product	Non-flammable.
Auto-ignition Temperature	Not applicable.
Flash Points	Not applicable.
Flammable Limits	Not applicable.
Products of Combustion	Not applicable.
Fire Hazards in Presence of Various Substances	Not applicable.
Explosion Hazards in Presence of Various Substances	**Risks of explosion of the product in presence of static discharge:** Slightly explosive in presence of open flames, sparks and static discharge. **Risks of explosion of the product in presence of mechanical impact:** Slightly explosive in presence of shocks.
Fire Fighting Media and Instructions	Not applicable.
Protective Clothing (Fire)	Not applicable.
Special Remarks on Fire Hazards	Not available.
Special Remarks on Explosion Hazards	Not available.

Continued on Next Page

+Section 6. Accidental Release Measures

Small Spill and Leak	Dilute with water and mop up, or absorb with an inert dry material and place in an appropriate waste disposal container.
Large Spill and Leak	Stop leak if without risk. Do not get water inside container. Do not touch spilled material. Use water spray to reduce vapors. Prevent entry into sewers, basements or confined areas; dike if needed. Call for assistance on disposal. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.
Spill Kit Information	The following EMD Chemicals Inc. SpillSolv (TM) absorbent is recommended for this product: SX1340 Formaldehyde Treatment Kit

Section 7. Handling and Storage

Handling	Avoid prolonged contact with eyes, skin, and clothing. Avoid contact with eyes. Do not ingest. Avoid breathing vapors or spray mists. Avoid prolonged or repeated contact with skin. Use only with adequate ventilation. Wash thoroughly after handling.
Storage	Keep container tightly closed. Keep container in a cool, well-ventilated area.

+Section 8. Exposure Controls/Personal Protection

Engineering Controls	Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective occupational exposure limits.
Personal Protection	
Eyes	Splash goggles.
Body	Lab coat.
Respiratory	Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate.
Hands	Gloves.
Feet	Not applicable.

Protective Clothing (Pictograms)

Personal Protection in Case of a Large Spill	Splash goggles. Full suit. Vapor respirator. Boots. Gloves. A self-contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Product Name	Exposure Limits
FORMALDEHYDE	**EH40-MEL (United Kingdom (UK), 1997).** STEL: 2.5 mg/m^3 15 minute(s). STEL: 2 ppm 15 minute(s). TWA: 2.5 mg/m^3 8 hour(s). TWA: 2 ppm 8 hour(s). **ACGIH (United States, 2000).** CEIL: 0.37 mg/m^3 CEIL: 0.3 ppm **NIOSH REL (United States, 1994).** CEIL: 0.1 ppm 15 minute(s). TWA: 0.01 ppm 10 hour(s). **OSHA Final Rule (United States, 1989).** STEL: 2 ppm 15 minute(s). TWA: 0.75 ppm 8 hour(s). **OSHA Transitional Rule (United States, 1993).** STEL: 2 ppm 15 minute(s). TWA: 0.75 ppm 8 hour(s).

Continued on Next Page

Methanol	**ACGIH (United States, 1994). Skin** TWA: 262 mg/m^3 STEL: 328 mg/m^3 **OSHA (United States, 1989). Skin** TWA: 260 mg/m^3 STEL: 325 mg/m^3 **ACGIH (United States, 1994). Skin** STEL: 328 mg/m^3 15 minute(s). STEL: 250 ppm 15 minute(s). TWA: 262 mg/m^3 8 hour(s). TWA: 200 ppm 8 hour(s). **NIOSH REL (United States, 1994). Skin** STEL: 325 mg/m^3 15 minute(s). STEL: 250 ppm 15 minute(s). TWA: 260 mg/m^3 10 hour(s). TWA: 200 ppm 10 hour(s). **OSHA Final Rule (United States, 1989). Skin** STEL: 325 mg/m^3 15 minute(s). STEL: 250 ppm 15 minute(s). TWA: 260 mg/m^3 8 hour(s). TWA: 200 ppm 8 hour(s).
Sodium Phosphate, Dibasic, Anhydrous	Not available.
Sodium Phosphate, Monobasic, Monohydrate	Not available.
Water	Not available.

Section 9. Physical and Chemical Properties

Odor	Pungent.
Color	Clear. Colorless.
Physical State and Appearance	Liquid.
Molecular Weight	Not applicable.
Molecular Formula	Not applicable.
pH	7 [Neutral.]
Boiling/Condensation Point	The lowest known value is 64.55°C (148.2°F) (METHANOL). Weighted average: 99.08°C (210.3°F)
Melting/Freezing Point	May start to solidify at -0.1°C (31.8°F) based on data for: Water. Weighted average: -5.72°C (21.7°F)
Specific Gravity	Weighted average: 0.96 (Water = 1)
Vapor Pressure	The highest known value is 12.9 kPa (97 mmHg) (@ 20°C) (METHANOL).
Vapor Density	The highest known value is 1.11 (Air = 1) (METHANOL). Weighted average: 1.06 (Air = 1)
Volatility	99.9% (v/v). (METHANOL.)
Odor Threshold	The lowest known value is 0.05 ppm (FORMALDEHYDE) Weighted average: 33.14 ppm
Evaporation Rate	0.36 (Water) compared to (n-BUTYL ACETATE=1)
VOC	6 (%)
LogK$_{ow}$	Not available.
Solubility	Soluble in water.

Continued on Next Page

+Section 10. Stability and Reactivity

Stability and Reactivity	The product is stable.
Conditions of Instability	Not available.
Incompatibility with Various Substances	Highly reactive with oxidizing agents, acids, alkalis. Slightly reactive to reactive with metals.
Rem/Incompatibility	Not available.
Hazardous Decomposition Products	COx , Na2O
Hazardous Polymerization	Will not occur.

Section 11. Toxicological Information

RTECS Number:	Formaldehyde	LP8925000
	Methanol	PC1400000
	Sodium Phosphate, Dibasic, Anhydrous	WC4500000
	Sodium dihydrogen phosphate monohydrate	Not available.
	Water	ZC0110000
Toxicity	Acute oral toxicity (LD_{50}): 42 mg/kg [Mouse]. (FORMALDEHYDE). Acute dermal toxicity (LD_{50}): 15800 mg/kg [Rabbit]. (METHANOL). Acute toxicity of the vapor (LC_{50}): 64000 ppm 4 hour(s) [Rat]. (METHANOL).	
Chronic Effects on Humans	**CARCINOGENIC EFFECTS**: Classified + (Proven.) by OSHA [FORMALDEHYDE]. Classified A2 (Suspected for human.) by ACGIH, 2A (Probable for human.) by IARC [FORMALDEHYDE].	
Acute Effects on Humans	Hazardous in case of eye contact (irritant). Inflammation of the eye is characterized by redness, watering, and itching. Hazardous in case of skin contact (irritant). Skin inflammation is characterized by itching, scaling, reddening, or, occasionally, blistering. Non-permeator by skin. Hazardous in case of inhalation (lung irritant). Non-hazardous in case of inhalation. Hazardous in case of ingestion.	
Synergetic Products (Toxicologically)	Not available.	
Irritancy	Draize Test: Not available.	
Sensitization	Not available.	
Carcinogenic Effects	Classified + (Proven.) by OSHA [FORMALDEHYDE]. Classified A2 (Suspected for human.) by ACGIH, 2A (Probable for human.) by IARC [FORMALDEHYDE].	
Toxicity to Reproductive System	Not available.	
Teratogenic Effects	Not available.	
Mutagenic Effects	Not available.	

Section 12. Ecological Information

Ecotoxicity	Not available.
BOD5 and COD	Not available.
Toxicity of the Products of Biodegradation	The products of degradation are less toxic than the product itself.

Continued on Next Page

Section 13. Disposal Considerations

EPA Waste Number	U122 U154
Treatment	Incineration, fuels blending or recycle. Contact your local permitted waste disposal site (TSD) for permissible treatment sites. ALWAYS CONTACT PERMITTED WASTE DISPOSER (TSD) TO ASSURE COMPLIANCE WITH ALL CURRENT LOCAL, STATE AND FEDERAL REGULATIONS.

Section 14. Transport Information

DOT Classification	Not available.
TDG Classification	Not available.
IMO/IMDG Classification	Not available.
ICAO/IATA Classification	Not available.

Section 15. Regulatory Information

U.S. Federal Regulations

TSCA 8(b) inventory: FORMALDEHYDE ; Methanol; Sodium Phosphate, Dibasic, Anhydrous; Sodium Phosphate, Monobasic, Monohydrate; Water
SARA 302/304/311/312 extremely hazardous substances: FORMALDEHYDE
SARA 302/304 emergency planning and notification: FORMALDEHYDE
SARA 302/304/311/312 hazardous chemicals: FORMALDEHYDE ; METHANOL; Sodium Phosphate, Dibasic, Anhydrous
SARA 311/312 MSDS distribution - chemical inventory - hazard identification: FORMALDEHYDE : Fire Hazard, Immediate (Acute) Health Hazard, Delayed (Chronic) Health Hazard; METHANOL: Fire Hazard, Immediate (Acute) Health Hazard, Delayed (Chronic) Health Hazard; Sodium Phosphate, Dibasic, Anhydrous: Immediate (Acute) Health Hazard
SARA 313 toxic chemical notification and release reporting: FORMALDEHYDE 4%; METHANOL 1.98%
Clean Water Act (CWA) 307: No products were found.
Clean Water Act (CWA) 311: FORMALDEHYDE ; Sodium Phosphate, Dibasic, Anhydrous
Clean air act (CAA) 112 accidental release prevention: FORMALDEHYDE
Clean air act (CAA) 112 regulated flammable substances: No products were found.
Clean air act (CAA) 112 regulated toxic substances: FORMALDEHYDE

WHMIS (Canada)

Class D-2A: Material causing other toxic effects (VERY TOXIC).
Class D-2B: Material causing other toxic effects (TOXIC).

CEPA DSL: FORMALDEHYDE ; METHANOL; Sodium Phosphate, Dibasic, Anhydrous; Water

This product has been classifed in accordance with the hazard criteria of the Controlled Product Regulations and the MSDS contains all required information.

International Regulations

EINECS

FORMALDEHYDE	200-001-8
Methanol	200-659-6
Sodium Phosphate, Dibasic, Anhydrous	231-448-7
Sodium Phosphate, Monobasic, Monohydrate	231-449-2
Water	231-791-2

DSCL (EEC)

R22- Harmful if swallowed.
R36/38- Irritating to eyes and skin.

Continued on Next Page

International Lists Australia (NICNAS): FORMALDEHYDE ; Methanol; Sodium Phosphate, Dibasic, Anhydrous; Sodium Phosphate, Monobasic, Monohydrate; Water

Japan (MITI): FORMALDEHYDE ; Methanol; Sodium Phosphate, Dibasic, Anhydrous; Water

Japan (MOL): FORMALDEHYDE

Korea (TCCL): FORMALDEHYDE ; Methanol; Sodium Phosphate, Dibasic, Anhydrous; Water

Philippines (RA6969): FORMALDEHYDE ; Methanol; Sodium Phosphate, Dibasic, Anhydrous; Water
China: No products were found.

State Regulations Pennsylvania RTK: FORMALDEHYDE : (special hazard, environmental hazard, generic environmental hazard); METHANOL: (environmental hazard, generic environmental hazard); Sodium Phosphate, Dibasic, Anhydrous: (environmental hazard, generic environmental hazard)
Massachusetts RTK: FORMALDEHYDE ; METHANOL; Sodium Phosphate, Dibasic, Anhydrous
New Jersey: Buffered Neutral Formalin 10%

California prop. 65: This product contains the following ingredients for which the State of California has found to cause cancer, birth defects or other reproductive harm, which would require a warning under the statute: FORMALDEHYDE
California prop. 65 (no significant risk level): FORMALDEHYDE
California prop. 65: This product contains the following ingredients for which the State of California has found to cause cancer which would require a warning under the statute: FORMALDEHYDE

Section 16. Other Information

National Fire Protection Association (U.S.A.)

Changed Since Last Revision +

ATTACHMENT D

SEVERE WEATHER FIELD OPERATING PROCEDURE

FLD 02 INCLEMENT WEATHER

Return to top

GENERAL

REFERENCES

Related FLD OPS:

FLD05 – Heat Stress Prevention and Monitoring
FLD06 – Cold Stress
FLD25 – Working at Elevations
FLD26 – Ladders
FLD27 – Scaffolds

PROCEDURE

Hot weather (ambient temperatures over 70°F), cold weather (ambient temperatures below 40°F), rain, snow, ice, and lightning are examples of inclement weather that may be hazardous or add risk to work activities. Heat stress and cold stress are covered under separate operating procedures.

Extremes of heat, cold, and humidity, as well as rain, snow, and ice, can adversely affect monitoring instrument response and reliability, respiratory protection performance, and chemical protective clothing materials.

Heat

Additional examples and protection from heat stress are addressed in WESTON Safety Procedure FLD05. Hot, dry weather increases risk of soil drying, erosion, and dust dispersion, which may present or increase risk of exposure and environmental impact from toxic hazards. Hot weather will increase pressure on closed containers and the rate of volatilization, thereby potentially increasing the risk of exposure to toxic, flammable, or explosive atmospheres.

Rain, Wet Weather, and High Humidity

Rain and wet conditions increase slipping and tripping hazards, braking distances of vehicles, and the potential for slippage or handling difficulties for devices such as augers and drills. Rain fills holes, obscures trip and fall hazards, and increases risk of electrical shock when working with electrical equipment. Changes in soil conditions caused by rain can impact trenching and excavating activities, creating the potential for quicksand formation, wall collapse, and cave-in. Vehicles become stuck in mud, and tools and personnel can slip on wet surfaces.

Rain and wet conditions may decrease visibility (especially for personnel wearing respiratory protection) and limit the effectiveness of certain direct-reading instruments (e.g., photoionization detectors [PIDs]).

Cold, Snow, and Ice

In addition to cold stress, which is covered in WESTON field procedure FLD06, cold weather affects vehicle operation by increasing difficulty in starting and braking. Ice, frost, and snow can accumulate on windows and reduce vision.

Cold, wet weather can cause icing of roadways, driveways, parking areas, general work places, ladders, stairs, and platforms. Ice is not always as obvious to see as snow or rain, and requires special attention, especially when driving or walking.

Snow and ice increase the risk of accidents such as slipping when walking, climbing steps and ladders, or working at elevation, and the risk of accidents when driving vehicles or operating heavy equipment. Heavy snow and ice storms may cause electric lines to sag or break, and the use of electrical equipment in snow increases the risk of electric shock. Snow can hide potholes and mud, which can result in vehicles getting stuck or persons falling when stepping into hidden holes. Snow also may cover water, drums or other containers, sharp metal objects, debris, or other objects that can cause falls or punctures.

Personnel performing activities that require working over ice should be aware of minimal ice thickness safety guidelines as follows:

- 4-inch minimum: activities such as walking or skating.
- 6-inch minimum: activities such as snowmobiling or the use of equipment with the same weight and cross-sectional area as a snowmobile.

Personnel should always be aware that these measurements are under ideal conditions and that snow cover, conditions on rivers, ponds, or lakes with active currents, and other environmental factor impact the safety of working on ice. Clear ice typically is the strongest, while ice that appears cloudy or honeycombed is not as structurally strong. Measurements made by drilling or cutting through the ice should be made every few feet to verify safe conditions. Under no circumstances should WESTON personnel operate motor vehicles such as cars or trucks on ice.

Provisions for rescue (e.g., ladders or long poles and effective communications) must be available at the work site.

Lightning

Lightning represents a hazard of electrical shock that is increased when working in flat open spaces, elevated work places, or near tall structures or equipment such as stacks, radio towers, and drill rigs. Lightning has caused chemical storage tank fires and grass or forest fires. Static charges associated with nearby electrical storms can increase risk of fire or explosion when working around flammable materials, and can adversely affect monitoring instruments.

Recognition and Risk Assessment

Few Occupational Safety and Health Administration (OSHA) regulations apply to the conditions covered in this procedure; however, under specific standards (e.g., Construction Industry, Subpart P, Excavations) and the OSHA General Duty Clause, inclement weather hazards must be addressed in safety programs.

Heat, rain, cold, snow, ice, and lightning are natural phenomena that complicate work activities, and add or increase risk. The potential for physical hazards must be considered for tasks that expose personnel to inclement weather. Risk assessment can be accomplished during the planning stages of a project by developing a task risk analysis for the most likely inclement weather conditions that may be encountered, i.e., rain and lightning in late spring, summer, and early fall, or lightning prone areas; cold, snow, and ice in winter. The SHSC must make decisions on the proper safety procedure and recommend them to the site manager. Each worker must evaluate the risk associated with his or her work and be actively alert to these hazards. Any site worker may stop work if safety procedures are not followed or the risk is too great.

A pre-site activity risk assessment must be completed when inclement weather occurs. Weather conditions that affect instruments and PPE function must be conveyed to site workers. All personnel should monitor function and integrity of PPE and be alert to changing weather conditions. A decision must be made on the proper safety procedures to use if work must continue, or to stop work if the risk is too great. The Appropriate Safety Professional **must be notified of all instances of the need to stop work for safety reasons, including inclement weather**.

Prevention and Protection Programs

Procedures applicable to inclement weather include the following:

Monitoring equipment and PPE must be maintained in proper working order and used according to manufacturers' instructions.

Walkways, stairs, ladders, elevated workplaces, and scaffold platforms must be kept free of mud, ice, and snow.

Vehicles used in rain or cold weather must have windshield wipers and defrosters, and windows must be kept clear of obstruction.

Employees must be protected from airborne contaminants using engineering controls such as wetting dry soil to prevent particle dispersion, and providing local ventilation to reduce volatile air contaminants to safe levels, or if engineering controls are infeasible, using prescribed personal protective equipment (PPE).

Required conformance with traffic laws, including maintaining speed within limits safe for weather conditions, and wearing seat belts at all times.

Using a walking stick or probe to test footing ahead of persons walking where there is standing water, snow, or ice to protect the walker against stepping into potholes or onto puncture hazards, buried containers, or other potential structurally unsound surfaces.

Prior to using vehicles or equipment in off-road work, walking the work area or intended travelway when puddles or snow may obscure potholes, puncture hazards, or buried containers, or other potential structurally unsound surfaces.

Arranging to have winches, come-alongs, or other mechanical assistance available when vehicles are used in areas where there is increased risk of getting stuck. Cable or rope and mechanical equipment used for pulling stuck vehicles must be designed for the purpose, of sufficient capacity for the load, and be inspected regularly and before use to ensure safety. **Manually pushing stuck vehicles is to be avoided**.

Monitoring wind shifts and velocity where change may result in dispersion of airborne contaminants into work area.

Prior to working in areas or beginning projects during times when there is an increased likelihood of lightning or the potential for lightning striking personnel, steps must be taken to predict the occurrence of lightning strikes, including:

a) Checking with client management to determine if there is any pattern or noted conditions that predict lightning or if there are structures that are prone to lightning strikes. Arrange for client notification when there is increased potential for lightning activities. Ensure that clients include WESTON workers in lightning contingency plans.

b) Monitoring weather reports.

c) Noting weather changes and conditions that produce lightning.

d) Stopping work in open areas, around drill rigs or other structures that may attract lightning, on or in water and in elevated work places when lightning strikes are sighted or thunder is heard near a work site.

e) Ensuring all personnel are provided with safe areas of refuge. Keep personnel from standing in open areas, under lone trees, or under drill rigs.

FLD 05 HEAT STRESS PREVENTION AND MONITORING

Return to top

GENERAL

Heat stress may occur at any time work is performed at elevated temperatures. Wearing chemical protective clothing often decreases natural body heat loss and increases the risk of heat stress.

If the body's physiological processes fail to maintain a normal body temperature because of excessive heat, a number of physical reactions can occur, with symptoms ranging from mild (such as fatigue, irritability, anxiety, and decreased concentration or dexterity) to fatal. Because heat stress is one of the most common and potentially serious illnesses at hazardous waste sites, regular monitoring and other preventive measures are vital to ensure worker safety.

Employees who are taking prescription or over-the-counter medications should consult with their personal physician prior to working in high-temperature environments.

REFERENCES

OSHA 29 CFR 1910 and 1926

Related FLD OPS:

FLD02 – Inclement Weather
FLD03 – Hot Processes – Steam
FLD08 – Confined Space Entry
FLD36 – Welding, Cutting and Burning
FLD37 – Pressure Washing

APPENDICES

A Common Heat Stress Disorders and Their Prevention and Treatment

PROCEDURE

Recognition and Risk Assessment

In the planning stages of a project, the potential for heat stress disorders must be considered as a physical hazard in the site-specific Health and Safety Plan (HASP). Risk assessment can be accomplished in the development stages of a project by listing in the HASP the most likely heat stress disorders that may occur.

The SHSC must make decisions on the proper safety procedures and recommend them to the site manager. Each worker must evaluate the risk associated with his or her work and be actively alert to these hazards. Any site worker may stop work if safety procedures are not followed or the risk is too great. In addition, all site personnel must be aware of these symptoms in both themselves and their co-workers.

Four common heat stress disorders and their associated prevention and treatment methods are provided in Appendix A.

Prevention and Protection Programs

Heat stress is affected by several interacting factors including, but not limited to, age, obesity, physical condition, substance abuse, level of personal protective equipment worn, and environmental conditions (temperature, shade, and humidity). Site workers must learn to recognize and treat the various forms of heat stress. The best approach is preventive heat stress management such as the examples given below.

Have workers drink 16 ounces of water before beginning work, at established breaks, and in the morning or after lunch. The body's normal thirst mechanism is not sensitive enough to ensure body fluid replacement, therefore, pre- and post-work fluid intake is necessary. Under heavy work and heat conditions, the body may lose up to 2 gallons of fluids per day. In order to prevent heat stress symptoms, the individual must ensure replacement of this moisture.

Provide disposable cups that hold about 4 ounces, and water that is maintained at 50 to 60°F. Have workers drink 16 ounces of water before beginning work, and a cup or two at each break period. Provide a shaded area for rest breaks. Discourage the intake of caffeinated drinks during working hours. Monitor for signs of heat stress.

Encourage workers to maintain a good diet during these periods. In most cases, a balanced diet and lightly salted foods should help maintain the body's electrolyte balance. Bananas are especially good for maintaining the body's potassium level. The most important measure to prevent heat-related illness is adequate fluid intake. Workers should drink 1/2 to 1 quarts of liquids per hour in high heat conditions. Most of this liquid should be water.

If utilizing commercial electrolyte mixes, double the amount of water called for in the package directions. Indications are that "full-strength" preparations taken under high heat stress conditions may actually decrease the body's electrolytes.

Acclimate workers to site work conditions by slowly increasing workloads, i.e., do not begin work activities with extremely demanding tasks. Rotate shifts of workers who are required to wear impervious clothing in hot weather. In extremely hot weather, conduct field activities in the early morning and evening.

Provide cooling devices to aid natural body heat regulation. These devices, however, add weight and their use should be balanced against worker efficiency. An example of a cooling aid is long cotton underwear, which acts as a wick to absorb moisture and protect the skin from direct contact with heat-absorbing protective clothing.

Ensure that adequate shelter is available to protect personnel against heat and direct sunlight, which can decrease physical efficiency and increase the probability of heat stress. If possible, set up the command post in the shade.

Good hygienic standards must be maintained by frequent showering and changes of clothing. Clothing should be permitted to dry during rest periods. Persons who notice skin problems should immediately consult medical personnel.

Heat Stress Monitoring and Work Cycle Management

When strenuous field activities are part of on-going site work conducted in hot weather, the following guidelines should be used to monitor the body's physiological response to heat, and to manage the work cycle, even if workers are not wearing impervious clothing. These procedures should be instituted when the temperature exceeds 70°F and the tasks/risk analysis indicates an increased risk of heat stress problems. Consult the HASP and a safety professional (e.g., Division safety manager, safety officer) if questions arise as to the need for specific heat stress monitoring. In all cases, the site personnel must be aware of the signs and symptoms of heat stress and provide adequate rest breaks and proper aid as necessary.

<u>Measure Heart Rate</u> – Heart rate should be measured by the radial pulse for 30 seconds as early as possible in the rest period. The heart rate at the beginning of the rest period should not exceed 110 beats per minute. If the heart rate is higher, the next work period should be shortened by 33%, while the length of the rest period stays the same. If the pulse rate still exceeds 110 beats per minute at the beginning of the next rest period, the following work cycle should be further shortened by 33%. The procedure is continued until the rate is maintained below 110 beats per minute.

<u>Measure Body Temperature</u> – When ambient temperatures are over 90°F, body temperatures should be measured with a clinical thermometer as early as possible in the rest period. If the oral temperature exceeds 99.6°F (or 1 degree change from baseline) at the beginning of the rest period, the following work cycle should be shortened by 33%. The procedure is continued until the body temperature is maintained below 99.6°F (or 1 degree change from baseline). Under no circumstances should a worker be allowed to work if their oral temperature exceeds 100.6°F.

<u>Measure Body Water Loss</u> – Body water loss greater than 1.5% of total body weight is indicative of a heat stress condition. Body weight is measured before personal protective equipment (PPE) is donned and after the PPE is removed following a work cycle. Body water loss can be measured with an ordinary bathroom scale, however, the scale must be sensitive to one-half pounds increments. A worker is required to drink additional fluids and rest if their body water loss is greater than 1.5%.

Note: For purposes of this operating practice, a break is defined as a 15-minute period and/or until an individual's vital signs are within prescribed guidelines.

A physiological monitoring schedule is determined by following the steps below:

Measure the air temperature with a standard thermometer.

Estimate the fraction of sunshine by judging what percent the sun is out (refer to Table 1).

Calculate the adjusted temperature based on the following formula:

Adjusted Temperature = Actual Temperature + 13 X
(fraction of the percent sunshine factor)

Using Table 2, determine the physiological monitoring schedule for fit and acclimated workers.

The length of work period is governed by frequency of physiological monitoring (Table 2). The length of the rest period is governed by physiological parameters (heart rate and oral temperature). For example, site personnel anticipate wearing level C (impermeable clothing) during site activities.

The air temperature is 80°F and there are no clouds in the sky (100% sunshine). The adjusted temperature is calculated in the following manner:

Adjusted Temperature (Adj T °F) = Actual Temperature (Amb T °F) + (13 x fraction of the percent sunshine factor).
Adj T °F = 80°F + (13 x 1.0)
Adj T °F = 93°F

Using Table 2, the pulse rate, oral temperature and body water loss monitoring would be conducted after each 60 minutes of work. The adjusted temperature may need to be redetermined if the percent sunshine and ambient temperature changes drastically during site work.

If an individual's heart rate exceeds 110 beats per minute at the beginning of the rest period, that individual will continue to rest until his or her heart rate drops to baseline; the next work period is then decreased by 33%.

TABLE 1

PERCENT SUNSHINE FACTORS
HEAT STRESS PREVENTION AND MONITORING

Percent Sunshine (%)	Cloud Cover	Sunshine fraction
100	No cloud cover	1.0
50	50% cloud cover	0.5
0	Full cloud cover	0.0

TABLE 2

PHYSIOLOGICAL MONITORING SCHEDULE
HEAT STRESS PREVENTION AND MONITORING

Adjusted Temperature	Level D (Permeable clothing)	Level C, B, or A (Nonpermeable clothing)
90^{O}F (32.2^{O}C) or above	After each 45 minutes of work	After each 15 minutes of work
87.5^{O}F (30.8^{O}-32.2^{O}C)	After each 60 minutes of work	After each 30 minutes of work
82.5^{O}-87.5^{O}F (28.1^{O}-32.2^{O}C)	After each 90 minutes of work	After each 60 minutes of work
77.5^{O}-82.5^{O}F (25.3^{O}-28.1^{O}C)	After each 120 minutes of work	After each 90 minutes of work
72.5^{O}-77.5^{O}F (22.5^{O}-25.3^{O}C)	After each 150 minutes of work	After each 120 minutes of work

APPENDIX A

COMMON HEAT STRESS DISORDERS AND THEIR PREVENTION AND TREATMENT

Heat Rash

Heat rash is caused by continuous exposure to heat and humidity, and is aggravated by chafing clothes. The condition decreases an individual's ability to tolerate heat and can be extremely uncomfortable.

Symptoms – Mild red rash, especially in areas of the body that come into contact with protective gear.

Treatment – Decrease amount of time spent working in protective gear and provide body powder to help absorb moisture and decrease chafing.

Heat Cramps

Heat cramps are caused by inadequate electrolyte intake. The individual may be receiving adequate water, however, if not combined with an adequate supply of electrolytes, the blood can thin to the point where it seeps into the active muscle tissue, causing cramping.

Symptoms – Acute painful spasms of voluntary muscles, most notably the abdomen and extremities.

Treatment – Move the victim to a cool area and loosen clothing. Have the victim drink 1 to 2 cups of lightly salted water or diluted commercial electrolyte solution immediately, and then every 20 minutes thereafter until symptoms subside. Electrolyte supplements can enhance recovery (e.g., Gatorade, Quench) however, it is best to double the amount of water required by the dry mix package directions or add water to the liquid form.

Heat Exhaustion

Heat exhaustion is a state of very definite weakness or exhaustion caused by the loss of fluids from the body. The condition is much less dangerous than heat stroke, but it nonetheless must be treated.

Symptoms – Pale, clammy, and moist skin, profuse perspiration, and extreme weakness. Body temperature is normal, pulse is weak and rapid, and breathing is shallow. The person may have a headache, may vomit, and may feel dizzy.

Treatment – Move the victim to a cool, air-conditioned or temperature-controlled area, loosen clothing, place in a position with the head lower than the feet (shock prevention), and allow the victim to rest. Consult a physician, especially in severe cases. Have the victim drink 1 to 2 cups of water immediately, and every 20 minutes thereafter until symptoms subside.

Heat Stroke

Heat stroke is an acute and dangerous reaction to heat stress caused by a failure of the body's heat regulating mechanisms, i.e., the individual's temperature control system (sweating) stops working correctly. Body temperature rises so high that brain damage and death may result if the person is not cooled quickly.

<u>Symptoms</u> – Red, hot, dry skin (although the person may have been sweating earlier); nausea, dizziness, confusion, extremely high body temperature, rapid respiratory and pulse rate, unconsciousness or coma.

<u>Treatment</u> – Remove the victim from the source of heat and cool the victim quickly. If the body temperature is not brought down quickly, permanent brain damage or death may result. Soak the victim in cool (not cold) water, sponge the body with cool water, or pour water on the body to reduce the temperature to a safe level (less than 102°F). Monitor the victim's vital signs and obtain immediate medical help. Do not give the victim coffee, tea, or alcoholic beverages.

FLD 06 COLD STRESS

Return to top

GENERAL

REFERENCES

Related FLD OPS:

FLD02 – Inclement Weather
FLD07 – Wet Feet
FLD15 – Remote Areas
FLD17 – Diving
FLD18 – Using Boats
FLD19 – Working Over Water
FLD25 – Working at Elevations

PROCEDURE

Persons working outdoors in low temperatures (below 40°F), and especially at or below freezing, are subject to cold stress. Exposure to extreme cold for a short time can cause severe injury to the surface of the body, or result in profound generalized cooling which, unchecked, could ultimately cause death. Areas of the body that have high surface-area-to-volume ratios, such as fingers, toes, and ears, are the most susceptible.

Chemical protective clothing generally does not afford protection against cold stress. In many instances, it increases susceptibility. Chemical hazard site workers must learn to dress carefully to provide both chemical protection and thermal insulation while not dressing so warmly that exercise or strenuous activity will result in cold stress.

Body heat is conserved through the constriction of surface blood vessels. This constriction reduces circulation at the skin layers and keeps blood nearer the body core.

Loss of body heat can occur through:

1. Respiration – In extreme cold, cover the mouth and nose with wool or fur to “pre-warm” the air you breath.

2. Evaporation – Wear layered clothing, and remove outer layers prior to overheating to avoid soaking clothing with perspiration. Replace layers prior to becoming chilled. Wear clothing that will “breath” or allow water vapor to escape to reduce the cooling effect of evaporation.

3. Conduction – Sitting on snow, touching cold equipment, and working in the rain are examples of how heat can be lost by conduction. A great deal of body heat is lost rapidly when a person becomes wet. Hypothermia from immersion in water has resulted in death at temperatures of 40°F or lower. Perspiration or rain should never be allowed to saturate clothing; such soaking will seriously reduce the insulative properties of the clothing, in addition to increasing heat loss. Most clothing loses approximately 90 percent of its insulating properties when wet.

4. Radiation – The greatest amount of body heat is lost from uncovered surfaces of the body, especially the head, neck, and hands. Covering these areas is, therefore, extremely important.

5. Convection – The body continually heats a thin layer of air next to the skin. As long as this warm air is retained next to the body, it will remain warm. If this warm air is removed by air currents (wind), the body will be cooled attempting to rewarm the surface air. The primary function of clothing is to retain this warm surface layer of air while allowing water vapor to pass through. Ensure that clothing remains secure around the body, especially at the neck and waist. Wind chill or equivalent chill temperature indices describe the chilling effect of moving air in combination with low temperature.

Two major factors that influence the potential of cold injury are ambient temperature and wind velocity. The term wind chill is used to describe the chilling effect of moving air in combination with low temperature. Additionally, water conducts heat 240 times faster than air; thus, the body cools suddenly when protective equipment is removed if the clothing underneath is perspiration-soaked.

Tables 1 and 2 should be consulted to adjust working schedules for wind chill conditions. These tables are meant as guides only; ambient temperatures and wind conditions should be monitored frequently and work schedules adjusted as required. Workers' physical symptoms or condition will also be an indicator of the need to modify work schedule.

Recognition and Risk Assessment

In the planning stages of a project and safety plan, the potential for cold stress disorders must be considered as physical hazards in the site-specific Health and Safety Plan (HASP). Risk assessment can be accomplished in the development stages of a project by listing in the HASP the most likely cold stress disorders which may occur. The SHSC must make decisions on the proper safety procedures and recommend them to the site manager. Each worker must evaluate the risk associated with his or her work and be actively alert to these hazards. Any site worker may stop work if safety procedures are not followed or the risk is too great. Two common cold stress disorders and treatment methods are identified below.

Frostbite

Local injury resulting from cold is included in the generic term frostbite. By definition, frostbite is the freezing of tissue, however, several stages are recognized, based on the degree of injury.

Frostbite most commonly affects the toes, fingers, and face, and occurs when an extremity loses heat faster than it can be replaced by the circulating blood. Frostbite may also result from direct exposure to extreme cold or high wind, as happens with the nose, ears, and hands. Feet may freeze because of the conduction of heat away from the skin's surface caused by damp socks and shoes.

Frostbite of the extremities can occur in three forms:

- Frost nip or incipient frostbite is characterized by sudden blanching or whitening of skin.
- Superficial frostbite is characterized by skin with a waxy or white appearance that is firm to the touch, but the tissue beneath is resilient.
- Deep frostbite is characterized by tissues that are cold, pale or darkened, and solid.

Treatment for frostbite:

- Move the victim indoors and/or away from additional exposure to cold, wet, and wind.
- Superficially frostbitten areas are best warmed by placing them next to warm skin. The basic tenant to rewarming frostbitten areas is to not raise the temperature much above that of the body. The abdomen and the armpit are body areas that can be used to rewarm frostbitten areas. Water at 99° to 104°F can be used. Avoid the use of fires, hot water, or external heaters to warm frostbitten areas.
- Give a warm drink (water or juices, **not** coffee, tea or alcohol). Do not allow the victim to smoke.
- If using water to rewarm the affected areas, keep the frozen parts in warm water until all paleness has turned to pink or burgundy red, but no longer. Remember, the tissue will be very painful as it thaws.
- After rewarming, elevate the area and protect it from further injury.
- Do not break blisters.
- Use sterile, soft, dry material to cover the injured areas.
- Keep victim warm and obtain medical care as necessary.
- Do **not** rub the frostbitten part (this may cause gangrene).
- Do **not** use ice, snow, gasoline or anything cold on the frostbitten area.
- Do **not** use heat lamps or hot water bottles to rewarm the frostbitten area.
- Do **not** place the frostbitten area near a hot stove.

Hypothermia

Systemic hypothermia occurs when body heat loss exceeds body heat gain and the body core temperature falls below the normal 99°F. While many hypothermia cases are caused by extremely cold temperatures, most cases develop in air temperatures between 30° and 50°F, especially when compounded with water immersion or soaking, and windy conditions.

Remember that the victim of hypothermia may not know, or refuse to admit, that he or she is experiencing hypothermia. All personnel must be observant for these signs for themselves and for other team members. Hypothermia can include one or more of the following symptoms.

- Uncontrollable shivering.
- Vague, slow, slurred speech.
- Irrational actions.
- Memory lapses.
- Incoherence.
- Fumbling hands, frequent stumbling, lurching gait.
- Apathy, listlessness, and sleepiness' inability to get up after resting.
- Unconsciousness, glassy stare, slow pulse and slow respiration.
- Death.

Below the critical body core temperature of 95°F, the body cannot produce enough heat by itself to recover. At this point, emergency measures must be taken to reverse the drop in core temperature. The victim may slip into hypothermia in a matter of minutes and can die in less than 2 hours after the first signs of hypothermia are detected. Treatment and medical assistance are critical.

Treatment for hypothermia:

- Prevent further heat loss by moving the person to a warmer location out of the wind, wet, and cold.

- Remove cold, wet clothing. If necessary, based upon the victim's condition, external sources of heat (e.g., warm blankets, warm water baths, or body contact) may be necessary to rewarm the victim.

- If the victim is conscious, provide warm liquids, candy, or sweetened foods. Carbohydrates are the food most quickly transformed into heat and energy. Do not give alcohol or caffeine.

- Keep the victim awake, monitor ABCs, perform first aid as appropriate, and obtain medical assistance soon as possible.

Prevention and Protection Programs

Site workers must learn to recognize and treat the various forms of cold stress. The best approach is preventive cold stress management, such as the following:

- Wear loose, layered clothing, masks, woolen scarves, and hats in extreme cold weather.

- Keep clothes dry by wearing water and wind resistant clothing and footwear.

- Eat well-balanced meals, ensure adequate intake of liquids and avoid alcoholic beverages. Dehydration increases risk of cold stress.

- Have warm shelter available and implement work-rest schedules.

- Monitor yourself and others for changes in physical and mental condition.

- If wearing a face protector, remove it periodically to check for frostbite.
- Never touch cold metal with bare hands.

The following guidelines should be used when working in air temperatures below 40°F.

- When cold surfaces below –7°C (19.4°F) are within reach, a warning should be given to each worker by the SHSC to prevent inadvertent contact by bare skin.
- If the air temperature is –17.5°C (0°F) or less, the hands should be protected by mittens. Machine controls and tools for use in cold conditions should be designed so that they can be handled without removing the mittens.

Provisions for additional total body protection are required if work is performed in an environment at or below 4°C (39.2°F). Workers should wear cold-protective clothing appropriate for the level of cold and physical activity:

- If the air velocity at the job site is increased by wind, draft, or artificial ventilation, the cooling effect of the wind should be reduced by shielding the work area or by wearing an easily removable windbreak garment.
- If only light work is involved and if the worker's clothing may become wet on the job site, the outer layer of the clothing in use may be of a type impermeable to water. With more severe work under such conditions, the outer layer should be water repellent, and the outerwear should be changed as it becomes wetted. The outer garments should include provisions for easy ventilation to prevent wetting of inner layers by sweat. If work is done at normal temperatures or in a hot environment before entering the cold area, the employee should make sure that clothing is not wet as a consequence of sweating. If clothing is wet, the employee should change into dry clothes before entering the cold. Workers should change socks and any removable felt insoles at regular daily intervals, or use vapor barrier boots. The optimal frequency of change should be determined empirically and will vary individually and according to the type of shoe worn and how much the individual's feet sweat.
- If the available clothing does not give adequate protection to prevent hypothermia or frostbite, work should be modified or suspended until adequate clothing is made available or until weather conditions improve.
- Workers handling evaporative liquid (gasoline, alcohol, or cleaning fluids) at air temperatures below 4°C (39.2°F) should take special precautions to avoid soaking clothing or gloves with the liquid because of the added danger of cold injury due to evaporative cooling.

Work/Warming Regimen

If work is performed continuously in the cold at an equivalent chill temperature (ECT) or below –7°C (19.4°F), heated warming shelters, tents, cabins, and break rooms should be made available nearby. Workers should be encouraged to use these shelters at regular intervals, frequency depending on the severity of the environmental exposure. The onset of heavy shivering, frostnip, the feeling of excessive fatigue, drowsiness, irritability, or euphoria are indications for immediate return to the shelter. When entering the heated shelter, the outer layer of clothing should be removed and the remainder of the clothing loosened to permit sweat evaporation, or the worker should change into dry clothing to avoid returning to work in wet clothing. Dehydration, or the loss of body fluids, occurs insidiously in a cold environment and may increase the susceptibility of workers to cold injury due to a significant change in blood flow to the extremities. Warm sweet drinks and soups should be provided at the work site to provide caloric intake and fluid replacement. The intake of caffeinated drinks should be limited because of the diuretic and circulatory effects.

For work practices at or below –12°C (10.4°F) ECT, the following should apply:

- The worker should be under constant protective observation (buddy system or supervision).
- The work rate should not be so high as to cause heavy sweating that will result in wet clothing. If heavy work must be done, rest periods must be taken in heated shelters and opportunities to change into dry clothing should be provided.
- New employees should not be required to work full-time in the cold during the first days of employment until they become accustomed to the working conditions and the use of required protective clothing.
- The weight and bulkiness of clothing should be included in estimating the required work performance and weights to be lifted by the worker.
- The work should be arranged in such a way that sitting or standing still for long periods is minimized. The worker should be protected from drafts to the greatest extent possible.
- The workers should be instructed in safety and health procedures. The training program should include, as a minimum, instruction in:
    - Proper rewarming procedures and appropriate first aid treatment.
    - Proper use of clothing.
    - Proper eating and drinking habits.
    - Recognition of signs and symptoms of impending hypothermia or excessive cooling of the body, even when shivering does not occur.
    - Safe work practices.

Table 1

Cooling Power of Wind on Exposed Flesh Expressed as Equivalent Temperature*

	Actual Temperature Reading (°F)											
Estimated Wind Speed (mph)	50	40	30	20	10	0	-10	-20	-30	-40	-50	-60
	Equivalent Chill Temperature (°F)											
Calm	50	40	30	20	10	0	-10	-20	-30	-40	-50	-60
5	48	37	27	16	6	-5	-15	-26	-36	-47	-57	-68
10	40	28	16	4	-9	-24	-33	-46	-58	-70	-83	-95
15	36	22	9	-5	-18	-32	-45	-58	-72	-85	-99	-112
20	32	18	4	-10	-25	-39	-53	-67	-82	-96	-110	-121
25	30	16	0	-15	-29	-44	-59	-74	-88	-104	-118	-133
30	28	13	-2	-18	-33	-48	-63	-79	-94	-109	-125	-140
35	27	11	-4	-20	-35	-51	-67	-82	-98	-113	-129	-145
40	26	10	-6	-21	-37	-53	-69	-85	-100	-116	-132	-148
(Wind speeds greater than 40 mph have little additional effect.)	**LITTLE DANGER** In <1 hour with dry skin. Maximum danger of false sense of security.				**INCREASING DANGER** Danger from freezing of exposed flesh within 1 minute.			**GREAT DANGER** Flesh may freeze within 30 seconds.				
	Trenchfoot and immersion foot may occur at any point on this chart.											

* Developed by U.S. Army Research Institute of Environmental Medicine, Natick, MA.

Table 2

Cold Work/Warmup Schedule for 4-Hour Shifts,

EQUIVALENT CHILL TEMPERATURE	MAXIMUM WORK PERIOD	NO. OF BREAKS
≥-24°F	Normal	1
-25° to –30°F	75 minutes	2
-31° to –35°F	55 minutes	3
-36° to –40°F	40 minutes	4
-41° to –45°F	30 minutes	5
≤-46°F	Stop work	Stop work

Revised 11/1999

FLD 07 WET FEET

Return to top

GENERAL

REFERENCES

Related FLD OPS:

FLD05 – Heat Stress Prevention and Monitoring
FLD06 – Cold Stress

PROCEDURE

Under both hot and cold stress conditions, feet that become wet and are allowed to remain wet can lead to serious problems. Trench foot, paddy foot, and immersion foot are terms associated with foot ailments resulting from feet being wet for long periods of time. All have similar symptoms and effects. Initial symptoms include edema (swelling), tingling, itching, and severe pain. These may be followed by more severe symptoms including blistering, death of skin tissue, and ulceration.

Recognition and Risk Assessment

In the planning stages of a project and safety plan, the potential for wet feet must be considered as a physical hazard. Risk assessment can be accomplished in part in the development stages of a project by listing in the Health and Safety Plan (HASP), the most likely task where wet feet may occur. These tasks could include extended work in chemical protective clothing and wading during biological assessments. The SHSC must make decisions on the proper safety procedures and recommend them to the site manager. Each worker must evaluate the risk associated with his or her work and be actively alert to these hazards. Any site worker may stop work if safety procedures are not followed or the risk is too great.

Prevention and Protection Program

Prevention methods are required when work is performed in wet conditions or when conditions result in sweating, causing the feet to become and remain wet. Proper hygiene is critical. Workers must dry their feet and change socks regularly to avoid conditions associated with wet feet. Use of foot talc or powder can additionally assist in prevention of this type of condition.

ATTACHMENT E

RESPIRATORY PROTECTION PLAN
(SEE FSO MANUAL)

1.5 RESPIRATORY PROTECTION PROGRAM

INTRODUCTION

Specific types of respirators and appropriate filtering media or air supplies will be assigned to each task within a project or program. Action levels or standard operating procedures will be established for each task requiring the use of a respirator. The action level or operating practice will establish when respirators are required and under what circumstances changes in respiratory protection may be made. A qualified person (program administrator) will be assigned to each program, project or site and will be responsible for implementing the respiratory protection program, including monitoring or sampling, determining when respiratory protection use is appropriate, what type of respirator is required, and when changes are needed.

This Respiratory Protection Program complies with the Occupational Safety and Health Administration (OSHA) standard 29 CFR 1910.134 (Respiratory Protection).

Policy and Applicability

It is the policy of Roy F. Weston, Inc. (RFW) to provide employees with a safe and healthful working environment. This is accomplished by utilizing facilities and equipment that have all feasible safeguards incorporated into their design. When effective administrative or engineering controls are not feasible, or when they are being initiated, equipment shall be used to ensure personnel protection.

The requirements of this program apply as minimum standards to WESTON employees, contractors, subcontractors, and visitors to WESTON work areas. Non-WESTON personnel who provide their own respiratory protection programs and respiratory protective equipment must ensure that their programs meet or exceed the requirements of this program.

RESPONSIBILITIES

Corporate Health and Safety Department

The Corporate Health and Safety Department (CHS) is responsible for developing and maintaining a written respiratory protection program to protect RFW personnel. The Respiratory Protection Program is designed and organized to ensure respirators are properly selected, used, and maintained by RFW personnel, and to meet federal regulatory standards (29 CFR 1910.134) or industry accepted standards (e.g., ANSI). CHS is responsible for assisting Project Management in interpreting the requirements of the program. In addition, CHS will develop and maintain training courses that meet the program requirements, and provide interpretations of this procedure when necessary. CHS maintains records of the participants in WESTON internal training courses.

Occupational Medical Consultant

Weston's Occupational Medical Consultant (OMC) is charged with establishing medical evaluation and surveillance procedures and reviewing the health status of all personnel who may be required to wear respiratory protective equipment in the completion of their assigned tasks as required by OSHA in 29 CFR 1910.134. The OMC is also responsible for maintaining records of the medical evaluations conducted for this program.

Division Managers, Project Managers, and Supervisors

Division Managers are responsible for implementing the respiratory protection programs as described in this document. Project Managers (and Site Managers who are responsible for project activities when the PM is not present) are responsible for the health and safety of the employees under their direction. This responsibility includes designating a respiratory program administrator, ensuring the availability of appropriate respirators and accessories, providing adequate storage facilities, and requiring that employees on their project sites follow the respiratory protection program procedures. Project Managers must be aware of tasks requiring the use of respiratory protection, and ensure all employees engaged in such work use the appropriate respirators at all times. Project Managers are responsible for maintaining records of the site hazard evaluations and ensuring that a copy of this written program is available at the project site.

Supervisors (Section Managers and Department Managers) will ensure each employee under his or her supervision using a respirator has received appropriate training in its use, a current medical evaluation that certifies the employee to wear a respirator, and a fit-test prior.

Operations Safety Staff

Operations safety staff (e.g., Division Safety Managers, Safety Officers, and Operations Safety/Technical Support staff) are responsible for providing technical assistance to the managers regarding implementation of this procedure. They may train program administrators for project sites, evaluate work activities for which respiratory protection is thought to be necessary, specify respiratory protection devices to be used for specific tasks, and evaluate implementation of the program at work sites.

Respirator Wearers

It is the responsibility of each respirator wearer to use his/her respirator when and where required and in the manner in which they were trained. Respirator wearers must retain records of their fit-tests, training attendance, and medical certifications. They must immediately report any personal characteristics or conditions that may impact their ability to effectively use a respirator and any malfunctions of the respirator to their supervisors, Site Managers, or Project Managers. The respirator wearer must also guard against mechanical damage to the respirator, clean the respirator as indicated in Appendix B-2, and store the respirator in a clean, sanitary location.
Voluntary use of filtering facepiece respirators (NIOSH-approved dust masks) is allowed at an employee's request provided such use does not compromise employee safety. Use of such a filtering facepiece is not covered by this program and does not require compliance with these requirements. Appendix D provides additional information on voluntary use of respirators.

MEDICAL EVALUATION

WESTON's occupational medical consultant (OMC) serves as the Occupational Physician, Occupational Health Provider for this respiratory protection program. Initially, and periodically thereafter, the OMC evaluates the overall health of the individual and the results of special medical tests (pulmonary function studies, EKG, etc.) to determine whether or not the employee can wear the required respirator without physical or psychological risk. The employee is certified to wear respiratory protective equipment if no medical restriction is applied. The employee, the employee's supervisor, the Safety Officer and Corporate Health and Safety are formally notified if certification is not granted.

Specific medical tests and procedures will be determined by the Occupational Health Physician and will be in accordance with OSHA medical surveillance requirements. The medical examination or questionnaire (as required by OSHA 29 CFR 1910.134) must be completed, and medical certification granted, prior to an employee being fit-tested or required to use a respirator in the work place.

SELECTION AND USE OF RESPIRATORY PROTECTIVE DEVICES

Respirator Authorization and Use

Respiratory protection is authorized and issued for the following personnel:

- Workers in areas known to have contaminant levels requiring the use of respiratory protection or in which contaminant levels requiring the use of respiratory protection may be created without warning (e.g., emergency purposes such as hazardous material spill responses).

- Workers performing operations in atmospheres documented to be hazardous and those unavoidably positioned where elevated levels of contaminants are generated.

- Workers performing operations or unavoidable located in atmosphere suspected of being hazardous, but for which adequate sampling data have not been obtained.

The use of respiratory protection is contingent upon the following conditions and criteria being met:

- Proof of training

- Medical clearance

- Fit-Testing

- Respirators must be used in according to the manufacturer's instructions, regulatory requirements, selection criteria and health and safety plan provisions.

- A respirator may not be used if any item of clothing, other personal protective equipment (PPE), hair or facial hair may interfere with the function or fit of the respirator.

- A respirator may not be used unless appropriate air sampling, monitoring or documented basis is performed to ascertain that the respirator is being used within established limits.

- Parts or attachments for one respirator type or brand may not be substituted with another type or brand unless specifically approved by the manufacturers.

- Respirators must be worn at all times in designated areas and may be removed only during prescribed decontamination procedures or in conformance with a predetermined contingency plan.

- Respirator use designated areas must be defined, ideally by signs, barrier markers or solid barriers, but at a minimum by clear delineation in the Health and Safety Plan (HASP).

- Whenever possible, respirators will be assigned to individuals for their exclusive use.

- The buddy system will be used on all WESTON controlled hazardous materials or waste sites except where workers are in non-hazardous situations and contact is maintained via 2-way radios.

- A safety watch system will be used on all projects where respiratory protection is required. The safety watch must be able to monitor site activities by line of sight, tie line or electronic communication from a safe location. Rescue gear must be immediately available, including PPE capabilities equal to that of the entry team. A minimum of one safety watch is required, more may be necessary based upon site conditions and will be specified in the HASP.

- Breathing air cylinders must be properly labeled, stored away from other compressed gasses, secured upright to prevent falling, and protected from damage by vehicles or other physical conditions.

- Air hoses of airline respirators must be monitored by the safety watch or air-line monitor and used in such a manner to protect them from damage. Examples of problematic conditions include airlines that are lying in direct contact with contaminants, snagging on unstable objects, crossing travel ways or work areas where they may be run over, crossing sharp edges or through doorways where they may be cut by sharp edges or a door closing.

- Steps must be taken to minimize contact of respirator parts with contaminants. Where risk of contact is high, additional PPE or procedures such as; face shields aprons, and wrapping of airline hose must be used.

Note that work periods will be established within the HASP and will be based upon criteria such as environmental conditions and respirator effectiveness. Under no conditions, where respiratory protection is required, will maximum work time without a break exceed 120 minutes.

Respirator Selection

Selection of the proper respirator(s) to be used in any work area or operation is made only after a determination as to the real and/or potential exposure of employees to harmful concentrations of contaminants in the workplace atmosphere. This evaluation will be performed prior to the start of any routine or non-routine tasks requiring respirators. The following items will be considered in the selection of respirators and cartridges:

- Effectiveness of the device against the substance of concern;

- Estimated maximum concentration of the substance in the work area;
- General environment (open shop or confined space, etc.);
- Known limitations of the respiratory protective device;
- Comfort, fit, and worker acceptance; and
- Other contaminants in the environment or potential for oxygen deficiency.

Respiratory protective devices must be certified by the National Institute for Occupational Safety and Health (NIOSH) according to 42 CFR Part 84 and will be selected using OSHA 29 CFR 1910.134 and this program. A decision logic flow chart for selecting respirators is available from the Corporate Health and Safety Department or accessible on WESTON's intranet.

Project Managers or Supervisors shall contact the appropriate health and safety staff (Safety Officers or their designees) for Health and Safety Plan (HASP) guidance prior to non-routine work that may expose workers to hazardous substances or oxygen deficient atmospheres.

Examples of work which may require the use of respirators includes, but are not limited to:

- Hazardous waste site activities
- Emergency response activities
- Asbestos sampling, oversight, or abatement activities
- Abrasive blasting activities
- Cutting or melting lead or sampling/stripping lead-based paints from surfaces
- Welding or burning
- Painting, especially with epoxy or organic solvent coatings
- Using solvents, thinners, or degreasers
- Any work which generates large amounts of dust
- Working in a confined space.

A review of the real and/or potential exposures (Hazard Assessment) is made on a program or project basis to determine if respiratory protection is required.

Types of Respirators

<u>Air-Purifying Respirator</u>

These respirators remove air contaminants by filtering, absorbing, adsorbing, or chemical reaction with the contaminants as they pass through the respirator canister or cartridge. This respirator is to be used only where adequate oxygen is available.

Air-Purifying respirators (APRs) may not be selected for use in situations where:

- Known or potential oxygen deficiency (less than 19.5%) conditions exist,

- The identity and/or concentration of the contaminant(s) is unknown or cannot be reasonably determined,

- Level of any contaminant exceeds the immediately dangerous to life or health (IDLH) value, the Assigned Protection Factor or the Maximum Use Concentration,

- A cartridge or canister certified for protection of the contaminant does not exist,

- A filter, cartridge or canister replacement schedule cannot be determined or is prohibitively short,

- The wearer has not been fit-tested or medically certified.

Air-purifying respirators can be classified as follows:

Particulate removing respirators, which filter out particulate radionuclides, dusts, fibers, fumes and mists. These respirators may be single-use disposable respirators or respirators with replaceable filters.

NOTE: Surgical masks do not provide protection against air contaminants. They are never to be used in place of an air-purifying respirator. NIOSH-approved disposable dust/mist respirators may be used when approved in the specific HASP.

- Gas- and vapor-removing respirators, which remove specific individual contaminants or a combination of contaminants by absorption, adsorption or by chemical reaction. Gas masks and chemical-cartridge respirators are examples of gas- and vapor-removing respirators.
- Combination particulate/gas- and vapor-removing respirators, which combine the respirator characteristics of both kinds of air-purifying respirators.

Supplied-Air Respirators (Air-Line)

These respirators provide breathing air independent of the environment. Such respirators are to be used when the contaminant is of such high concentration or toxicity that an air-purifying respirator is inadequate. Supplied- air respirators, also called air-line respirators, are classified as follows:

Demand: This respirator supplies air to the user on demand (inhalation) which creates a negative pressure within the facepiece. Leakage into the facepiece may occur if there is a poor seal between the respirator and the user's face. Demand-type Supplied Air respirators are not approved for RFW use.

Pressure-Demand: This respirator maintains a continuous positive pressure within the facepiece, thus preventing leakage into the facepiece.

Continuous Flow: This respirator maintains a continuous flow of air through the facepiece and prevents leakage into the facepiece.

Self-Contained Breathing Apparatus (SCBA)

This type of respirator allows the user complete independence from a fixed source of air and offers the greatest degree of protection. Training and practice in its use and maintenance are essential.

Identification of Respirator Cartridges and Gas Mask Canisters

Respirator cartridges and canisters are designed to protect against individual or a combination of potentially hazardous atmospheric contaminants, and are specifically labeled and color coded to indicate the type and nature of protection they provide. The NIOSH approval label will also specify the maximum concentration of contaminant(s) for which the cartridge or canister is approved.

Warning Signs of Respirator Failure

Particulate Air-Purifying

When breathing difficulty is encountered with a filter respirator (due to partial clogging with increased resistance), the filter(s) must be replaced. Disposable filter respirators must be discarded.

Gas or Vapor Air-Purifying

If, when using a gas or vapor respirator (chemical cartridge or canister), any of the warning properties (e.g., odor, taste, eye irritation, or respiratory irritation) occur, the respirator wearer must promptly leave the area and check the following:

- Proper face seal
- Damaged or missing respirator parts
- Saturated or inappropriate cartridge or canister

If no discrepancies are observed, the cartridge or canister must be replaced. If any of the warning properties appear again, the concentration of the contaminants may have exceeded the cartridge or canister design specification. When this occurs an airline respirator or SCBA is required.

Service Life of Air-Purifying Respirator Canisters and Cartridges

The canisters or cartridges of air-purifying respirators are intended to be used until filter resistance precludes further use, or the chemical sorbent is expended as signified by display of the End of Service Life Indicator (ESLI), or based upon the change-out criteria documented in the HASP. New canisters, cartridges or filters shall always be provided when a respirator is reissued. Workers must be directed to obtain a replacement canister or cartridge if in doubt about the previous use of the respirator. Workers who may have difficulty determining when the ESLI indicates that a cartridge is expended (e.g., color-blind employees who may be unable to distinguish a color change) will not be permitted to work while wearing a respirator unless an alternate acceptable change-out criterion is established for them.

Supplied Air Respirator/SCBA Cautions

Workers must leave the area immediately if, when using an airline respirator, any problem occurs with the respirator, the compressor failure alarm is activated, an air pressure drop is sensed, or the cylinder low air pressure alarm is activated. Airline couplings must be incompatible with other gas systems to prevent accidental introduction of non-respirable gases. Prior to entry or use SCBA cylinders must be filled to at least 90% of the manufacturer's recommended pressure level.

Breathing Air Criteria

Amendment 1 - (AUGUST 1999)

Any compressed air for air supplying respirators (this includes SCBA cylinders, cascade cylinders, hip-air bottles, etc.) must be certified to meet at least the requirements for Grade D breathing air as described in ANSI/Compressed Gas Association Commodity Specification for Air , G-7.1- 1989, to include:

1. *Oxygen content of 19.5 – 23.5 %;*

2. *Hydrocarbon (condensed) content of 5 milligrams per cubic meter of air or less;*

3. *Carbon monoxide (CO) content of 10 ppm or less;*

4. *Carbon Dioxide content of 1,000 ppm or less;*

5. *Lack of noticeable odor; and*

6. *The moisture content in the cylinder does not exceed a dew point of –50 deg.F (-45.6 deg.C) at 1 atmosphere pressure.*

Certification must be obtained for all individual cylinders or tubes on air trailers. Acceptable certification for Grade D breathing air will be as follows:

1. *Obtain individual cylinder certification from the vendor indicating that* ***each*** *cylinder meets the requirements for Grade D breathing air as indicated above or:*

2. *If only batch cylinder certification can be obtained from the vendor the Site Manager / Supervisor / Health and Safety Coordinator or designated person will be responsible for verifying the oxygen concentration in* ***each*** *breathing air cylinder and documenting the verification prior to use of the breathing air. Verification will be made by extracting a sample of air and testing with Oxygen Meters or appropriate chemical indicator tubes.*

3. *To determine the oxygen content in each cylinder the following field sampling procedure must be used:*

4. *Prior to sampling refer to Weston Field Operating Practice FLD 16 "Pressure Systems – Compressed Gas Systems" and follow all procedures and guidance given therein.*

5. *Insure that all cylinders to be sampled are secured. An Oxygen Meter (calibrated) or chemical indicator tubes (Drager) may be used to measure the sample from the cylinders.*

6. *Since there is a* ***HIGH PRESSURE HAZARD*** *samples should be extracted from the downstream side of a supply pressure regulator or from the downstream side of a throttling valve (such as a SCBA fill valve) into a tedlar or common garbage bag. Samples should not be taken directly from the cylinder valve.*

7. *A minimum of 19.5% oxygen must be present in order to be acceptable.*

Verification results must be documented.

RESPIRATOR TRAINING

Respirator users and supervisors who oversee workers who wear respirators will receive training on the requirements of this Respiratory Protection Program and their responsibilities under it. They will be trained on the proper selection and use, as well as the limitations of the respirator. Training also covers how to ensure a proper fit before use and how to determine when a respirator is no longer providing the protection intended.

CHS or their designees provide training to respirator wearers in the use, maintenance, capabilities, and limitations of respirators prior to assignment of personnel to tasks requiring the use of respirators and annually thereafter. Additional training describing the site-specific procedures and conditions will be arranged by the Site Manager. The training program will include the following topics:

- Nature and degree of respiratory hazard.
- Respirator selection, based on the hazard and respirator capabilities and limitations.
- Donning procedures and fit-tests including hand's-on practice.
- Care of the respirator, e.g., procedures for cleaning, maintenance, storage, and/or replacement.
- Use and limitations of respirator.

RESPIRATOR FIT-TESTING

A fit-test shall be used to determine the ability of each individual respirator wearer to obtain a satisfactory fit with any respirator (both negative and positive pressure). Medical certification in accordance with section 3.0 of this document will be acquired for the individual prior to performing a fit-test for them. Either quantitative or qualitative fit-tests may be performed as required to achieve the desired fit factor and assigned protection factor. Personnel must successfully pass the fit-test before being issued a respirator. Assigned protection factors will be

taken from best available information, using OSHA documents first, and NIOSH or ANSI recommendations when there is no OSHA guideline.

CHS develops and maintains the fit-test procedure. Fit-testing will follow one of the protocols listed in the procedure that is available from the CHS or accessible on WESTON's intranet. Professional staff (e.g., Safety Officers, SHSCs, Site Managers, and Project Managers) may conduct fit-tests in accordance with the WESTON procedure. The program administrator is responsible for ensuring that the fit-test is performed in compliance with the procedure. The test results will be the determining factor in selecting the type, model, and size of negative or positive pressure respirator for use by each individual respirator wearer.

Fit-testing is required prior to the initial use of any negative or positive pressure tight-fitting respirator, whenever a different respirator facepiece (size, style, model or make) is chosen, and at least annually as long as the individual continues to wear a respirator while performing work activities. Additional criteria that would require fit-testing at more frequent intervals include;

- Reports or observance of employee condition which could affect respirator fit (e.g., new dentures, major gain or loss of weight, cosmetic surgery), or

- Notification by the employee that the respirator fit is unacceptable.

Fit Checking

Each time a respirator is donned, the user will perform positive and negative pressure fit checks. These checks are not a substitute for fit-testing. Respirator users must be properly trained in the performance of these checks and understand their limitations. The Respirator Fit-Test procedure that is available from the Corporate Health and Safety Department or accessible on WESTON's intranet provides mandatory guidance.

Qualitative Fit-Testing

Federal regulations (29 CFR 1910.134) require qualitative fit-tests (QLFT) of respirators under certain criteria and describe step-by-step procedures. This test checks the subject's response to a chemical introduced outside the respirator facepiece. This response is either voluntary or involuntary depending on the chemical used. Acceptable methods are described in the Respirator Fit-Test procedure that is available from the Corporate Health and Safety Department or accessible on WESTON's intranet.

QLFT protocols may only be used for fit-testing negative pressure air purifying respirators that must achieve a fit factor of 100 or less. A safety factor of 10 is applied, so the maximum protection for a negative pressure respirator that is qualitatively fit-tested is 10 times the PEL for the contaminant of concern. QLFT protocols may be used for any positive pressure (powered air purifying or atmosphere-supplying) respirators.

Quantitative Fit-Testing

Quantitative fit-testing (QNFT) can be performed on both full-face and half-face negative pressure respirators. Fit factors are determined by comparing the particle concentration outside the respirator with the concentration inside the respirator facepiece. An acceptable fit is achieved when the respirator wearer successfully completes a series of programmed exercises (e.g., normal breathing, deep breathing, moving head up and down, moving head side to side, reading, and normal breathing).

Fit-testing must follow one of the protocols listed in the procedure that is available from the Corporate Health and Safety Department or accessible on WESTON's intranet.

Special Problems

<u>Facial Hair</u>

No attempt will be made to fit a respirator on an employee who has facial hair which comes between the sealing surface of the facepiece and the face, or if facial hair interferes with normal functioning of the exhalation valve of the respirator.

Glasses and Eye/Face Protective Devices

Proper fitting of a respiratory protective device facepiece for individuals wearing corrective eyeglasses or goggles, may not be established if temple bars or straps extend through the sealing edge of the facepiece. If eyeglasses, goggles, face shield or welding helmet must be worn with a respirator, they must be worn so as not to adversely affect the seal of the facepiece. If a full-facepiece respirator is used, special prescription glasses inserts are available if needed. Contact lenses may be worn with full-face respirators provided the wearer has successfully demonstrated that contact lenses can be worn without problem in non-exposure situations (i.e., during fit-testing).

Recordkeeping

Respirator fit-testing shall be documented and shall include the type of respirator, brand name and model, method of test and test results, test date and the name of the instructor/tester. A form for documenting fit-tests is provided in the procedure that is available from the Corporate Health and Safety Department or accessible on WESTON's intranet.

MAINTENANCE AND ISSUANCE OF RESPIRATORS

Maintenance

The maintenance of respiratory protective devices involves a thorough visual inspection (facepiece, head straps, valves, connecting surfaces/tubes, elastic pieces, and cartridges) for cleanliness and defects (i.e., cracked, broken, deteriorated, or defective parts). Worn-out or deteriorated parts will be replaced prior to use. No respirator with a known defect is to be issued for use. No attempt is to be made to replace components, make adjustments or make repairs on any respirator beyond those recommended by the manufacturer.

Under no circumstances will parts be substituted, as such substitutions will invalidate the approval of the respirator. Either the manufacturer or a qualified trained technician will conduct any repair to reducing or admission valves, regulators, or alarms.

Cleaning of Respirators

All respirators in routine use shall be cleaned and sanitized on a periodic basis. Respirators used non-routinely shall be cleaned and sanitized after each use and filters and cartridges replaced. Routinely used respirators are maintained individually by the respirator wearer or as indicated in the HASP.

Cleaning and disinfecting of respirators must be done frequently to ensure that skin-penetrating and dermatitis-causing contaminants are removed from the respirator surface. Respirators maintained for emergency use or those used by more than one person must be cleaned after each use.

Procedures outlined in Appendix B-2 (Mandatory) must be followed for proper respirator cleaning. The priority for selection of cleaning options is the manufacturer's recommendations first, and OSHA procedures second.

The following outlines basic procedures for cleaning, disinfecting and storing respirators:

- Remove and properly dispose of used filters, cartridges, or canisters.

- Wash facepieces and breathing tubes in a cleaner-disinfectant solution. A hand brush (not wire) may be used to remove dirt. Solvents that can affect rubber and other parts shall not be used.
- Rinse completely in clean, warm water.
- Air-dry in a clean area in such a way as to prevent distortion.
- Clean other respirator parts as recommended by the manufacturer.
- Inspect valves, headstraps, and other parts to ensure proper working condition.
- Reassemble respirator and replace any defective parts.
- Place in a clean, dry plastic bag or other suitable container for storage after each cleaning and disinfecting.

Issuance of Respirators

Respiratory protective equipment shall not be ordered, purchased, or issued to personnel unless the respirator wearer is medically certified, has received respirator training and a fit-test.

Storage

After inspection, cleaning, and any necessary minor repairs, store respirators to protect against sunlight, heat, extreme cold, excessive moisture, damaging chemicals or other contaminants. Respirators placed at stations and work areas for emergency use shall be stored in compartments, cases or brackets built for that purpose, shall be quickly accessible at all times and will be clearly marked. Routinely used respirators, such as half-mask or full-face air-purifying respirators, shall be placed in sealable plastic bags.

Respirators may be stored in such places as lockers or toolboxes only if they are first placed in carrying cases or cartons that are substantial enough to protect the respirator from damage. Respirators shall be packed or stored so that the facepiece and exhalation valves will rest in a normal position and not be crushed. Emergency use respirators shall be stored such that they are quickly accessible and clearly marked. Cartridges or canisters are to be sealed until needed for use.

PROGRAM SURVEILLANCE

An appraisal or evaluation of the effectiveness of the Respiratory Protection Program shall be carried out when required due to changes in regulations, work place conditions, or recommendations from program administrators. The Corporate Health and Safety Department will initiate evaluations when regulations change. Site Managers and program administrators are responsible for initiating and conducting evaluations due to work place conditions or perceived problems with the implementation of this program. Appropriate actions shall be taken to correct defects found in the program. The evaluation of the Respiratory Protection Program will include determining if proper respirator fit is achieved, appropriate respirators and cartridges are being selected and used, and respirators are being properly used and maintained.

Evidence of excessive exposure of respirator wearers to respiratory hazards will be followed up by investigation to determine why inadequate respiratory protection was provided. The findings of the investigation will be documented, and this documentation will list corrective actions and set target dates for the implementation of the plans. The Corporate Health and Safety Department is responsible for evaluating and revising the written program if corrective actions involve these procedures.

RECORDKEEPING

The following list indicates which records shall be developed and maintained, and who is responsible for maintaining them:

- Medical evaluations: RFW Occupational Medical Provider and employee.
- WESTON Training Course attendance lists: Corporate Health and Safety Department.
- Training certificates: Safety Officer and employee.
- Written Respiratory Protection Program: Corporate Health and Safety Department (copies are kept on project sites by the Site Manager or Project Manager.
- Hazard Evaluations in Health and Safety Plans: Project Manager.
- Fit-Test Records: Safety Officer and employee.

Appendix B-2 - Respirator Cleaning Procedures (Mandatory)

These procedures are provided for employer use when cleaning respirators. They are general in nature, and the employer as an alternative may use the cleaning recommendations provided by the manufacturer of the respirators used by their employees, provided such procedures are as effective as those listed here in Appendix B-2. Equivalent effectiveness simply means that the procedures used must accomplish the objectives set forth in Appendix B-2, i.e., must ensure that the respirator is properly cleaned and disinfected in a manner that prevents damage to the respirator and does not cause harm to the user.

Procedures for Cleaning Respirators

1. Remove filters, cartridges, or canisters. Disassemble facepieces by removing speaking diaphragms, demand and pressure-demand valve assemblies, hoses, or any components recommended by the manufacturer. Discard or repair any defective parts.
2. Wash components in warm (43 deg. C [110 deg. F] maximum) water with a mild detergent or with a cleaner recommended by the manufacturer. A stiff bristle (not wire) brush may be used to facilitate the removal of dirt.
3. Rinse components thoroughly in clean, warm (43 deg. C [110 deg. F] maximum), preferably running water. Drain.
4. When the cleaner used does not contain a disinfecting agent, respirator components should be immersed for two minutes in one of the following:

   a. Hypochlorite solution (50 ppm of chlorine) made by adding approximately one milliliter of laundry bleach to one liter of water at 43 deg. C (110 deg. F); or,
   b. Aqueous solution of iodine (50 ppm iodine) made by adding approximately 0.8 milliliters of tincture of iodine (6-8 grams ammonium and/or potassium iodide/100 cc of 45% alcohol) to one liter of water at 43 deg. C (110 deg. F); or,
   c. Other commercially available cleansers of equivalent disinfectant quality when used as directed, if their use is recommended or approved by the respirator manufacturer.

5. Rinse components thoroughly in clean, warm (43 deg. C [110 deg. F] maximum), preferably running water. Drain. The importance of thorough rinsing cannot be overemphasized. Detergents or disinfectants that dry on facepieces may result in dermatitis. In addition, some disinfectants may cause deterioration of rubber or corrosion of metal parts if not completely removed.

6. Components should be hand-dried with a clean lint-free cloth or air-dried.

7. Reassemble facepiece, replacing filters, cartridges, and canisters where necessary.

8. Test the respirator to ensure that all components work properly.

Appendix D - Information for Employees Using Respirators When Not Required Under the Standard (Non-Mandatory)

Respirators are an effective method of protection against designated hazards when properly selected and worn. Respirator use is encouraged, even when exposures are below the exposure limit, to provide an additional level of comfort and protection for workers. However, if a respirator is used improperly or not kept clean, the respirator itself can become a hazard to the worker. Sometimes, workers may wear respirators to avoid exposures to hazards, even if the amount of hazardous substance does not exceed the limits set by OSHA standards. If your employer provides respirators for your voluntary use, of if you provide your own respirator, you need to take certain precautions to be sure that the respirator itself does not present a hazard.

You should do the following:

1. Read and heed all instructions provided by the manufacturer on use, maintenance, cleaning and care, and warnings regarding the respirators limitations.

2. Choose respirators certified for use to protect against the contaminant of concern. NIOSH, the National Institute for Occupational Safety and Health of the U.S. Department of Health and Human Services, certifies respirators. A label or statement of certification should appear on the respirator or respirator packaging. It will tell you what the respirator is designed for and how much it will protect you.

3. Do not wear your respirator into atmospheres containing contaminants for which your respirator is not designed to protect against. For example, a respirator designed to filter dust particles will not protect you against gases, vapors, or very small solid particles of fumes or smoke.

4. Keep track of your respirator so that you do not mistakenly use someone else's respirator.

WESTON FIT TEST RECORD

NAME (print)________________________ **DATE**______________

EMPLOYEE NO.__________ **YOUR WORK LOCATION**____________

NAME of TEST ADMINISTRATOR (print)____________________________

(Circle all responses)

	Qualitative Fit Test Protocol Administered	
	Irritant Smoke	**Bitrex**
Negative Pressure Mask(s)		
Type of Mask:__________		
Manufacturer:__________	**Pass/Fail**	**Pass/Fail**
Model: __________		
Size: __________		
Positive Pressure Mask(s)		
Type of Mask: __________		
Manufacturer: __________	**Pass/Fail**	**Pass/Fail**
Model: __________		
Size: __________		

Comments:

Clean Shaven? **YES / NO** **Spectacle kit required?** **YES / NO**

I hereby certify that the above-named individual has been qualitatively fit tested, that all WESTON fit test procedures have been completed and that the above information reflects the results of the test.

Test Administrator Signature: ______________________________

The fit test documented by this form is intended for use in conjunction with a fully implemented respiratory protection program as required by 29 CFR 1910.134. This fit test in no way certifies that the individual being fit tested will use the respirator as it is designed or according to manufacturer's directions. Proper use of respiratory protection is the responsibility of the individual and the individual's employer. The fit test has been conducted by an individual who has received instruction in fit testing and is authorized to perform the test. Should the individual being fit tested have a significant weight gain or loss, have facial or dental surgery, suffer injury that changes facial structure, or be assigned another brand and model of respirator, the designated respirator may not fit properly, the fit test is invalidated, and the person should be fit tested again before further respirator use. This fit test applies only to the respirator(s) size, model, and manufacturer indicated on the form.

RISKS AND LIABILITY

Any individual engaged in activities requiring the use of a respirator faces the risk of health impairment. Fit testing cannot completely eliminate risk and injuries that may occur despite successful completion of the fit test. Fit testing simply determines that at the time of the test, the particular respirator fit properly. This fit test has been administered in accordance with OSHA 29 CFR 1910.134 regulations. Roy F. Weston, Inc. does not make any warranties, either expressed or implied, concerning the proper use or function of respiratory protection used by the individual subsequent to this fit test. In no event shall Roy F. Weston, Inc. be liable for any loss of special, incidental, consequential, or other damages caused by subsequent use of respiratory protection.

Test Subject Signature: ______________________________

Revised 01/2000

ATTACHMENT F

PERSONAL PROTECTIVE EQUIPMENT PROGRAM
(SEE FSO MANUAL)

1.4 PERSONAL PROTECTIVE EQUIPMENT PROGRAM

INTRODUCTION

The objective of the Personal Protective Equipment (PPE) Program is to protect employees from the risk of injury by creating a barrier against workplace hazards. Personal protective equipment is not a substitute for good engineering or administrative controls or good work practices, but should be used in conjunction with these controls to ensure the safety and health of employees. Personal protective equipment will be provided, used, and maintained when it has been determined that its use is required and that such use will lessen the likelihood of occupational injury and/or illness.

The use of PPE can itself, create significant worker hazards, such as heat stress, physical and psychological stress, impaired vision, reduced mobility, and distorted communication. In general, the higher the level of PPE protection, the greater these risks. For any given situation, PPE must be selected to provide the appropriate level of protection without creating unnecessary risk to the wearer.

PPE selection shall be based on an evaluation of the performance characteristics of the PPE relative to the characteristics of the site, task-specific conditions, duration of exposure to those conditions and other safety hazards to which the employee is, or may be exposed. PPE requirements are to be discussed with each worker prior to the start of work. Employees will be trained in the proper use, maintenance, and care and cleaning of PPE. Defective and/or damaged PPE shall not be used.

This program addresses eye, face, head, foot, and hearing and hand protection. Separate programs address respiratory protection. Facility or Site Safety Plans will reference this program and will specify the PPE to be used in the performance of tasks outlined.

RESPONSIBILITIES

Supervisors and/or Project Management

Supervisors and Project Managers have the primary responsibility for implementation of the PPE Program in their work area. This involves:

- Providing appropriate PPE and making it available to employees.
- Ensuring employees are trained on the proper use, care, and cleaning of PPE.
- Supervising staff to ensure that the PPE Program elements are followed and that employees properly use and care for PPE.
- Seeking assistance from Corporate Health and Safety (CHS) or designees to evaluate hazards.
- Notifying CHS or designees when new hazards are introduced or when processes are added or changed.
- Ensuring defective or damaged equipment is immediately replaced.

Employees

The PPE user is responsible for following the requirements of the PPE Program. This involves:

- Wearing PPE as required.
- Attending required training sessions.
- Caring for, cleaning, and maintaining PPE as required.
- Informing the supervisor of the need to repair or replace PPE.

Operations Safety Professionals

Safety professionals in the operations groups include the Division Safety Managers, Safety Officers, employees in the Operations Safety/Technical Support Group, or Site Health and Safety Coordinators. They are responsible for the technical implementation, and administration of the PPE Program. This involves:

- Assisting in or conducting workplace hazard assessments to determine the presence of hazards that necessitate the use of PPE.

- Conducting periodic workplace reassessments as requested by supervisors and/or as deemed necessary.

- Maintaining records of hazard assessments.

- Providing guidance to the Supervisor or Project Manager for the selection and purchase of approved PPE.

- Periodically reevaluating the suitability of previously selected PPE.

Corporate Health and Safety

Corporate Health and Safety (CHS) and its designees are responsible for the development and communication of the PPE Program. This involves:

- Providing training and technical assistance to supervisors concerning the proper use, care, and cleaning of approved PPE.

- Providing technical guidance as necessary for the selection and purchase of approved PPE.

- Reviewing, updating, and evaluating the overall effectiveness of the PPE Program.

PROGRAM COMPONENTS

Hazard Assessment and Equipment Selection

OSHA requires employers to conduct inspections of all workplaces to determine the need for personal protective equipment (PPE) and to select the proper PPE for each task performed. For each work site, a certification must be completed which lists the findings of the inspection and the specific protective equipment needed.

Project Managers or their designated Site Supervisors are responsible for ensuring that a survey is conducted for each work area to identify sources of hazards, including impact, penetration, compression, chemical, heat, dust, electrical sources, material handling, and light radiation. Surveys will typically be documented in the appropriate section of the project Health and Safety Plan, or by using the **Hazard Assessment Certification Form** (Appendix D-1) which identifies the workplace surveyed, the person conducting the survey, findings of potential hazards, and date of the survey.

Selection of the most appropriate level of protection will depend upon:

- Hazards, known or potential.
- Properties such as toxicity, radioactivity, route of exposure and matrix (i.e., air, soil, water) in which the contaminants are known or suspected.
- Type and measured concentrations of contaminants.
- Potential for exposure based upon task.
    - Physical hazards.
    - Biological hazards.
    - Chemical hazards.
    - Radiological hazards.

Once the hazards of a workplace have been identified, the Supervisor or Project Manager (in consultation with the appropriate safety professionals) will re-evaluate the suitability of the PPE that was initially selected. New or additional protective equipment will be selected as conditions change to ensure a level of protection that will protect the employees from the hazards. Care will be taken to recognize the possibility of multiple and simultaneous exposure to a variety of hazards.

Note: Working in Protective Clothing can increase the potential for heat or cold-induced illness. Refer to WESTON Field Operating Procedures for Heat Stress (FLD05) and/or Cold Stress (FLD06)

Protective Devices

All personal protective clothing and equipment will be of safe design and construction for the work to be performed and shall be maintained in a sanitary and reliable condition. Only those items of protective clothing and equipment that meet National Institute for Occupational Safety and Health (NIOSH) or American National Standards Institute (ANSI) standards will be procured or accepted for use. Newly purchased PPE must conform to the following ANSI standards (or those that supercede them) that have been incorporated into the OSHA PPE regulations:

- Eye and Face Protection: ANSI Z87.1-1989
- Head Protection: ANSI Z89.1-1986
- Foot Protection: ANSI Z41.1-1991
- Hand Protection: There are no ANSI standards for gloves at this time; however, selection must be based on the performance characteristics of the glove in relation to the tasks to be performed.

Careful consideration will be given to comfort and fit of PPE in order to ensure that it will be used. Protective devices are generally available in a variety of sizes. Care should be taken to ensure that the right size is selected.

Guidelines for the purchase of personally assigned PPE (e.g., safety boots, prescription safety glasses) can be found in Appendix B. Employees needing this PPE should notify their supervisor for approval. Concerns or conflicts regarding the purchase and reimbursement of individual PPE should be brought to the attention of CHS.

Assistance in selecting PPE can be found through various sources, including: Vendor glove or clothing selection guides, safety officer and previous safety plan data. Additional information can be found on the NIOSH Home Page as Recommendations for Chemical Protective Clothing, under http://cdc.gov/niosh/ncpc.1.html.

Eye and Face Protection

Prevention of eye injuries requires that all persons who may be in eye hazard areas wear protective eyewear. This includes employees, visitors, contractors, or others passing through an identified eye hazard area. To provide protection for these personnel, Site Management or Supervisors of such areas shall procure a sufficient quantity of goggles and/or plastic eye protectors that afford the maximum amount of protection possible. If these personnel wear prescription glasses, they shall be provided with a suitable eye protector to wear over them.

Suitable protectors shall be used when employees are exposed to hazards from flying particles, molten metal, acids or caustic liquids, chemical liquids, gases, or vapors, bioaerosols, or potentially injurious light radiation. Side protectors shall be used with standard safety glasses when there is a hazard from flying objects.

Face shields shall be used when there is a hazard from chemical splash to protect both the eyes and the face. Face shields shall only be worn over primary eye protection (e.g., safety glasses or goggles). Protectors shall be distinctly marked to identify the manufacturer.

Equipment fitted with appropriate filter lenses shall be used to protect against light radiation (e.g., welding or cutting operations) See 29 CFR 1910.133(a)(5) for filter lens information. Tinted and shaded lenses are not filter lenses unless they are marked or identified as such.

Prescription Safety Eyewear

For employees who wear prescription lenses, eye protectors shall either incorporate the prescription in the design or fit properly over the prescription lenses (goggles, faceshields, etc.). The proper position of the prescription lenses or the protective lenses must not be disturbed by the protective device. Personnel requiring prescription safety glasses must contact their Supervisor to have their request for prescription safety glasses processed.

Emergency Eyewash Facilities

Emergency eyewash facilities meeting the requirements of ANSI Z358.1 will be provided in all areas where the eyes of any employee may be exposed to corrosive materials. All such emergency facilities will be located where they are easily accessible in an emergency.

Head Protection

Head protection will be furnished to, and used by, all employees and contractors engaged in construction and other miscellaneous work (as defined by the Health and Safety Plan). Head protection is also required to be worn by inspectors and visitors at construction sites when hazards from falling or fixed objects, or electrical shock are present. Bump caps/skull guards will not be worn as substitutes for safety caps or hats because they do not afford protection from high impact forces or penetration by falling objects.

Foot Protection

Safety shoes shall be worn on all field operations, construction sites, hazardous waste or emergency response operations, in warehouses, maintenance, and other areas as determined by documented procedures (Workplace Hazard Assessment) and the HASP. All safety footwear shall comply with ANSI Z41-1991, American National Standard for Personal Protection Protective Footwear.

Safety shoes or boots with impact protection are required to be worn in work areas where carrying or handling materials such as packages, objects, parts or heavy tools, which could be dropped; and for other activities where objects might fall onto the feet. Safety shoes or boots with compression protection are required for work activities involving skid trucks (manual materials handling cars) or other activities in which materials or equipment could potentially roll over an employees feet. Safety shoes or boots with puncture protection must be evaluated where sharp objects such as nails, wire, tacks, screws, large staples, scrap metal etc., could be stepped on by employees causing a foot injury.

Hand Protection

Suitable gloves shall be worn when hazards from chemicals, cuts, lacerations, abrasions, punctures, burns, biological agents, and harmful temperature extremes are present. Glove selection shall be based on performance characteristics of the gloves, conditions, duration of use, and hazards present. One type of glove may not work in all situations.

The first consideration in the selection of gloves for use against chemicals is to determine the nature of the substances to be encountered. Employees will read instructions and warnings on chemical container labels, materials safety data sheets (MSDSs), and HASPs before working with any chemical.

Recommended glove types may be listed on the MSDS in the section for personal protective equipment.

Chemicals may eventually permeate glove materials. However, gloves can be worn safely for limited time periods if specific use (e.g., limited contact with contaminants) and other characteristics (e.g., thickness and permeation rate and time) are known. Safety professionals can assist in determining the specific type of glove material that should be worn for a particular chemical.

Hearing Protection

Personnel shall be provided protection against the effects of hazardous noise exposures whenever sound-pressure levels exceed 85 dB(A) steady-state expressed as a Time-Weighted Average (TWA) or 140 dB(A) impulse.

Feasible engineering or administrative controls will be used whenever sound-pressure levels exceed those levels documented in 29 CFR 1910.95, Table G-16. Where engineering controls are not feasible, suitable PPE (earmuffs or plugs) is to be provided. See FLD 01 (Noise) for additional information.

Personal Flotation Devices (PFDs)

Selection and use of PFDs can be found in WESTON Field Operating Practice FLD18 and FLD19.

Personal Fall Arrest Systems (PFASs)

Selection and use of PFASs can be found in WESTON Field Operating Practice FLD25.

Hazardous Waste Operations And Emergency Response

PPE selection for operations conducted at hazardous waste sites or hazardous substance/material spills will follow criteria established by EPA as Levels of Protection (LOP). These specific levels and the necessary components for each level have been divided into four categories according to the degree of protection afforded. These LOPs and general guidelines for use are:

- Level A: Worn when the highest level of respiratory, skin, and eye protection is needed.
- Level B: Worn when the highest level of respiratory protection is needed, however contaminants do not create undue risk for skin exposure.
- Level C: Worn when the criteria for using air-purifying respirators are met. Skin protection is essentially as for Level B.
- Level D: Refers to a general work uniform. No exposure to airborne or contact contaminants requiring the use of respiratory or advanced skin protection.

Refer to Appendix D for additional information relative to EPA Levels of Protection.

Other Requirements

Employees shall wear clothing suitable for the weather and work conditions encountered. The minimum for fieldwork will be short-sleeved shirts, long pants and leather or other protective work shoes or boots.

Permission to use PPE other than that identified above (i.e., swim or dive clothing) will be approved through the HASP. Protective clothing will be fire/heat-resistive material as necessary based upon the hazards evaluated.

UXO sweep personnel will not use footwear containing metal toe-caps.

Persons involved in activities which subject their hands to injury (e.g., cuts, abrasions, punctures, burns, chemical irritants, toxins, vibration, and force which restrict blood flow) will use hand protection appropriate for the hazard.

Persons exposed to vehicular or equipment traffic will wear reflectorized or high visibility vests or apparel.

Cleaning and Maintenance

All PPE will be kept clean and properly maintained. Cleaning is particularly important for eye and face protection where dirty or fogged lenses could impair vision. PPE will be inspected, cleaned, and maintained at regular intervals so that the PPE provides the requisite protection. PPE shall not be shared between employees unless it has been properly cleaned and sanitized between uses. PPE will be distributed for individual use whenever possible.

It is important to ensure that contaminated PPE that cannot be decontaminated is disposed of in a manner that protects employees from exposure to hazards.

Training

Any worker required to wear PPE shall receive training in the proper use and care of PPE. Periodic retraining shall be offered by CHS or designees to both the employees and the supervisors, as needed. The training shall include, but not necessarily be limited to, the following subjects:

- When PPE is necessary to be worn.
- What PPE is necessary
- How to properly don, doff, adjust, and wear PPE.
- The limitations of the PPE.
- The proper care, maintenance, useful life and disposal of the PPE.

Typical delivery of training is through formal programs such as, HAZWOPER training, Refresher training or specific hazard training. Additional training is offered through routine site training and site-specific training. After the training, the employees shall demonstrate that they understand the components of the PPE Program and how to use PPE properly, or they shall be retrained.

Recordkeeping

Written records shall be kept that identifies the people trained, the type of training provided, and the dates when training occurred. Corporate Health and Safety and Safety Officers maintain records of employee training. Project files will contain the documented Hazard Assessment Forms or HASPs.

REFERENCES

American National Standards Institute, American National Standard ANSI Z41-1991, Personnel Protection - Protective Footwear

American National Standards Institute, American National Standard ANSI Z87.1-1989, Practice for Occupational and Educational Eye and Face Protection.

American National Standards Institute, American National Standard ANSI Z89.1-1986, Safety Requirements for Industrial Head Protection

OSHA Standard 29 CFR 1910.132,General Requirements

OSHA Standard 29 CFR 1910.133,Eye and Face Protection

OSHA Standard 29 CFR 1910.135,Head Protection

OSHA Standard 29 CFR 1910.136, Occupational Foot Protection

OSHA Standard 29 CFR 1910.138, Hand Protection

APPENDIX A

General Guidelines for Choosing Personal Protective Equipment

1. Description and Use of Eye/Face Protectors

Safety Glasses

Protective eyeglasses are made with safety frames, tempered glass or plastic lenses, temples and side shields which provide eye protection from moderate impact and particles encountered in job tasks such as carpentry, woodworking, grinding, scaling, etc. Safety glasses are also available in prescription form for those persons who need corrective lenses.

Single Lens Goggles

Vinyl framed goggles of soft pliable body design provide adequate eye protection from many hazards. These goggles are available with clear or tinted lenses, perforated, port vented, or non-vented frames. Single lens goggles provide similar protection to spectacles and may be worn in combination with spectacles or corrective lenses to insure protection along with proper vision.

Welders/Chippers Goggles

These goggles are available in rigid and soft frames to accommodate single or two eyepiece lenses.

Welder's goggles provide protection from sparking, scaling, or splashing metals and harmful light rays. Lenses are impact resistant and are available in graduated shades of filtration.

Chippers/Grinders goggles provide eye protection from flying particles. The dual protective eye cups house impact resistant clear lenses with individual cover plates.

Face Shields

These normally consist of an adjustable headgear and face shield of tinted/transparent acetate or polycarbonate materials, or wire screen. Face shields are available in various sizes, tensile strength, impact/heat resistance and light ray filtering capacity. Face shields will be used in operations when the entire face needs protection and should be worn to protect eyes and face against flying particles, metal sparks, and chemical/biological splash. Face shields must be worn in conjunction with primary eye protection (e.g., safety glasses or safety goggles).

Welding Shields

These shield assemblies consist of vulcanized fiber or glass fiber body, a ratchet/button type adjustable headgear or cap attachment and a filter and cover plate holder. These shields will be provided to protect workers eyes and face from infrared or radiant light burns, flying sparks, metal spatter and slag chips encountered during welding, brazing, soldering, resistance welding, bare or shielded electric arc welding and oxyacetylene welding and cutting operations.

2. Head Protection

Head injuries are caused by falling or flying objects, or by bumping the head against a fixed object. Head protectors, in the form or protective hats, must resist penetration and absorb the shock of a blow. The shell of the protective hat is hard enough to resist the blow and the headband and crown straps keep the shell away from the wearer's skull. Protective hats can also protect against electrical shock.

Protective hats are made in the following types and classes:

- Type 1 - Helmets with a full brim.
- Type 2 - Brimless helmets with a peak extending forward from the crown.
- Class A - General service, limited voltage. Intended for protection against impact hazards. Used in mining, construction, and manufacturing.
- Class B - Utility service, high voltage. Used by electrical workers.
- Class C - Special service, no voltage protection. Designed for lightweight comfort and impact protection. Used in certain construction, manufacturing, refineries, and where there is a possibility of bumping the head against a fixed object.

Inspection, maintenance and replacement of hard hats will follow the requirements of the manufacturer.

3. Foot Protection

There are many types and styles of protective footwear and it is important to realize that a particular job may require additional protection other than listed here. Footwear that meets established safety standards will have an American National Standards Institute (ANSI) label inside each shoe.

Reinforced Toe Safety Shoes

These shoes are designed to protect the feet from common machinery hazards such as falling or rolling objects, cuts, and punctures. The entire toe box and insole are reinforced with steel or composite material, and the instep is protected by steel, aluminum, or plastic materials. Safety shoes are also designed to insulate against temperature extremes and may be equipped with special soles to guard against slip, chemicals, and/or electrical hazards.

Safety Boots

When splash, spark, chemicals or molten materials are present leather safety boots offer the minimal amount of protection. When working with corrosives, caustics, cutting oils, and petroleum products, neoprene or nitrile boots are often required to prevent penetration. When working with electricity, special electrical hazard boots are available and are designed with non-conductive materials.

4. Hand Protection

Skin contact is a potential source of exposure to toxic materials and for this reason it is important that the proper steps be taken to prevent such contact. Most accidents involving hands and arms can be classified under four main hazard categories: chemicals, abrasions, cutting, and heat. Gloves are available that can protect workers from any of these individual hazards or any combination thereof.

Gloves should be replaced periodically, depending on frequency of use and permeability to the substance(s) handled. Gloves which become contaminated should be carefully removed and disposed after use in accordance with established decontamination procedures and HASP requirements.

Gloves should also be worn whenever it is necessary to handle rough or sharp-edged objects, and very hot or very cold materials. The type of glove materials to be used in these situations includes leather, welder's gloves, aluminum-backed gloves, and other types of insulated glove materials.

Careful attention must be given to protecting your hands when working with tools and machinery. Power tools and machinery must have guards installed or incorporated into their design that prevent the hands from contacting the point of operation, power train, or other moving parts. To protect hands from injury due to contact with moving parts, it is important to:

- Ensure that guards are always in place and used.
- Always lockout machines or tools and disconnect the power before making repairs.
- Treat a machine without a guard as inoperative; and
- Do not wear gloves around moving machinery, such as drill presses, mills, lathes, and grinders.

The following is a guide to the most common types of protective work gloves and the types of hazards they can guard against:

- Disposable gloves: usually made of latex or nitrile, can help guard against mild irritants.
- Fabric Gloves: Made of cotton or fabric blends are generally used to improve grip when handling slippery objects. They also help insulate hands from mild heat or cold.
- Leather Gloves: These gloves are used to guard against injuries from sparks or scraping against rough surfaces. They are also used in combination with an insulated liner when working with electricity.
- Metal Mesh Gloves: These gloves are used to protect hands form accidental cuts and scratches. They are used most commonly by persons working with cutting tools or other sharp instruments.
- Aluminized Gloves: Gloves made of aluminized fabric are designed to insulate hands from intense heat. These gloves are most commonly used by persons working molten materials.
- Chemical Resistance Gloves: These gloves may be made of rubber, neoprene, polyvinyl alcohol or vinyl, etc. These gloves protect hands from corrosives, oils, and solvents. When selecting chemical resistance gloves, be sure to consult the manufacturers recommendations and the HASP, especially if the gloved hand will be immersed in the chemical.

APPENDIX B

Personal Safety/Protective Equipment Policy

It is WESTON policy to require employees to wear protective safety equipment when indicated by hazards encountered on the job. When safety equipment is required, it will be provided pursuant to the following policy.

Safety Glasses

Prescription and non-prescription safety glasses will be procured by WESTON through an outside supplier, at no cost to the employee. Employees needing prescription glasses or inserts may purchase appropriate glasses or inserts after approval of their supervisor (see below).

For Prescription Glasses and Respirator Inserts, the employee will be responsible for providing a copy of his/her prescription that is less than 2 years old, and for any examination fee necessary to obtain such prescription. Requests for safety glasses (prescription) should be directed to the employee's supervisor for review and approval. WESTON will not normally provide or pay for the cost of contact lenses.

Safety glasses damaged on the job will be replaced by WESTON. Prescription safety glasses or respirator inserts will be replaced by WESTON as needed, usually at intervals of at least 2 years. Requests for replacement at less than 2 year intervals will be considered if the employee's prescription changes.

Costs for prescription safety glasses and respirator inserts will be borne by the employee's Operating Unit. Typical costs are estimated not to exceed $200 per employee (more if allowed by the employees supervisor).

Safety Boots

One pair of appropriate safety boots (ankle protection, leather or equivalent, ANSI-approved, safety toe-cap) will be provided for each employee who is required to work in the field, for each maintenance employee, or as required based upon appropriate task hazard assessment. Requests must be approved as indicated above. Safety boots will be replaced as necessary, (typically at intervals of 2 years) and as approved by the OU manager.

Costs for safety boots will be borne by the employee's Operating Unit. Costs are estimated not to exceed $100 per employee (more if approved by the employees supervisor).

Specialized Equipment

All other safety equipment required for an assignment (e.g., hard hats, gloves, protective clothing, chemical-resistant overboots, respirators, rain gear, etc.) will be provided by WESTON. Use of specialized equipment will be charged to projects or OUs in accordance with established policy and rental/purchase rates.

Revised 11/1999

APPENDIX C

LEVEL A PPE

Respiratory Protection

Level A respiratory protection is positive-pressure, full face-piece, self-contained breathing apparatus (SCBA), or full face-piece positive-pressure supplied air respirator (with escape bottle for immediately dangerous to life or health [IDLH] or potential IDLH atmosphere).

Protective Clothing

This protective clothing level is used when the potential exists for splash or immersion by chemicals or radiologically contaminated liquids or for exposure to vapors, fumes, gases, or particulates that are harmful to the skin or capable of being absorbed through the skin. This class of protection is acceptable for radiological work activities categorized as "high" involving pressurized or large volume liquids or the potential for a closed system breach. Level A protective clothing includes:

- A totally encapsulating, non-permeable, chemical-resistant suit.
- Coveralls inner suit.
- Clothing under coveralls (e.g., shorts and T-shirt/long underwear).
- Disposable gloves and boot covers (worn over fully encapsulating suit).
- Boots, chemical-resistant, ANSI-approved protective toe and shank (depending on suit construction, worn over or under suit boot).
- Hard hat (under suit), as needed.
- Hearing protection (as needed).

Positive-pressure SCBA or positive-pressure air-line respirators equipped with an escape air supply are used when chemical exposure levels will create a substantial possibility of immediate death, immediate serious illness or injury, or will impair the ability to escape.

Totally encapsulating chemical protective suits are used in conditions where skin absorption of a hazardous substance may result in a substantial possibility of immediate death, immediate serious illness or injury, or will impair the ability to escape.

The level of protection provided by the selected PPE shall be increased when additional information on site conditions indicates that increased protection is necessary to reduce worker exposure to below PELs and published exposure levels for hazardous substances and health hazards.

The level of worker protection provided may be decreased when additional information and/or site conditions demonstrate that decreased protection will not result in hazardous exposures to workers.

Totally Encapsulating Suits

Prior to the selection of a totally encapsulating suit, the following considerations are necessary:

- Reevaluating the technical approach to the task in favor of engineering controls rather than PPE.
- Assuring that totally encapsulating suits that are tested and capable of maintaining positive air pressure.
- Assuring that totally encapsulating suits that are tested and capable of preventing inward test gas leakage of no more than 0.5 percent (or within the most recent guidelines established by OSHA, NIOSH or NFPA).

Other Protective Apparatus

Other protective apparatus that must be considered include:

- A cooling unit/system.
- Two-way radio communications.
- Cold weather gear/clothing.
- Protection from biological hazards/pests.
- Flash Protective Garments (e.g., Nomex or equivalent) as necessary.
- Ballistic/EOD Gear.

LEVEL B PPE

Respiratory Protection

Level B respiratory protection is positive-pressure, full face-piece SCBA, or a positive-pressure supplied air respirator (with escape bottle for IDLH or potential IDLH atmosphere).

Protective Clothing

Level B protective clothing provides a high level of skin protection. It is used when the potential exists for contact with chemicals and/or radiologically contaminated liquids that could saturate/penetrate cloth coveralls. Level B protective clothing includes:

- A hooded one-piece non-permeable, chemical resistant outer suit.
- Coveralls inner suit(s).
- Clothing under coveralls (e.g., cotton shorts and T-shirt/long underwear).
- Outer chemical-resistant work gloves (rated for contaminants) taped or secured to outer suit.
- Inner gloves of light-weight surgical-type latex rubber or nitrile rubber (cotton liners optional).
- Chemical-resistant ANSI-approved boots.
- Disposable outer boot covers (booties) taped to outer suit.

- Hard hat (as needed).
- Hearing protection (as needed).

Other Protective Apparatus

Other protective apparatus that must be considered include:

- A cooling unit/system.
- Two-way radio communications.
- Cold weather gear/clothing.
- Protection from biological hazards/pests.
- Flash Protective Garments (e.g., Nomex or equivalent) as necessary.
- Ballistic/EOD Gear.

LEVEL C PPE

Respiratory Protection

Level C respiratory protection includes a NIOSH-approved air-purifying respirator, full-face or half-mask cartridge or canister-equipped.

Protective Clothing

Level C protective clothing provides a high level of skin protection. It is used when the potential exists for contact with chemicals and/or radiologically contaminated liquids that could saturate/penetrate cloth coveralls. Level C protective clothing includes:

- Chemical Resistant outer suit.
- Coveralls.
- Absorbent undergarments (e.g., cotton shorts and T-shirt/long underwear).
- Chemical-resistant outer gloves rated for contaminant.
- Inner gloves of light-weight nitrile or latex rubber.
- Safety glasses or safety goggles (not required with full-face respirator).
- Face shield if splash hazard exists (as necessary with full-face respirator).
- ANSI-approved safety boots (chemical resistant as necessary).
- Outer disposable booties.
- Hard hat (as needed).
- Hearing protection (as needed).

Other Protective Apparatus

Other protective apparatus that must be considered include:

- A cooling unit/system.
- Two-way radio communications.
- Cold weather gear/clothing.
- Protection from biological hazards/pests.
- Flash Protective Garments (e.g., Nomex or equivalent) as necessary.
- Ballistic/EOD Gear.

LEVEL D PPE

Respiratory Protection

No respiratory protection is required.

Protective Clothing

Level D protective clothing provides a low level of skin protection. It is used when there is no potential for contact with hazardous levels of chemicals or radiological contamination.
This level can under certain conditions be worn in the Exclusion Zone or the Contamination Reduction Zone.

Level D protective clothing includes:

- Coveralls or appropriate work uniform (e.g., long pants, and shirts with sleeves).
- Clothing under coveralls.
- Work gloves where appropriate.
- PVC or latex rubber surgical/light-weight gloves when sampling or handling any potentially contaminated surface or item.
- Safety glasses or safety goggles.
- ANSI-approved safety boots.
- Hard hat (as needed).

MODIFIED LEVEL D

Modified Level D PPE is worn on sites where minimal exposure to contaminants has been determined, levels of which do not create a respiratory hazard, but may create a minimal skin contact concern.

Modified Level D provides protection in the form of Level D and includes:

- Chemical-resistant outer clothing and/or.
- Chemical resistant outer gloves (as necessary).
- Inner surgical-type latex or nitrile gloves (as necessary).
- Outer disposable boot covers (as necessary).
- Flash Protective Garments (e.g., Nomex or equivalent) as necessary.

Other Protective Apparatus

Other protective apparatus that must be considered for both Level D and Modified Level D include:

- A cooling unit/system.
- Two-way radio communications.
- Cold weather gear/clothing.
- Protection from biological hazards/pests.
- Flash Protective Garments (e.g., Nomex or equivalent) as necessary.
- Ballistic/EOD Gear.

APPENDIX D

PPE Selection Process (Hazard Assessment)

Steps to facilitate the selection of PPE and provide an effective hazard assessment include:

Identify work area, the activity or task to be performed, and the corresponding PPE requirements.

Assessment guidelines include:

- A walk-through survey to identify known or potential hazard categories; Impact, Penetration, Compression (roll-over), Chemical, Heat/Cold, Harmful dust, Light (Optical Radiation), Ionizing or Non-Ionizing Radiation.
- Sources of Hazards to be aware of include; Motion (i.e., machinery or processes or people), Temperature extremes (i.e., burns, ignition sources, cold or heat exposures), Types of Chemical exposure, Sources of Harmful Dusts, Sources of Radiation (i.e., welding, cutting, high intensity lights, non-ionizing, ionizing radiation), Sources of Falling objects or the potential for falls or for dropping objects, Sources of sharp objects, Sources of Rolling or Pinching Objects, Workplace layout, electrical hazards.
- Determine type of exposure for the work areas and specific work activities.
- Determine level of respiratory protection for the work areas and specific work activities (see WESTON Respiratory Protection Program).
- Determine level of protective clothing for the work areas and specific activities.
- Evaluate the chemical-resistant characteristics needed for the potential exposures and select clothing with the appropriate protection factor.
- Evaluate potential physical hazards associated with the work areas and specific work activities (e.g., walking/working surfaces, electrical installations/lines, and noise exposure) and select PPE to mitigate identified hazards.
- Consider climatic conditions and select PPE to accommodate the conditions (e.g., cooling units, insulated clothing/footwear, etc.).
- Evaluate potential biological hazards (e.g., snakes, and insects) and select PPE to mitigate identified hazards.
- Evaluate type and level of work (e.g., heavy, moderate, light) and select PPE for the work.
- Evaluate PPE for both chemical and radiological hazards when mixed waste is involved.

Revised 11/1999

APPENDIX D-1

Hazard Assessment Certification Form

Date:
Location:

Assessment Conducted By:

Specific Tasks Performed at this Location:

Hazard Assessment and Selection of Personal Protective Equipment

I. Overhead Hazards

Hazards to consider include:

Suspended loads that could fall
Overhead beams or loads that could be hit against
Energized wires or equipment that could be hit against
Employees work at elevated site who could drop objects on others below
Sharp objects or corners at head level
Other (explain)

Hazards Identified:

Head Protection

Hard Hat: Yes No

II. Eye and Face Hazards

Hazards to consider include:

Chemical splashes
Dust
Smoke and fumes
Welding operations
Lasers/optical radiation
Projectiles
Other (explain)

Hazards Identified:

Eye Protection

Safety glasses Yes No
Goggles Yes No
Face Shield Yes No
Tinted Lens Yes No Degree of Filtering:____

III. Hand Hazards

Hazards to consider include:

Chemicals
Sharp edges, splinters, etc.
Temperature extremes
Biological agents
Exposed electrical wires
Sharp tools, machine parts, etc.
Material handling
Other (explain)

Hazards Identified:

Hand Protection

Gloves: Yes No

Chemical resistant
Temperature resistant
Abrasion resistant
Electrical Protective
Other (Explain)

Foot Hazards

Hazards to consider include:

Heavy materials handled by employees
Sharp edges or points (puncture risk)
Exposed electrical wires
Unusually slippery conditions
Wet conditions
Construction/demolition
Other (explain)

Hazards Identified:

Foot Protection

Safety shoes: Yes No

Types:
Toe protection
Metatarsal protection
Puncture resistant
Electrical insulation
Non-Static
Other (Explain)

V. Body Protection

Hazards to consider include:

Chemical Contact
Fire or Flash
Temperature Extremes
UXO
Radiation (Ionizing)
Radiation (Non-Ionizing)
Other (explain)

Hazards Identified:

Body Protection:

Types:
Chemical-Resistant Coveralls
Thermal Protection
Welding "Leathers"
Ballistic Shields for UXO operations
Flash Protection (e.g., Nomex or equivalent)
Ballistic or cut-resistant chaps

VI. Noise

Noise Source:

Protection Needed:

VII. Other Identified Safety and/or Health Hazards:

Hazard

Recommended Protection

I certify that the above inspection was performed to the best of my knowledge and ability, based on the hazards present on (date) ______________________.

____
(Signature)

ATTACHMENT G

SITE SPECIFIC HAZARD COMMUNICATIONS PROGRAM/CHECKLIST

1.3 HAZARD COMMUNICATION PROGRAM

PURPOSE

The Hazard Communication Standard (HCS) of the Occupational Safety and Health Administration (OSHA) requires employers to establish programs that will transmit information on the hazards of chemicals to employees. This information is transmitted by means of labels, Material Safety Data Sheets (MSDS), and training programs. By the implementation of the following program WESTON is committed to ensure that all employees have the "right to know" the hazards and identities of the chemicals they work with or to which they are potentially exposed. This knowledge will reduce the incidence of chemically related occupational illness and injury and provide a safer working environment. This written program is available to employees and other affected individuals upon request.

Hazardous materials covered by this program are those referenced in the Hazard Communication Standards, 29 CFR 1910.1200 and 29 CFR 1926.59. Unless exempted from coverage by these standards, and/or as discussed within the context of this program, all hazardous chemicals in use at a site or facility and any hazardous chemical created by work activities conducted by WESTON (or by others which creates an exposure to WESTON personnel) must meet the requirements of the standard and of WESTON's Program. WESTON is not normally a manufacturer, importer, or distributor of hazardous materials. This program is intended, therefore, to address the regulatory requirements that apply to employers only. For purposes of the standard and of this program, exposure is defined to include any route of entry (inhalation, ingestion, skin contact, or absorption) and also includes potential (i.e., accidental or possible) exposure, including foreseeable emergencies. Foreseeable emergencies include, but are not limited to, employee exposures that may result from equipment failure, container rupture, or failure of control equipment that could cause an uncontrolled release of a hazardous chemical.

RESPONSIBILITY

Managers responsible for each facility, project or site are responsible for assuring labels are placed where required, comparing MSDS's and other information with label information to ensure correctness and maintaining the inventory of hazardous substances. All employees are responsible for ensuring and maintaining compliance with this program, any questions or concerns should be directed to site or location management or the appropriate safety officer.

EMPLOYEES AFFECTED

This program applies to all WESTON employees and other individuals who may encounter a hazardous material in a WESTON work area. WESTON's work activities cover a wide range of tasks that may involve hazardous materials from common household cleaners and office supplies to chemical reagents and wastes. The following categories of workers are identified to appropriately indicate how this program will apply to them.

Field Workers

Employees at field sites may encounter known, manufactured hazardous materials such as such as chemical reagents, as well as uncontrolled hazardous wastes that are not clearly identified or defined. This program will be strictly implemented for the former, and applied as appropriate and practical for the latter.

Before assignment to hazardous field operations, personnel are required to successfully complete a 40-Hour Indoctrination Health and Safety Training Course (or equivalent) that includes instruction in physical, biological, radiological, and toxic hazards of chemicals that are likely to be encountered in their work assignments. These required training programs are intended to minimize the risks associated with activities involving the uncontrolled hazardous wastes.

In addition, site-specific health and safety plans (HASPs) are developed prior to initiating work activities to evaluate and document site hazards. Parts of the HASPs provide a basis for acquiring and distributing information that would normally be provided in Material Safety Data Sheets (MSDSs) and labeling on containers for manufactured substances. Regular safety meetings are scheduled to review or amend the HASP and to provide training on non-routine work assignments involving hazardous materials.

Non-field Personnel Working with Hazardous Materials

WESTON recognizes that personnel other than field personnel require Hazard Communication Training (e.g; laboratory, mail room, maintenance, graphics, office and print shop employees). Training of these employees is accomplished during the Indoctrination Training for new employees and during section meetings or by attending job-specific training courses. Non-field activities will comply fully with requirements for MSDSs and container labeling.

Multi-Employer Work Places, Subcontractors and Clients

WESTON subcontractors, clients and client subcontractors whose employees could come in contact with WESTON controlled hazardous substances on any WESTON project site or location must be formally notified of the presence of those hazardous substances subject to the HCS.

Other employers, clients, or contractors whose employees could be exposed to hazardous chemicals used or stored by WESTON will be informed of the hazardous chemicals, the labeling system in use, and the location of MSDSs for the hazardous substances. Also, other parties or contractors using or storing hazardous chemicals to which WESTON employees could be exposed will be required to provide similar information and access to their MSDSs.

Subcontractors must have a Hazard Communication Program and implement that program fully at the work site. They must also inform WESTON's site manager of any hazardous substances used in their work for WESTON, must have appropriate MSDS's on site, and must have containers correctly labeled.

Site Managers and Client Service Managers are responsible for ensuring that clients provide hazard communication information where exposure to hazardous substances subject to this Standard may occur.

LABELING REQUIREMENTS

All containers of hazardous materials subject to the HCS must be labeled with the chemical name (as cross-referenced with the MSDS listing) and appropriate hazard warnings (to include target organ effects, if known). Labels must be legible and prominently displayed.

The use of standard formats such as the Hazardous Material Identification System (HMIS) or the NFPA 704M system may be used for in-plant containers. If used, information relative to the system use and definitions must be displayed in a prominent location. Additionally, affected personnel must receive training in the use of the system and in specifics of the chemicals, such as harmful effects and target organ effects.

Labels must not conflict with Hazardous Materials Transportation Act labeling requirements and must meet requirements of OSHA substance specific health standards if such regulated substances are present. Manufacturer's, importer's, distributor's, or employer's existing labels may be used (and are preferred), if the information is found to be correct and sufficient.

Workplace containers of hazardous chemicals filled from other containers must be labeled tagged or marked to indicate the identity of the hazardous chemical, and the appropriate hazard warnings (to include target organ effects). Labels are not required on portable containers filled from a correctly labeled container if only the worker filling the container uses the material from that container and the material is used immediately (before the end of the day). Labels must remain on containers and must remain legible until the contents no longer create a hazard.

Piping systems designed or routinely used by WESTON personnel are not considered to be containers for the purpose of this program. However, piping systems will be labeled to indicate the materials inside them for safety reasons.

MATERIAL SAFETY DATA SHEETS (MSDS)

An employee that routinely orders and uses chemicals or hazardous substances is required to request an MSDS from the supplier or manufacturer if one is not supplied with the item. A record of requests for MSDSs must be maintained and may be documented simply by an entry in the site logbook. The MSDSs will be maintained in the location in the workplace that is designated by the manager, and known and accessible to the employees.

MSDSs must be kept up to date. Upon receipt of new MSDS materials, the old form will be replaced with the new information. If review of the form indicates new hazard information (e.g., recent evaluation as a carcinogen) this information must be transmitted to affected personnel.

While the majority of chemicals used by WESTON will not contain trade secret information, the possibility remains that a material may be listed as a trade secret on the MSDS. If a WESTON site receives a MSDS that lists the components as trade secret, the responsible person must immediately make note that emergency information must be acquired directly from the manufacturer in case of an emergency.

INVENTORY/LISTING

A listing of hazardous substances must be kept in each location, office or site where hazardous materials are stored or used. The list must be kept up to date as chemicals are added, used or deleted from the inventory. The basis for the list will be the file of MSDSs at the work location.

The list of hazardous chemicals must be attached at the front of the MSDS file. For operations that have a site-specific HASP, the completed chemical hazard page of the HASP, with a reference to the MSDSs on-site and their location, will serve as the hazardous chemical list. The hazardous chemical list must use identities that are referenced on the appropriate MSDSs

The MSDS list must be maintained in an acceptable manner, for example as part of the HASP that is maintained onsite; in a notebook maintained onsite; or within a computer system with site access. Affected employees must have access to these materials during the course of their work shifts. If computerized data are utilized, all affected personnel must know how to use the computer equipment in order to gain access to the needed information.

Safety plans for field site operations serve the purpose of hazard communication for contaminants present. Copies of the HASP must be available on field sites, must be identified at formal briefings or site safety meetings prior to field activity commencement, and must be available for review by site personnel. Typically, site personnel are required to review the HASP prior to commencing work at the site.

TRAINING

Information and training will be provided to employees regarding the chemical hazards in their work areas, including by-products and hazardous chemicals introduced by another employer. This training is necessary when those chemicals are known to be present in such a manner that WESTON employees may be exposed under normal conditions of use or in a foreseeable emergency.

Initial Hazard Communication training will be conducted as a stand-alone course or in combination with other WESTON training programs such as those conducted under 29 CFR 1910.120 or 29 CFR 1926.21.

Training will be repeated for workers at a site whenever it is evident that personnel are not aware of the requirements of the Hazard Communication Standard, or the procedures established to comply with this written program. For field personnel at hazardous waste sites, refresher training is provided as a natural progression of the annual training requirements under 29 CFR 1910.120.

Prior to beginning use of a new hazardous substance that is not commonly used and that may result in serious health impacts upon exposure, the supervisors will review MSDS and label information with employees who will be using the substance. Prior to beginning a new or non-routine task involving use of chemicals, a Safety Plan, Safety Plan Amendment or Task Risk Assessment will be completed identifying the hazards of the substance, how the task will affect risk of exposure and any changes in protective measures, equipment or procedures.

Attendance at training courses will be recorded and documented.

LOCATION-SPECIFIC PROGRAMS

Location-specific Hazard Communication Programs will be developed for each WESTON Office or work location where employees have potential exposure (as defined in the standard) to hazardous chemicals. Each location-specific Hazard Communication Program will comply with the requirements of this document. A model for the location-specific Hazard Communication Program can be found in Attachment A.

PROGRAM AVAILABILITY

Information on the WESTON Hazard Communication Program, the Hazard Communication Standard, or requirements for MSDS's and labeling is available from WESTON's Division Safety Managers or Corporate Health and Safety Department. Location-specific program information can be obtained through the respective manager or safety officer. Requests for information can be made during normal work hours. Emergency information may be obtained, as necessary, through the WESTON 24-Hour paging system.

ATTACHMENT A

MODEL LOCATION-SPECIFIC HAZARD COMMUNICATION PROGRAM

Model Location-Specific Hazard Communication Program

This document (or similar document) is used in conjunction with WESTON's written Hazard Communication Program as a means of meeting site or location specific requirements and to ensure compliance with the Hazard Communications/Standard. While responsibility for activities within this document reference several WESTON positions, it is the responsibility of all personnel to effect compliance.

To ensure that information about the dangers of all hazardous chemicals used by WESTON are known by all affected employees, the following hazardous information program has been established. All affected personnel will participate in the Hazard Communication Program. This location-specific program and the written Hazard Communication Program will be available for review by any employee, employee representative, representative of OSHA, NIOSH or any affected employer/employee on a multi-employer site.

List of Hazardous Chemicals

A list of known hazardous chemicals used by WESTON personnel must be prepared and attached to this document or in a centrally identified location with the MSDS's. Further information on each chemical may be obtained by reviewing the appropriate MSDS's. The list will be arranged to enable cross-reference with the MSDS file and the label on the container. The location manager is responsible for ensuring the chemical listing remains up-to-date. An example of the list is available at the end of this document.

Container Labeling

Employees will verify that all containers received from the chemical manufacturer, importer or distributor for use on site will be clearly labeled. The employee is responsible for assuring labels are placed where required and for comparing MSDS's and other information with label information to ensure correctness.

Material Safety Data Sheets (MSDS's)

The location is responsible for establishing and monitoring WESTON's MSDS program for the location. He/she will make sure procedures are developed to obtain the necessary MSDS's and will have employees review incoming MSDS's for new or significant health and safety information. He/she will see that any new information is passed on to the affected employees. If an MSDS is not received at the time of initial shipment, the employee will call the manufacturer and have an MSDS delivered for that product in accordance with the requirements of WESTON's written Hazard Communication Program.

A list of all hazardous chemicals in use will be kept in the MSDS folder and the folder will be kept at a location known to all site workers. MSDS's will be readily available to all employees during each work shift. If an MSDS is not available, the SO will be immediately contacted. When revised MSDS's are received, the employee will immediately replace the old MSDS's.

Employee Training and Information

The location manager will ensure that all program elements specified below are supplied to all affected employees.

At the time of initial assignment for employees to the work site or whenever a new hazard is introduced into the work area employees will attend a health and safety meeting or briefing that includes the information indicated below.

- Hazardous chemicals present at the work site
- Physical and health risks of the hazardous chemicals
- The signs and symptoms of overexposure
- Procedures to follow if employees are overexposed to hazardous chemicals
- Location of the MSDS file and written hazard communication program
- How to determine the presence or release of hazardous chemicals in the employees work area
- How to read labels and review MSDS's to obtain hazard information
- Steps WESTON has taken to reduce or prevent exposure to hazardous chemicals
- How to reduce or prevent exposure to hazardous chemicals through use of controls, procedures, work practices and personal protective equipment
- Hazardous, non-routine tasks to be performed (if any)
- Chemicals within unlabeled piping (if any)

Hazardous Non-Routine Tasks

When employees are required to perform hazardous non-routine tasks the affected employee(s) will be given information by the supervisor about the hazardous chemicals he or she may utilize during such activity. This information will include specific chemical hazards, protective and safety measures the employee can use and steps WESTON is using to reduce the hazards. These steps include, but are not limited to, ventilation, respirators, minimum staff requirements, and emergency procedures.

Chemicals in Unlabeled Pipes

Work activities may be performed by employees in areas where chemicals are transferred through unlabeled pipes. Prior to starting work in these areas, the employee shall contact the supervisor at which time information will be provided as to the chemical(s) in the pipes, potential hazards of the chemicals or the process involved, and safety precautions, which should be taken.

Multi-Employer Worksites

It is the responsibility of the location manager to provide other employers with information about hazardous chemicals imported by WESTON to which their employees may be exposed, along with suggested safety precautions. It is also the responsibility of manager to obtain information about hazardous chemicals used by other employers to which WESTON employees may be exposed. WESTON's chemical list will be made available to other employers as requested. MSDS's will be available for viewing as necessary.

The location, format and procedures for accessing MSDS information must be relayed to affected employees.

Site or other location name/address:

____

____

Site/Project/Location Manager: ______________________________

Site/Location Safety Officer: ______________________________

Format for List of Chemicals: HASP: _____ Other: _____

Location of MSDS Files: ______________________________

____

Training Conducted by (name and date): __________________________

Indicate format of training documentation: Field Log: _____ Other: _____

Date of client briefing regarding hazard communication: __________________

If multi-employer site, indicate name of affected companies: ________________

____

____

Dates other employer(s) notified of chemicals, labeling and MSDS information:

____

Dates WESTON notified of other employers' or clients' hazard communication program:

____

SITE HAZARDOUS CHEMICAL LIST

HAZARDOUS CHEMICAL	QUANTITY	CROSS-REFERENCE	DATE ADDED

SITE-SPECIFIC HAZARD COMMUNICATION PROGRAM-FORM 28

Location-Specific Hazard Communication Program/Checklist

To ensure an understanding of and compliance with the Hazard Communication Standard, WESTON will use this checklist/document (or similar document) in conjunction with the WESTON Written Hazard Communication Program as a means of meeting site- or location-specific requirements.

While responsibility for activities within this document reference the WESTON Safety Officer (SO), it is the responsibility of all personnel to effect compliance. Responsibilities under various conditions can be found within the WESTON Written Hazard Communication Program.

To ensure that information about the dangers of all hazardous chemicals used by WESTON are known by all affected employees, the following Hazard Communication Program has been established. All affected personnel will participate in the Hazard Communication Program. This written program, as well as WESTON's Corporate Hazard Communication Program, will be available for review by any employee, employee representative, representative of OSHA, NIOSH, or any affected employer/employee on a multi-employer site.

☐ Site or other location name/address: Raritan Arsenal

☐ Site/Project/Location Manager: Paul Bovitz

☐ Site/Location Safety Officer: Ryan Brown

☐ List of chemicals compiled, format: ☒ HASP ☐ Other: ______

☐ Location of MSDS files: HASP

☐ Training conducted by: Name: Ryan Brown Date: ______

☐ Indicate format of training documentation: ☒ Field Log: ☐ Other: ______

☐ Client briefing conducted regarding hazard communication: ______

☐ If multi-employer site (client, subcontractor, agency, etc.), indicate name of affected companies:

______

☐ Other employer(s) notified of chemicals, labeling, and MSDS information: ______

☐ Has WESTON been notified of other employer's or client's hazard communication program(s), as necessary? ☐ Yes ☐ No

List of Hazardous Chemicals

A list of known hazardous chemicals used by WESTON personnel must be prepared and attached to this document or placed in a centrally identified location with the MSDSs. Further information on each chemical may be obtained by reviewing the appropriate MSDS. The list will be arranged to enable cross-reference with the MSDS file and the label on the container. The SO or Location Manager is responsible for ensuring the chemical listing remains up-to-date.

Container Labeling

The WESTON SO will verify that all containers received from the chemical manufacturer, importer, or distributor for use on-site are clearly labeled.

The SO is responsible for ensuring that labels are placed where required and for comparing MSDSs and other information with label information to ensure correctness.

Material Safety Data Sheets (MSDSs)
FORM 28

The SO is responsible for establishing and monitoring WESTON's MSDS program for the location. The SO will ensure that procedures are developed to obtain the necessary MSDSs and will review incoming MSDSs for new or significant health and safety information. He/she will see that any new information is passed on to the affected employees. If an MSDS is not received at the time of initial shipment, the SO will call the manufacturer and have an MSDS delivered for that product in accordance with the requirements of WESTON's Written Hazard Communication Program.

A log for, and copies of, MSDSs for all hazardous chemicals in use will be kept in the MSDS folder at a location known to all site workers. MSDSs will be readily available to all employees during each work shift. If an MSDS is not available, immediately contact the WESTON SO or the designated alternate. When a revised MSDS is received, the SO will immediately replace the old MSDS.

Employee Training and Information

The SO is responsible for the WESTON site-specific personnel training program. The SO will ensure that all program elements specified below are supplied to all affected employees.

At the time of initial assignment for employees to the work site, or whenever a new hazard is introduced into the work area, employees will attend a health and safety meeting or briefing that includes the information indicated below.

- Hazardous chemicals present at the work site.
- Physical and health risks of the hazardous chemicals.
- The signs and symptoms of overexposure.
- Procedures to follow if employees are overexposed to hazardous chemicals.
- Location of the MSDS file and Written Hazard Communication Program.
- How to determine the presence or release of hazardous chemicals in the employee's work area.
- How to read labels and review MSDSs to obtain hazard information.
- Steps WESTON has taken to reduce or prevent exposure to hazardous chemicals.
- How to reduce or prevent exposure to hazardous chemicals through the use of controls procedures, work practices, and personal protective equipment.
- Hazardous, nonroutine tasks to be performed (if any).
- Chemicals within unlabeled piping (if any).

Hazardous Nonroutine Tasks

When employees are required to perform hazardous nonroutine tasks, the affected employee(s) will be given information by the SO about the hazardous chemicals he or she may use during such activity. This information will include specific chemical hazards, protective and safety measures the employee can use, and steps WESTON is using to reduce the hazards. These steps include, but are not limited to, ventilation, respirators, presence of another employee, and emergency procedures.

Chemicals in Unlabeled Pipes

Work activities may be performed by employees in areas where chemicals are transferred through unlabeled pipes. Prior to starting work in these areas, the employee will contact the SO, at which time information as to the chemical(s) in the pipes, potential hazards of the chemicals or the process involved, and the safety precautions that should be taken will be determined and presented.

Multi-Employer Work Sites

It is the responsibility of the SO to provide other employers with information about hazardous chemicals imported by WESTON to which their employees may be exposed, along with suggested safety precautions. It is also the responsibility of the SO and the Site Manager to obtain information about hazardous chemicals used by other employers to which WESTON employees may be exposed. WESTON's chemical listing will be made available to other employers, as requested. MSDSs will be available for viewing, as necessary. The location, format, and/or procedures for accessing MSDS information must be relayed to affected employees.

ATTACHMENT H

DRUG AND ALCOHOL PROGRAM

DRUG AND ALCOHOL TESTING (OPERATING PRACTICE 11-09-001) WITH GUIDANCE

Revised: September 2004

1. PURPOSE

Weston Solutions, Inc. (WESTON®) is committed to providing a safe workplace and high standards of health and safety for employees. Consistent with this commitment and in order to carry out the purposes of WESTON's *Drugfree Workplace*, Operating Practice, the Company implements this Drug and Alcohol Testing operating practice to screen all employees, to the extent permitted by applicable law, for drugs and alcohol in the workplace.

Guidance: *"all employees. to the extent permitted by applicable law" - according to current Canadian law, we can not conduct drug or alcohol testing for persons working in Canada; the only exception is for employees holding U.S. commercial drivers licenses regulated by U.S. DOT and if they travel within the U.S.*

Note: CEHS = Corporate Environmental Health and Safety Department

Testing will be performed during the following instances:

- Pre-employment
- Post Accident or Injury
- Return to Duty and Follow-up
- Reasonable Cause
- Site-specific Project Assignments

In addition, random testing and client-required testing will be conducted as required by law or contract.

2. DEFINITIONS

2.1 Drug: Any chemical substance that, when consumed, tends to produce a physical, mental or emotional change in a person.

2.2 Legal Drug: Prescribed drug or over-the-counter drug which has been legally obtained and is being used solely for the purpose for which it was prescribed or manufactured.

2.3 Illegal Drug: Any drug which (i) is not legally obtainable; (ii) may be legally obtainable but has not been legally obtained; or (iii) is being used in a manner or for a purpose other than as prescribed.

2.4 Alcohol: Any beverage that contains alcohol.

2.5 CDL (Commercial Driver's License): Employees who operate a commercial motor vehicle and are required to be in possession of a commercial driver's license (CDL). A CDL is required for all employees that operate vehicles that fall into the following categories:

- Gross vehicle weight rating (GVWR) of 26,001 or more pounds;
- Gross combined weight rating (GCWR) of 26,001 or more pounds inclusive of a towed unit with a GVWR of more than 10,000 pounds;
- Designated to transport 16 or more passengers, including the driver;
- Transportation of hazardous materials requiring the vehicle to be placarded.

2.6 Laboratory: A licensed facility contracted by WESTON's Medical Review Officer (MRO) to perform drug testing. For USDOT-mandated controlled substance (drug) testing, the laboratory must be certified by the U.S. Department of Health and Human Services (DHHS), Mandatory Guidelines for Federal Workplace Drug Testing Programs, and subsequent amendments. The DHHS agency that certifies drug-testing laboratories is the Substance Abuse and Mental Health Services Administration (SAMHSA).

2.7 Confirmation Test: For alcohol testing, a confirmation test means a second test following a screening test with a result of 0.02 or greater that provides a quantitative data of alcohol concentration. Confirmation of the screening test must be by an Evidential Breath Testing (EBT) device (also known as a Breathalyzer). For controlled substances testing, a confirmation test means a second analytical procedure to identify the presence of a specific drug metabolite which is independent of the screen test and which uses a different technique and chemical principle from that of the screen test in order to ensure reliability and accuracy.

2.8 Reasonable Cause: Reasonable cause (suspicion) may arise when an employee experiences work performance problems with no apparent explanation, manifests abnormal, erratic or uncharacteristic behavior, places himself/herself or others at risk for personal injury, or otherwise gives a manager or supervisor reason to believe the employee may be using or under the influence of illegal drugs, alcohol or drugs.

2.9 Substance Abuse Professional (SAP): A certified professional (medical doctor or doctor of osteopathy), or a licensed or certified psychologist, social worker, employee assistance professional, or addiction counselor (certified by the National Association of Alcoholism and Drug Abuse Counselors Certification Commission), with knowledge of and clinical experience in the diagnosis and treatment of drug and alcohol-related disorders.

2.10 Serious Accident: Any significant motor vehicle accident or non-motor vehicle incident which involves other than minor property damage, the issuance of a citation, any death, towing of vehicles from the scene, or injuries requiring medical attention away from the scene, or upon reasonable suspicion that drugs and or alcohol may have been involved. Also included are significant near-incidents which have/had the potential for serious injury or other than minor property damage.

2.11 Serious Injury: Any injury requiring other than first aid or the one time treatment by a physician, e.g. OSHA recordable injuries, or upon reasonable suspicion that drugs and or alcohol may have been involved in the event resulting in the injury.

3.0 POLICY

It is WESTON's policy to perform drug and/or alcohol testing in the following instances:

Note: Medical Contacts or Safety Officers will schedule all drug tests referenced within this guidance document through WESTON's medical provider network using the appropriate WESTON authorization forms. Routine drug testing results are typically received within 5 business days from the date of sample collection.

- Pre-employment: A drug test will be administered on all prospective new employees.

  Guidance: *All new employees (anyone who will be receiving a WESTON paycheck) starting on or after 1 January 2001 will need to be scheduled through the local Safety Officer or Medical Contact for a* ***drug test not later than his/her first week of employment. At the discretion of the Hiring Manager, temporary employees obtained through a service provider (who do not receive a WESTON paycheck) may also be required to pass a drug test administered through the service provider or WESTON.*** *When possible, hiring managers should have a prospective new employee (or temporary employee) tested prior to the actual start date if such agreement is acceptable to both parties.* ***Pre-employment testing may not be accomplished more than 60 days in advance of the start date.***

  Note: If an employee received and passed a pre-employment drug test and there is a break in service of greater than one calendar year (12 months), a new pre-employment drug test will be required.

  WESTON's medical provider will send an email to the local Medical Contact as well as CEHS when there is a negative test result. The local Medical Contact is responsible for communicating receipt of the negative test result (typically received with 5 business days) to the hiring manager.

  WESTON's medical provider will inform CEHS of any confirmed positive test results, typically within 5 business days. CEHS and/or Human Resources will notify the hiring manager by phone upon receipt of a positive test result. If the prospective new employee has not started work with us, the offer will be rescinded. If the person has already started work when the positive test result is received, employment will be terminated.

- Post Accident or Injury: Drug and alcohol testing will be administered after a serious accident or serious injury occurs.

  Guidance: *Managers are to schedule an employee involved in a serious accident or injury for a drug and alcohol test within 24 hours of such incident using the local Safety Officer or Medical Contact for scheduling the testing. A serious accident or injury may involve property damage in excess of $1,000 or involve lost time from the job beyond the day of the incident. This type of testing will be conducted on a case-by-case basis with consultation with CEHS and/or the Law Department. It is important that decisions do not impact or delay necessary medical treatment. If an incident occurs after normal business hours or over a weekend and the Corporate Director, EHS/QA can not be reached by cell phone for consultation, a Division Safety (EHS) Manager may authorize testing based upon the definition provided above.*

WESTON's medical provider will send an email to the local Medical Contact as well as CEHS when there is a negative test result. The local Medical Contact is responsible for communicating receipt of the negative test result to the hiring manager. WESTON's medical provider will inform CEHS of any confirmed positive test results. CEHS will then inform Human Resources who will notify the employee's manager by phone upon receipt of a positive test result and review the steps to be taken with respect to an EAP and substance abuse counseling referral, as well as leave without pay status. If the employee has less than one-year tenure, employment will be terminated.

- <u>Return to Duty and Follow-up</u>: Drug and alcohol testing will be administered upon return to work and on a random basis thereafter following a drug or alcohol rehabilitation program.

  Guidance: *Any employee(s) who receives a confirmed positive drug test result and successfully completes a substance abuse counseling program, including passing a second drug and/or alcohol test to clear him/her for return to work, will be placed in a random drug-testing program administered by CEHS. Such employee(s) will be subject to random drug testing for the duration of their employment with the company. A second confirmed positive drug or alcohol test result, post-counseling program, will require termination of employment.*

- <u>Reasonable Cause</u>: Drug and alcohol testing will be administered when an employee's on-the-job behavior indicates he/she may be under the influence of drugs or alcohol in violation of Company policy.

  Guidance: *Managers/supervisors will receive training on WESTON's Employee Assistance Program, as well as the recognition of performance indicators linked to possible substance abuse. Reasonable Cause shall mean that evidence which forms a reasonable basis for concluding that it is more likely than not that a person has engaged in substance abuse. Facts which could give rise to reasonable cause include, but are not limited to: the odor of alcohol or drugs; impaired behavior such as slurred speech and decreased motor coordination; marked changes in personality or job performance; and unexplained accidents.*

  Managers/supervisors should review their observations in consultation with Human Resources, CEHS or the Law Department to determine the proper course of action and whether drug and/or alcohol testing is warranted. If testing is to be performed, the local Medical Contact or Safety Officer will schedule a test as soon as possible ***(without notice to the employee)****, not later than 24 hours and preferably the same day.* ***The employee's manager or a trained supervisor must accompany the employee to the testing facility.***

  WESTON's medical provider will send an email to the local Medical Contact as well as CEHS when there is a negative test result. The local Medical Contact is responsible for communicating receipt of the negative test result to the employee's manager. WESTON's medical provider will inform CEHS of any confirmed positive test results. CEHS will then inform Human Resources who will notify the employee's manager by phone upon receipt of a positive test result and review the steps to be taken with respect to an EAP and substance abuse counseling referral, as well as leave without pay status. If the employee has less than one-year tenure, employment will be terminated.

- Site-specific Project Assignments: WESTON reserves the right to conduct testing for drugs and/or alcohol on certain projects or assignments when the Company deems it necessary or appropriate to do so. All such testing will be in accordance with this operating practice.

  Guidance: *PMs or CSMs desiring to implement a site-specific drug and/or alcohol testing program when not required by law or contract must prepare a justification of need document that details significant and appropriate factors and rationale for such testing initiative. Approval to institute such program must be obtained from the Director of Human Resources or his/her designee prior to implementation.*

- Random Testing: WESTON reserves the right to conduct random testing for drugs and/or alcohol when it is required by applicable law, regulation or client contractual obligations, or when the Company otherwise deems it necessary or appropriate to do so. Employees returning after a positive test result will be subject to a random testing program. All CDL Drivers will be enrolled in a random testing program at the frequency specified by the Department of Transportation.

  Guidance: *An employee who receives a confirmed positive drug test result and successfully completes a substance abuse counseling program, including passing a second drug test to clear him/her for return to work, will be subject to random drug testing for the duration of their employment with the company. A second confirmed positive drug or alcohol test result, post-counseling program, will require termination of employment.*

  CEHS is responsible for determining the frequency of such testing and WESTON's medical provider will select individual employees for such testing and will provide CEHS with a list of employees to be scheduled. CEHS will then notify the appropriate local Medical Contact who will schedule the selected employee(s) for testing. Sample collection should occur within 24 hours of notification.

  WESTON's medical provider will send an email to the local Medical Contact as well as CEHS when there is a negative test result. The local Medical Contact is responsible for communicating receipt of the negative test result to the hiring manager. WESTON's medical provider will inform CEHS of any confirmed positive test results. CEHS will then inform Human Resources who will notify the employee's manager by phone upon receipt of a positive test result and review the steps to be taken with respect to an EAP and substance abuse counseling referral, as well as leave without pay status. If the employee has less than one year tenure, employment will be terminated

  Employees who are required to have and maintain a CDL for use on WESTON business will be enrolled in a random testing program in accordance with U.S. DOT regulations. Additionally, for those employees who are CDL-drivers, WESTON'S Medical Review Officer will inform the employee who has a confirmed positive drug test result that he/she may request a re-test of the original specimen/sample within 72 hours of receipt of the confirmed positive test result, at the employee's pre-paid expense. The employee will be placed on leave without pay status until the results are received and follow-up is accomplished as determined by a negative or positive test result..

- Client-required Testing: WESTON will review Client-required drug and alcohol testing programs prior to employee participation, to ensure that appropriate safeguards and protocols are in place.

  Guidance: *If a Client requirement for drug testing is identified at the RFP/proposal preparation stage, the CSM or PM should inform the Client that WESTON maintains a Drug and Alcohol Testing Program that is consistent with Federal Government requirements. WESTON prefers that Client-required testing be conducted through WESTON's Program with the oversight of WESTON's Medical Review Officer and with appropriate certifications to the Client. Additional costs associated with site-specific drug testing should be considered when pricing such projects (approximately $56/test).*

  The Client should be informed that WESTON's Program can be modified to meet special testing requirements, such as adding additional substances for testing that are not part of WESTON's routine panel of five substances. If the Client insists that WESTON employees be tested under the Client's program, a copy of the Clients program should be obtained and provided to the Contracts and CEHS Departments for review of appropriate safeguards for employee confidentiality, testing protocols, and indemnification.

  If WESTON 's Program is utilized, tests should be scheduled through the local Safety Officer or Medical Contact. WESTON's medical provider will send an email to the local Medical Contact as well as CEHS when there is a negative test result. The local Medical Contact is responsible for communicating receipt of the negative test result to the hiring manager and the Client (if required). WESTON's medical provider will inform CEHS of any confirmed positive test results. CEHS will then inform Human Resources. Human Resources will notify the employee's manager by phone upon receipt of a positive test result and review the steps to be taken with respect to an EAP and substance abuse counseling referral including leave without pay. If the employee has less than one year tenure, employment will be terminated.

  If the Client 's Program is utilized, tests will need to be scheduled through the Client's designated contact with negative results provided to the local WESTON Medical Contact and positive results provided only to CEHS. The local Medical Contact is responsible for communicating receipt of the negative determination to the employee's manager. CEHS will inform Human Resources of any confirmed positive test results who will notify the employee's manager by phone upon receipt of a positive test result and review the steps to be taken with respect to an EAP and substance abuse counseling referral including leave without pay; or if the employee has less than one year tenure, employment will be terminated.

3.1 Pre-employment Testing

Urine specimens will be taken from all prospective employees as part of the employment procedure. An applicant will not be eligible for employment if a test result is positive. If an applicant tests positive for illegal drugs, management may, at its discretion, in consultation with the Vice President of Human Resources or his/her designee, permit the applicant to request a re-confirmation test on the original specimen at the applicant's expense.

3.2 Employees With Less Than One Year of Service

Any employee, except as required by law, e.g., a CDL-Driver, who receives a confirmed positive test result will be subject to immediate termination of employment, notwithstanding any other provisions in this operating practice.

3.3 Testing Methods

WESTON will use a SAMSHA approved laboratory. Drugs tested will follow the protocol and cut-off levels that are in compliance with the Department of Health & Human Services (DHHS) guidelines, unless a client or applicable law specifies a different protocol and/or cut-off levels. WESTON reserves the right to expand the recommended list to include newly developed substances, changes in WESTON policy, or changes to Federal laws and regulations. Specimens will be testing using approved screening procedures with confirmation testing using GC/MS or other approved procedures. A Breathalyzer test will be used when testing for alcohol is required.

Sample collection, analysis, review of results and employee/employer notification will be conducted under the direction of a MRO selected and/or approved by WESTON. All specimen samples shall be collected with due regard to the privacy of the employee and in a manner reasonably calculated to prevent substitution or contamination of the sample. Specimen collection shall be documented, and documentation procedures shall include labeling of specimen containers to reasonably preclude erroneous identification of test results. The MRO will review all tests, including those tests mandated under U.S. DOT CDL regulations, and will notify the Corporate Environmental, Health and Safety Department of all positive test results. Results of all such testing will be maintained in the employee's confidential medical file.

3.4 Commercial Driver's License ("CDL") and Other Regulatory Testing

Applicants and employees required to have CDLs must have a pre-placement drug test and be enrolled in a Random Testing Program in accordance with U.S. Department of Transportation (U.S. DOT) requirements. Similarly, applicants and employees subject to other regulatory testing requirements will be tested according to relevant regulatory guidelines.

3.5 Substances to be Included in Testing

Alcohol (ethanol), amphetamines, cannabinoids (marijuana), cocaine, opiates, phencyclidine (PCP), and their metabolites will be included. Because WESTON is concerned about the abuse of prescribed and over-the-counter medications as well as illegal drugs and alcohol, the above list may be expanded to include yet to be developed substances, changes in WESTON policy, or changes to Federal laws and regulations.

3.6 Employee Assistance and Alcohol/Drug Rehabilitation Programs

See Section 5.0 of WESTON Operating Practice 05-01-010, *Drugfree Workplace*, regarding counseling, rehabilitation and assistance that may be provided through the Company's employee assistance program. The employee assistance program will refer CDL-Drivers to a separate SAP in accordance with U.S. DOT requirements.

3.7 Failure or Refusal to Submit to Testing

An employee's failure or refusal to submit to required medical or physical examinations, including drug testing, shall be grounds for disciplinary action, up to and including termination of employment.

3.8 Training

All supervisory and management level employees will be trained in the recognition of substance abuse to aid in the detection of and assistance with abusers. Non-supervisory employees will also be trained in substance abuse educational resources. Training will be conducted in accordance with applicable regulatory guidelines, including U.S. DOT regulations for CDL-Drivers.

4.0 TESTING RESULTS AND CONFIDENTIALITY

4.1 General Procedures

Upon receipt of a positive confirmed test result from the testing laboratory, WESTON's MRO will make a good faith effort (within three days) to inform an employee or applicant by telephone of such positive test result, and discuss any possible factors that may have influenced the result. The MRO will communicate any options that may be available to the employee or applicant.

Following such communication or attempt to communicate such information, the MRO will communicate the results to WESTON. Any employee (including CDL-Drivers) who receives a confirmed positive test result will be placed on leave without pay (LWOP) status and be required to participate in an appropriate substance abuse counseling program approved by WESTON, consistent with WESTON's *Drugfree Workplace*, Operating Practice 05-01-010. Upon completion of such a program, and the successful passing of a drug test, an employee may be returned to his/her former work status, and will be subject to subsequent random drug testing.

Employees who test positive and elect not to participate in a WESTON-approved substance abuse counseling program will have his/her employment terminated. Any employee who was referred to a substance abuse counseling program, and/or participated in such a program and fails a subsequent drug test will have his/her employment terminated.

A CDL-Driver employee who has received a positive result may at his/her sole expense, request a re-test of the original specimen, if such request is made within 72 hours of his/her receipt of such positive result in accordance with U.S. DOT regulations.

WESTON will provide to the employee or applicant, upon request, a copy of his/her drug or alcohol test results.

4.2 Confidentiality

WESTON, its medical consultant(s), the testing laboratory, drug and alcohol rehabilitation programs and their agents who receive or have access to information concerning drug tests shall keep all such information confidential.

Release of such information under any circumstances shall be solely pursuant to a written consent form signed voluntarily by the person tested, except where such release is compelled by a court order or otherwise by law, or where deemed appropriate by a professional or occupational licensing board in a related disciplinary proceeding.

5.0 INTERPRETATION

The Vice President, Human Resources, or his/her designee, will provide guidance concerning necessary interpretations of the provisions of this operating practice.

The following form shall be used by the Company to obtain consent from all applicants and employees prior to conducting any test for Drug or Alcohol abuse:

ACKNOWLEDGEMENT OF OPERATING PRACTICE AND CONSENT FOR ALCOHOL, DRUG, AND SUBSTANCE SCREENING

I acknowledge that I have received and read the Weston Solutions, Inc. (WESTON®) *Drug and Alcohol Testing* Operating Practice 11-09-001 and *Drug-Free Workplace*, Operating Practice 05-01-001.

I hereby give my consent to Weston Solutions, Inc. (WESTON®), WESTON's authorized Medical Provider(s), and their contracted local medical facilities to collect blood, urine and/or saliva from me to determine the presence or use of alcohol, drugs or other controlled or illegal substances. Further, I give my consent for the release of the test results to authorized WESTON personnel for appropriate review consistent with the above-referenced operating practices. I also understand that if I refuse to consent, I will be subject to termination of my employment.

Agreed to: ____________________ *Date:* ____________

Witness: ____________________ *Date:* ____________

PLEASE RETURN SIGNED FORM TO THE LAW DEPARTMENT, M-3

ATTACHMENT I

UXO INFORMATION

Attachment I

Unexploded Ordnance (UXO) Support Plan

for

Raritan Arsenal
Edison, New Jersey

Table of Contents

List of Tables

1 INTRODUCTION

WESTON Solutions Inc., (WESTON) recognizes that a safe working environment can only be achieved by close and complete cooperation between management and employees. Direction and administration of UXO avoidance plan procedures are a corporate responsibility, while implementation in a safe and efficient manner is the direct responsibility of all WESTON personnel.

WESTON prepared this site-specific UXO Work Plan for UXO safety support services to be performed during activities at the Site.

This WP is tailored to the potential hazards and level of effort required to complete UXO related services. The plan describes health and safety procedures and the equipment required to minimize the potential for hazardous exposures during these activities.

Adherence to the requirements of this WP will significantly reduce, but not eliminate, the potential for occupational injury and illness at each work area. Should operational circumstances substantially differ from those described and/or anticipated, activities shall be temporarily terminated until the suspect hazards are evaluated and appropriate health, safety, and operational precautions are implemented.

1.1 Purpose

This WP establishes procedures, guidelines, and general safety precautions to be followed by WESTON employees when providing UXO services during intrusive activities and drilling/soil sampling activities.

2 SCOPE OF WORK

2.1 Description of Tasks

WESTON is providing the necessary personnel, equipment, materials, supplies, and facilities to perform UXO services. On-site fieldwork will include:

- **Unexploded Ordnance Safety Support -** A UXO team consisting of a minimum of two qualified UXO personnel (one UXO Technician III and one UXO Technician II) shall be used to provide safety support prior to intrusive activities.

2.2 Work Schedule

To be determined by the WESTON Project Manager in consultation with the US Army Corps of Engineer's Project Manager.

3 ORGANIZATIONAL STRUCTURE/RESPONSIBILITY

3.1 Management Organization

WESTON's **Project Manager** is responsible for making resources available (personnel, facilities, and equipment); communicating and implementing instructions from the client; for scoping, negotiating, or modifying costs and schedules; managing all aspects of the project; coordinating all contract work; and overseeing task identification and resolution. The Project Manager is responsible for achieving the contractual cost and schedule targets; coordinating the preparation of the Avoidance Plan specifications and schedules; and identifying the technical and site personnel to accomplishing the scope of work. WESTON's Project Manager interfaces directly with the client's Project Manager, advises on the status of progress, and promptly implements authorized changes.

3.2 On-Site UXO Technical Organization

As the minimum the UXO organization will consist of one on-site UXO team, comprised of one Senior UXO Supervisor (SUXOS) {Qualified at the UXO Technician III level or higher) and one UXO Technician II. Should work areas become widely dispersed or complex such that one team will not suffice, additional UXO personnel (UXO Technician II level) may be brought in to in supplement the original team and further insure safety.

The SUXOS has direct responsibility and is the technical lead for all on-site UXO operations. The SUXOS has the final authority for on-site personnel regarding all matters concerning UXO. This person shall be a graduate of the U.S. Naval Explosive Ordnance Disposal School in Indian Head, MD, and shall have a minimum of 10 years of combined active-duty military EOD and contractor UXO experience. This person:

- Implements and executes the tasks outlined in the Statement of Work
- Assures that all personnel are briefed daily on health and safety requirements
- Monitors all aspects of UXO related activities and ordnance and explosive (OE) characterization and investigation
- Continually evaluates operations to determine the effectiveness and efficiency of established procedures.
- Prepares daily field reports and logs of all on-site activities and recommends implementation of corrective actions as necessary
- Final authority for on-site personnel regarding all matters concerning UXO and can temporarily stop UXO related operational activities to correct safety deficiencies
- Monitors the ordnance related work performance of operational personnel to assure observance of all UXO related safety and health rules
- Maintains records on all UXO related health and safety issues and assures reportable accident and incident reports are submitted in a timely manner.

The **UXO Technician II** shall be a graduate of the U.S. Naval Explosive Ordnance Disposal School in Indian Head, MD. He shall have at least three years of active duty and EOD experience; and may be an UXO assistant with five years combined active military EOD and contractor UXO experience. This person:

- Is responsible for safely conducting all site inspection and remedial investigation support activities as assigned by the UXO Technician III

- Is responsible for the ordnance related safety of all non-EOD personnel in his accompaniment
- Can temporarily stop UXO related operational activities to correct safety deficiencies

3.3 Visitors

Visitors not directly affiliated with the project activities are not permitted within the project boundaries without prior notice. If possible, the UXO Technician III shall be notified 24-hours prior to any planned visit – the notice shall include the identity, number of visitors in the party, duration of visit, and purpose of visit. This allows for the scheduling of work and safety escorts (if required).

4 TRAINING REQUIREMENTS

4.1 Health and Safety Training

WESTON personnel will receive safety and health training to enable them to perform their assigned tasks safely and efficiently. WESTON personnel will be required to read the project Site Safety and Health Plan (SSHP) and this WP prior to working on the site. They shall acknowledge their understanding of both documents by signing WESTON's Work Plan Acknowledgment Form.

WESTON's SUXOS will conduct daily Morning Safety Meetings to inform all personnel and visitors of daily objectives, planned operations, and associated hazards. The Morning Safety Meetings are described in Section 6.1.1.

Personnel will be encouraged to keep the lines of communications between the field operations personnel and supervisors open to permit the free flow of information and exchange of ideas to enhance operations.

4.2 Site Specific Training

Prior to beginning site work, project personnel will receive site-specific training. As the minimum, this training will consist of hazards communication, names of personnel responsible for site health and safety; known health and safety hazards on-site; use of personal protective equipment (PPE); safe work practices expected; safe and effective use of equipment on-site; and medical surveillance requirements including recognition of symptoms and signs of exposure to hazards, decontamination procedures, UXO awareness, and the emergency response plan.

The individual conducting site-specific training will document the training.

Project personnel are also required to receive an explosive ordnance safety briefing from the USAF EOD Detachment prior to beginning work on the project. All site personnel are required to have this training.

4.2.1 UXO Training

Only UXO qualified personnel will be involved in UXO procedures. All personnel involved in the handling of UXO will be graduates of the U.S. Naval School of Explosive Ordnance Disposal, Indian Head, and MD.

The SUXOS will review all available data relating to the UXO anticipated to be on-site. All operational personnel will be refreshed on the recognition of the anticipated UXO items as dictated by historical records. As additional UXO are encountered, training will be provided to assure all personnel are alerted to the additional hazards.

Operational personnel will also be briefed on the hazards associated with electro-explosive devices (EED) and their susceptibility to electromagnetic radiation (EMR) in the radio frequency (RF) range.

4.2.2 OSHA Training

All UXO personnel shall have successfully completed a 40-hour comprehensive course with training in hazard recognition and basic health and safety issues, as required by the occupational safety and health regulations contained in 29 CFR 1910.120(e). Completion of an annual 8-hour refresher course is also required. Personnel engaged in site supervisory positions will have completed the 8-hour OSHA supervisory training as specified in 29 CFR 1910.120(e).

4.2.3 Hazards Communication Training

WESTON will communicate the hazards of materials used or encountered to on-site personnel. All WESTON personnel will be aware of client concerns for adequate Hazards Communication Training due to federal state, and local regulations directly affecting certain activities. WESTON will comply with all federal and state hazard communication standards.

4.2.4 Hearing Conservation Training

Training for personnel exposed to excessive noise levels will include the physical and psychological effects of high noise levels; noise exposure limits; and the selection, use, and limitations of hearing protection devices.

4.3 Visitor Training

All on-site visitors shall receive a health and safety briefing that describes operational activities and associated hazards. Visitors will be briefed on the boundaries of the work area and the procedures for entrance and exit from the site. Visitors will also be advised of emergency evacuation procedures and assembly points.

Appropriate protective clothing items will be provided to the visitors prior to entry to operational areas. All hazardous OE activities will cease when visitors are present and when a non-UXO qualified person is escorted or wanders into the exclusion zone. However, if the visitors are UXO qualified, UXO activities in the exclusion zone may continue. This visitor briefing will be documented. All personnel who enter the exclusion zone during UXO operations should be essential to the conduct of the operation.

5 HAZARD EVALUATION

WESTON will comply with all federal and state hazard communication standards. The potential hazards to personnel performing the functions outlined in this WP have been identified as explosive, chemical, industrial, and physical. All personnel prior to commencing work activities shall review the entire WP. All employees working on-site must be capable of identifying any additional hazards at the work site and notifying supervisory personnel. Supervisory personnel will determine the impact or risk of any newly identified potential hazard. All hazards or suspected conditions that may pose hazards must be assessed to assure proper protection of operational personnel, the public, and the environment.

In the event additional hazardous materials or hazardous conditions are discovered that pose an imminent threat to the safety of operational personnel, the public, and/or the environment, operations will cease until a safe course of action is determined. Determination to proceed must consider the personal protective equipment (PPE) required for continuance of operations.

The cardinal rule to be observed in any location or operation involving explosives, ammunition, severe fire hazards, or toxic materials is to limit exposure to a minimum number of personnel, for a minimum amount of time, to the minimum amount of hazardous material consistent with safe and efficient operations. All operations shall be examined to devise methods for reducing the number of people exposed, the time of exposure, and the quantity of material handled at any given time. Determination of personnel limits requires that jobs not essential to a particular hazardous operation be performed elsewhere and that no unnecessary personnel visit the operational area.

5.1.1 Ordnance and Explosives (OE) Hazards

Minimal OE hazards have been encountered during previous investigations. WESTON will perform avoidance techniques as a precaution while working in areas suspected of containing UXO. These techniques include marking and avoiding suspect UXO, and relocating surface and subsurface sampling sites to areas free of anomalies which may be UXO.

5.1.1.1 Ordnance Safety Precautions

Maximum safety can only be achieved through adherence to applicable safety precautions, a preplanned approach, and intensive supervision. The following precautions shall be observed:

- Only UXO qualified personnel will be involved in UXO avoidance procedures.
- UXO that has been exposed to fire and detonation must be considered extremely hazardous.
- Do not wear outer or undergarments made of wool, silk, or synthetic textiles (such as rayon and nylon) while working near UXO. These materials can generate sufficient static charge to ignite fuels or initiate explosives. Any person coming in contact with a UXO shall ground himself prior to touching EEDs in order to discharge any electrostatic charge accumulation from the body.
- Do not depress plungers, turn vanes, or rotate spindles, levers, setting rings, or other external fittings on the UXO. Such action may arm, actuate, or function the UXO.
- Do not dismantle, strip, or subject any UXO to unnecessary movement, except in response to a valid requirement.
- Assume a practice UXO contains a live charge until is can be determined otherwise.
- Do not allow unauthorized or unnecessary personnel to be present in the vicinity of UXO.

Limit personnel exposure time. Operations shall always be based upon minimum exposure consistent with efficient operations.

- Avoid inhalation of, and skin contact with, smoke, fumes, and vapors associated with explosives and hazardous materials.
- Do not rely on the color-coding of UXO for positive identification of contents. Munitions having no, incomplete, or improper color-coding may be encountered.
- Avoid the area forward of the nose of a munition until it can be determined that the item is not a shaped-charge type item.

5.1.1.2 Recovered Chemical Warfare Materiel

Chemical Warfare Materiel (CWM) is not suspected at this site. If suspected CWM is located at any time, all work will cease immediately. Site workers will withdraw along cleared paths from the area containing the CWM. WESTON personnel will clearly mark the area containing CWM and report the chemical event. WESTON personnel shall standby in an upwind location until relieved by a government representative. The report of discovery of suspected CWM will be made to the Site Manager immediately upon discovery.

If the presence of CWM is confirmed, the government representative will report the chemical event to the appropriate agencies.

When reporting the suspect CWM, UXO personnel will give the following information to the Site Manager; lack of information shall not delay the report.

- Date and local time of event
- Location
- Quantity and type of munition(s) or container(s) and chemical agents involved
- Description of what has happened
- Description of property damage
- Personnel casualties and/or injuries
- Whether medical services or facilities are required
- Assistance required
- Any other pertinent information

5.1.2 Explosives and Propellants

5.1.2.1 Properties of Initiating Explosives

Initiating explosives include lead azide, mercury fulminate, lead styphnate, and tetracene. They manifest extreme sensitivity to friction, heat, and impact. When involved in a fire, they can be expected to detonate without burning. In storage, initiating explosives shall be kept wet with water/alcohol mixtures. Place emphasis on cleanliness and general housekeeping, since contamination of these explosives with foreign, particularly gritty material markedly increases their sensitivity. Storage water must be free of bacteria-forming impurities, which could react to form gases.

5.1.2.2 Properties of Booster Explosives

Explosives used for this purpose include tetryl, RDX, PETN, and RDX with added ingredients. These explosives have sensitivities between initiating explosives and those of explosives used as bursting charges, such as TNT. They may be ignited by heat, friction, or impact and may detonate when burned in large quantities or at too great a depth. Some of these materials are toxic when taken internally or by skin contact, and special PPE precautions may be necessary to protect personnel. Efforts should be utilized to minimize dust in the employee's breathing zone.

5.1.2.3 Properties of Bursting Explosives

Bursting explosives include explosive D (ammonium picrate), amatol, picric acid, TNT, tritonal, RDX compositions, HMX compositions, torpex, DBX, and HBX. In general, these materials are less sensitive than initiating or boostering explosives. Alkaline cleaning agents or other alkaline products should not be permitted in buildings where large quantities of these explosives are located.

- ***Amatol*** forms sensitive compounds with copper and brass.
- ***DBX*** is an aluminized explosive that is somewhat hygroscopic and reacts with metals in the same manner as amatol.
- ***HBX*** out gasses when exposed to water.
- ***HMX*** compositions usually result in power explosives with a high degree of thermal stability.
- ***Pentolite*** tends to separate into its ingredients (PETN and TNT) and should, therefore, be handled as carefully as PETN.
- ***Picratol*** is a mixture of TNT and explosive D.
- ***Tetrytol*** is a mixture of tetryl and TNT, which is stable in storage but exudes at 149°Fahrenheit.
- ***Tritonal*** is a mixture of TNT and aluminum powder and is more sensitive to impact than TNT. Tritonal must not be exposed to water.

5.1.2.4 Properties of Other Explosives

Other frequently encountered military explosives include black powder and nitroglycerin.

- ***Black powder*** deteriorates rapidly on absorption of moisture but retains its explosive properties indefinitely if kept dry.
- ***Nitroglycerin*** is extremely sensitive to impact and friction.

6 SITE CONTROL MEASURES

6.1 Daily Operational Procedures

The protocols shall include, but not be limited to, the following:

- The SUXOS will review existing site conditions and recommend any required health and safety modifications to this WP based on the same.
- All safety and monitoring equipment will be checked for proper function.
- The SUXOS will ensure that first aid equipment is complete and readily available.
- At the morning safety meeting, personnel will be briefed and updated on safety precautions, any change to the tasks and objectives of the WP, and anticipated weather conditions.

6.1.1 Morning Safety Meetings

Prior to commencing work each day, the SUXOS will conduct a morning safety meeting for all personnel and visitors. At a minimum, the meeting will include the daily objectives, planned operations, potential hazards and risks associated with each day's planned activities, previous confirmed encounters with hazardous materials, and any other issues relevant to the WP tasks and objectives. Meeting attendance will be documented on a Safety Meeting Attendance Log.

6.2 Activity Exclusion Zones

Designated exclusion zones are the primary means of maintaining site control and reducing migration of hazardous materials into uncontaminated areas during UXO operational activities. The exclusion zones will limit hazardous area access, contain hazardous materials, secure the work zone, and a buffer zone between the potentially hazardous area and the remainder of the site. Site control will be maintained at all times. Only those personnel directly involved with the task being performed will be permitted in exclusion zone.

The UXO Team will be alert to anyone entering an exclusion zone without proper authorization. Intruders will be directed to the field office. Visitors will not be permitted to enter the exclusion zone until all credentials are in order, a safety briefing has been presented, the visitor log is properly annotated, and UXO related operations have ceased.

6.3 Safe Work Practices

Personnel working with ordnance or explosives shall comply with the following general precautions while conducting operation activities:

- Operations will cease and personnel will evacuate the site when severe weather, with lighting, is within five miles of the work site.
- Cease UXO operations during sand or dust storms.
- Carrying fire or spark-producing devices is prohibited.
- Eating, drinking, chewing gum or tobacco, and smoking are prohibited.
- Fires for heating or cooking are only permitted in authorized areas.
- Do not conduct any operational activities without approved operating procedures and proper supervision.
- Do not become careless by reason of familiarity with OE related materials.

- Avoid direct physical contact with suspect chemical hazards.
- All field personnel shall use all of their senses to alert team personnel of a suspected or potentially dangerous situation. If an alarm sounds or the presence of a strong nauseating odor or the visual observance of fire or smoke should occur all personnel are to evacuate the site and notify the UXO Team Leader.
- Field teams must be aware of monitoring equipment, wind direction, nearest water source, evacuation routes and emergency communication and notification procedures.
- Personnel working in the operational area will be restricted to the minimum of two. The "buddy system" will be in effect at all times.
- A first aid-kit shall be readily available at all times.
- Operational activities will only be conducted during daylight hours.

7 SITE PROCEDURES

Items encountered during operations that are positively identified as UXO, will be reported to the Site Manager. Disposition of these items is the responsibility of U.S. military EOD personnel.

UXO avoidance is the primary objective of this task, not broad scale UXO clearance. If possible, when anomalies are present at a pre-selected surface or subsurface sampling site, then a new location may be selected.

7.1 Unexploded Ordnance Safety Support

7.1.1 General Support Considerations

A UXO team consisting of a minimum of two qualified UXO personnel shall be used to provide safety support prior to or during intrusive activities. The UXO team should review any archival information available regarding the area of the proposed activities. If possible, the UXO team should determine the probable types of UXO that may be encountered and specific safety considerations. The UXO team should meet with on-site management and conduct a general work and safety briefing prior to commencement of any on-site activities.

The UXO team should physically preview the actual construction footprint with the on-site management and discuss visual observations and potential areas of concern. In the event UXO is discovered, the UXO team shall place flagging adjacent to the discovery for subsequent visual reference, select a course around the item, and lead project personnel out of the area. The UXO team will safeguard the site pending arrival of the appropriate authority.

If the item is determined to be UXO or a positive identification cannot be made, the Site Manager will be informed that EOD support is required. If the suspect UXO can be safely moved, it may be moved to a safe holding area until the EOD response is complete. If the item cannot be safely moved, no further activities are allowed at that location until EOD has removed the item. Once the item is removed, activities may resume.

7.1.2 Geophysical Instruments

7.1.2.1 Schonstedt Magnetic Locators

Schonstedt Heliflux Magnetic Locators detect surface and subsurface ferrous metal items. The technology is based upon fluxgate sensors organized in a gradiometer format. The Schonstedt locator is a hand-held unit that employs two (2) fluxgate magnetometers that are aligned and mounted a fixed distance apart to detect changes in the earth's ambient magnetic field caused by ferrous metal (the sensors are fixed and aligned to eliminate a response to the earth's ambient field). The Magnetic Locators respond with an audio output and a meter deflection when either one of the two sensors is exposed to a disturbance of the earth's ambient field associated with a ferrous target and/or the presence of a permanent field associated with a ferrous target (in most cases, it will be a combination of both circumstances). The Schonstedt Heliflux Magnetic Locators are highly portable magnetometers that will be used to quickly screen surface and near-surface areas for ferrous content. A Schonstedt appropriately configured for down-hole operations or a Forester Ferex Ordnance Locator, designated the MK26 Ordnance Locator will be used to clear boreholes.

The Schonstedt Model GA-72CV is a reconfigured GA-52C with several design upgrades, as described below. All principles of operation and capabilities are identical. The GA-72CV:

- Has a plastic case with an attached handle grip.
- Has a meter that reads "+" and "-" ranges during operation. This meter aids in determining the orientation or horizontal and near-horizontal subsurface objects.
-

The Schonstedt magnetic locators are all generally capable of ordnance location to the depths shown in Table 1. Detection capabilities should be verified on site prior to beginning operations.

Table 1: Depth Capabilities

ITEM	DEPTH (Feet)
81 mm mortar	1
175 mm projectile	5
MK81 bomb	9

SOURCE: GA-72CV Instruction Manual, August, 1992

7.1.2.2 Foerster Ordnance Locators

The Foerster Ferex Ordnance locator - designated the MK26 Ordnance Locator, is a military-approved locator in use by U.S. Military EOD forces for detecting subsurface ordnance items. The locator is a hand-held unit that incorporates two flux-gate magnetometers, aligned and mounted a fixed distance apart to detect changes in the earth's ambient magnetic field caused by ferrous metal or disturbances caused by soil conditions. When in the down-hole mode and with the indicated settings the MK26 can detect a 40mm target at the distances in Table 2.

Table 2: Foerster Detection Capability

Mode	Scale	Detection Area
1	3	6 Inches
1	1	10 Inches
1	0.03	17 Inches

7.1.3 Calibration

Prior to use in the field each day, geophysical instrumentation will be checked for operational reliability and calibration prior to use in the field. The SUXOS will ensure that this is done against a known, buried item. Copies of instrument checkout and calibration verification will be maintained on-site.

If equipment field checks indicate that a piece of equipment is operating incorrectly and field repair cannot be made, the equipment will be immediately tagged and removed from service. Replacement equipment will meet the same specifications for accuracy and sensitivity as the equipment removed from service.

7.1.4 Maintenance

If an equipment problem is encountered, maintenance will be performed as soon as possible; records of the unscheduled maintenance and corrective action (vendor receipts) will be maintained and will indicate equipment identification, problem description, corrective action, person performing the maintenance, and associated costs.

7.2 Ordnance Procedures

7.2.1 Surface Sweeps

A surface sweep will be done for each area that may contain UXO during this project. The surface sweep allows subsequent unimpeded access by site workers. Access routes will be cleared to a minimum width of twice the width of the widest vehicle. Work areas requiring a surface sweep will be swept to the size of the work area with a 10" buffer zone. Areas swept for surface access will be clearly marked upon completion of the sweep.

An exclusion area will be established around each area during operations. The exclusion area will encompass the area of activity, and it will control access and egress. Only UXO personnel and the USACE Safety Specialist (if on site) will be authorized within the exclusion area during UXO operations. If anyone other than the authorized individuals is found within the exclusion area, all UXO operations will stop until the unauthorized personnel have exited the area. For the purpose of this plan, the exclusion zone will be 200'.

The UXO Team, will use a magnetometer to assist in the investigation, and will inspect the surface for UXO, OE and OE-related scrap. OE related scrap may be collected by the team as it performs the surface sweep. Scrap (if collected) will be placed at the corner of each work area. Any item of OE related scrap too large to be comfortably collected in this manner will be marked. Collected scrap will not be removed from the range.

A magnetometer will be used on this project to assist in the visual surface clearance.
The team will place a pin flag at the location of suspect OE, and record the locations of the pin flags for follow-on action as directed by the SUXOS. The team will use a distinctive color-coding system – dependent upon the colors available at the project site. At mobilization, the SUXOS will designate the color-coding system to mark the following:

- Color 1 = To mark individual OE items and areas containing multiple OE. Only UXO personnel will handle items marked with this color.
- Color 2 = To mark OE-related scrap items free of explosive hazards.
- Color 3 = Surface sweep lane boundaries.

The SUXOS may adjust the color code dependant on site conditions. The SUXOS must ensure that all personnel are fully briefed on any changes to prevent confusing hazardous items with safe to handle material.

UXO personnel will perform Explosive Ordnance Reconnaissance (EOR) procedures on all ordnance items discovered during this surface clearance. EOR procedures are conducted to determine the condition, identity and hazard presented by the item. EOR procedures will not be conducted until all non-UXO qualified personnel have withdrawn to a safe area.

The location of all discovered UXO will be marked on a project map.

7.2.2 Sub-Surface UXO Clearance

For the sub-surface UXO clearance, anomaly acquisition will be conducted with a geophysical instrument in what is commonly known as a mag and flag operation. Once grid boundaries are established, each grid will be subdivided into search lanes that are approximately 5 feet wide. The width of the lane will depend on terrain and may vary from 3 to 5 feet in width. UXO personnel will assemble in line formation, one per search lane, and advance in a slow, continuous pace, visually inspecting the surface for UXO and evidence of explosive compounds in the soil (stains); simultaneously, they will search for subsurface anomalies with a metal detector. This process will continue until the assigned search lane is completed. Each time the instrument indicates an anomaly, the operator places a pin flag next to the highest obtainable reading from the instrument. Once all anomalies have been marked, the UXO personnel will perform anomaly excavation procedures.

A variation of the mag & flag procedure is called a mag & dig. In this case the grid is divided into lanes as before but there is a two-man crew for each lane. As the crew advances each anomaly is excavated as it is encountered. Depending on site conditions it is sometimes more advantageous to use the mag & dig instead of the mag & flag operation. The Senior UXO Technician on site will make the determination to use this technique.

Because of the detection limits of the instruments, the clearance may need to proceed in a series of "lifts" until the required construction depth is reached. The UXO team will use the all-metals detectors to clear the site to 2 feet. Construction personnel will then remove the top 20 inches. This process will be repeated until the required depth is reached.

For areas where the entire site does not require clearance to depth, such as for footings or fence posts, UXO personnel will use down hole instruments to clear the dig site. This will be done in a series of lifts using an auger to cut an access hole to lower the instrument probe until the desired depth is reached. Depth of each lift will depend on the detection capability of the instrument.

7.2.2.1 Excavation Procedures

The UXO Team will excavate down to each anomaly and perform Explosive Ordnance Reconnaissance (EOR) procedures, assessing all suspect ordnance to determine their condition and potential hazards.

- Qualified UXO personnel will perform excavations so that identification procedures can be conducted. If the anomaly cannot be uncovered within the specified depth, the UXO Team will conspicuously mark the site with flagging material and continue. The on-site government USACE Safety Specialist will determine if deeper excavation is required.
- If earth moving machinery (EMM) is used in the excavation of the anomaly, the EMM shall not dig any closes than 12 inches from the anomaly. Once the excavation is within 12 inches of the anomaly, the excavation must be completed manually. If a non-UXO qualified person operates the EMM, the operator shall leave the immediate

area of the excavation while the UXO team completes the manual excavation. If qualified, UXO personnel may operate the EMM.

- Due to the nature of training mines and the potential for booby traps and anti-handling devices, before moving a mine that is recovered, the mine will be thoroughly checked for these devices. As an additional precaution, a grapnel hook and rope may be employed to remotely move the mine – removing UXO technicians from the immediate area of the mine.
- If the subsurface contact proves to be non-UXO, it will be removed and the hole rechecked with a geophysical instrument. If the hole is "clean," it will be refilled and tamped. If the contact is a UXO, it will be marked with a pin flag for disposal as required. The area of 1meter radius around the identified anomaly will be checked to ensure that the primary anomaly was not masking additional anomalies and to ensure that all anomalies have been investigated.
- Each UXO will have its condition and identification determined by qualified UXO personnel.
- All access/excavation/detonation holes will be backfilled with the soils excavated from the hole.

7.3 Fence Post Holes, Soil Sampling and Well Drilling Sites

Down-hole UXO avoidance is not anticipated for the successful execution of this project, however, the procedures are included in the event of a requirement for borehole soil sampling.

The UXO team shall locate magnetic anomaly free areas for soil and groundwater sampling. This shall be accomplished using a magnetometer with down-hole monitoring capabilities. The UXO team shall start the borehole with a hand auger.

At a two-foot depth, the hand auger will be withdrawn and the magnetometer will be lowered into the borehole and the borehole checked for magnetic anomalies. If no magnetic anomalies are found, the procedure will be repeated at two-foot intervals to a depth of maximum depth of 6 feet. If virgin soils are reached at a shallower depth, the UXO Technician III may cease the operation if in his/her opinion the chance of encounter with UXO has been eliminated.

7.4 UXO Operations

7.4.1 UXO Identification

UXO personnel will perform UXO identification and characterization in accordance with EP 385-1-95a *Basic Concepts and Safety Considerations for Ordnance and Explosives Operations* after the suspect UXO has been found.

7.4.2 UXO Reporting

Suspected UXO will be reported to the SUXOS when found. He will investigate the item and report the suspect UXO to the Site Manager. He will then coordinate with the USAF EOD Unit for support.

The SUXOS will ensure that each suspected UXO is listed by type of ordnance, and location within the grid. If a grid system is used, the location within the grid will be measured from the two closest grid corners and the identification of the grid corners measured from (such as 25 feet from northwest corner and 75 feet from northeast) will be included as part of the description. For subsurface UXO the depth below ground surface must also be measured and the type of soil (such as sand, clay, loam, etc.) recorded.

At the end of each day's activities the SUXOS on site will turn in the list of suspected UXO to the site manager. A listing of all found UXO and their disposition will be included in the final report.

7.4.3 UXO Disposal

WESTON will perform no UXO disposal during the execution of this project. USAF EOD personnel will perform all UXO and suspect UXO disposal operations.

7.4.4 Inert Ordnance

During construction activities any inert ordnance items located will be inspected by the UXO Technician (Tech II or higher) and then by the SUXOS who will place the item in a secure storage container after re-inspecting all items to ensure that the items are free from all energetic materials. The SUXOS will maintain an inventory of all items placed in the secure storage container. These will be turned in to USACE at the project completion, or as directed by the USACE, left on the site property.

FLD 21 EXPLOSIVES

GENERAL

Explosives are a special category of hazardous materials. If improperly handled, processed, or stored, explosives can cause substantial property damage, injuries, or death. Thus, the safety of explosives operations must be a primary concern at WESTON.

Explosions fall generally into two major categories: detonations and deflagrations. Detonations are chemical reactions containing large amounts of energy per unit mass. A detonation produces a shock wave that travels faster than the speed of sound in air. Explosive hazards include potential exposure to energetic materials or to the use to metastable or exothermic materials that, although not intended for use as explosives, could react explosively. Another type of explosion is referred to as a deflagration. Deflagrations occur when the pressure of vapors trapped within a space or container exceed the ability of the container to retain the pressure. If the failure produces enough energy, the escaping vapors can be ignited resulting in a fireball sometimes referred to as a BLEVE (Boiling Liquid Expanding Vapor Explosion) that can be deadly and cause severe extensive damage from the fire, shockwave and flying debris. It is different than a detonation because the shock wave associated with a deflagration travels slower than the speed of sound in air.

Recognition and Risk Assessment

WESTON activities involve potential exposure to explosives or use of explosives in a number of ways. Explosives may be used for seismic investigations to improve production of wells, and may also be used in construction. Explosives in the form of containers potentially under pressure due to miss management or abandonment, containers that have been impacted by a fire or other catastrophe may be encountered in hazardous materials response or remediation. Explosions may also be associated with process equipment and repair or replacement of fuel systems. WESTON activities involving exposure to explosives also include investigation and remediation of (1) soils presenting explosive hazards, (2) buildings with explosives residues that represent explosion hazards, (3) unexploded Ordnance (UXO), and (4) military munitions that have been abandoned, expelled from demolition pits or burning pads, lost, discarded, or buried. These are the four categories of explosives referred to as ordnance and explosive (OE). Explosives are also used to dispose of OE categories 3 and 4.

Handling of containers that may present explosion hazards and OE investigation and disposal or any investigation and remediation work where OE may be present are topics addressed in other procedures. This FLD addresses use of explosives for well development, construction and seismic investigations.

REFERENCES

Related FLD OPS:

FLD01 – Noise Protection
FLD30 – Hazardous Materials Use and Storage

29 CFR 1926 sub Part U
USACE EM 385-1-1 Section 29

RESPONSIBILITIES

The project manager, person (s) preparing site specific safety plans and persons providing technical review of site specific safety plans are responsible for determining the hazards associated with explosive materials and a particular explosives operation, specifying the appropriate control measures needed to mitigate those hazards including assignment of qualified persons to perform work with explosives or blasting and establishing controls for explosives used for blasting, seismic investigations, developing wells, etc., and participating in periodic inspections to ensure that appropriate control measures are in effect. It is also the responsibility of the project manager and site manager and Site Safety Officer to ensure explosive handlers and blasters are properly qualified, that blasters licenses are in place and only persons with Commercial Drivers Licenses with explosive endorsements or authorized military personnel operate vehicles transporting explosives.

Prevention and Protection Programs

Only personnel who are approved by the site manager and the Site Health and Safety Coordinator (SHSC) shall be allowed access to an area where there is a recognized potential for explosives or where explosives are being used. Only properly certified persons will perform explosives handling or blasting work.

Explosives are considered a hazardous material and once used, must be handled and disposed of in accordance with Resource Conservation Recovery Act (RCRA) guidance.

PROCEDURE

Potentially Explosive Containers

Working near explosive or potentially explosive containers requires extreme caution. Containers that are over-pressurized to the extent that the container head (opening/bung) is swollen several inches above the level of the chime should not be moved. The practice of tapping containers to determine their contents is neither safe nor effective. A laser thermometer can be used at a distance to determine the level of substance in a container and whether the contents are liquid or non-liquid.

When sampling or venting is required, remotely operated tools are the safest available means of opening containers. Sampling or venting is performed using a backhoe spike, hydraulic drum opener, or pneumatic device. Critically swollen drums should be vented or opened in-place. Drums that can be moved should be staged in an open area. Drums should be placed in rows with adequate aisle space to allow ease in backhoe maneuvering. Once staged, the drums are quickly opened by remotely punching a hole in the drum head or lid with the spike or pneumatic drill, which removes the bung.

Heavy equipment shall be equipped with blast shields to protect against flying debris. Blast shield shelters will be provided for personnel who must remain with in the exclusion distance of potential explosions and fragmentation hazards. Site personnel not protected by blast shields should be far enough away from the potentially explosive containers to avoid being hit by debris if an explosion occurs.

Explosives as Monitoring Devices for Construction and Well Development

Explosives as identified in Table 1 are occasionally used for project work. For example, electronically detonated black powder shells (Betsy Seismic shells) are used as a seismic source for underground surveys. Explosives, blasting caps, detonation cord, etc may be used for construction and well development. Material safety data sheets shall be obtained for explosive products intended for use at a site.

Handling of explosives and performance of blasting will comply with 29 CFR 1926 Subpart U and EM 385-1-1 Section 29.

When using explosives for project work, the following precautions shall be observed:

- Only trained and qualified personnel are authorized to perform explosives work.
- Un-used explosives must be promptly returned to the manufacturer or approved on-site storage.
- Adequate security measures should be taken when storing explosives onsite. DOD and/or U.S. Bureau of Alcohol, Tobacco and Fire Arms regulations must be followed
- The explosives should not be stored behind doors that can be removed. Hinges may or may not be welded and could be removed by unauthorized personnel.
- Signs indicating explosive hazards must be prominent.
- Detonators should be stored away from explosives.
- Gasoline other that in vehicle fuel tanks must not be carried in a vehicle containing explosives.
- An approved Explosives Management Plan must be in place prior to handling of explosives or blasting.

TABLE 1
EXPLOSIVES CLASSIFICATION SYSTEMS

HAZARD	EXAMPLE	DOT CLASSIFICATION
Blast and fragment	Bulk explosive or artillery shell	Class A
Intense heat/fire	Rocket motor	Class B
Minimal hazard	Squibs, small-arms ammunition detonators	Class C
Insensitive high explosives substance	________	Blasting agent

EXPLOSIVES MANAGEMENT PLAN

The following represents minimal requirements for an Explosives Management Plan:

GENERAL

This Explosives Management Plan outlines the procedures to be used by WESTON personnel to acquire, receipt, store, transport, issue, and report the loss of explosives utilized during this project. All personnel involved with explosives will comply with all federal, state, and local laws as required.

LICENSES /PERMITS

ACQUISITION

The types and estimated quantities of explosives that are anticipated are listed in Table -1:

Table 1 Explosive Quantity

ITEM	QUANTITY
Boosters, Cast	TBD
Shaped Charges	TBD
Time Fuse	TBD
Non-electric Detonators	TBD
Detonating Cord	TBD
Fuse Igniters	TBD
NONEL	TBD

Explosives will be purchased from a commercial vendor. Vendor information will be provided as required.

INITIAL RECEIPT

The following procedures will be adhered to upon receipt of explosive materials.

a. Explosives on site will be limited to what will be used in one day with the provision that unused explosives will be returned to the vendor or supplier, or they will be stored in accord with 27 CFR 55.

b. Upon arrival at the site the blaster will escort the vendor to the explosives storage magazine.

c. The vehicle transporting the explosives will be escorted to the explosives bunker prior to unloading.

d. All unauthorized personnel will remain at a minimum of 900 ft from explosive vehicle while it is loading/unloading.

e. An individual authorized to receive the explosives will compare the explosives delivery record to the actual quantity delivered prior to accepting custody for the explosives.

f. Once the quantity has been confirmed, the explosive delivery record will be signed and the explosives transferred to and stored in the approved bunker.

g. All material introduced or removed from the magazine will be entered on stack cards and explosive records updated.

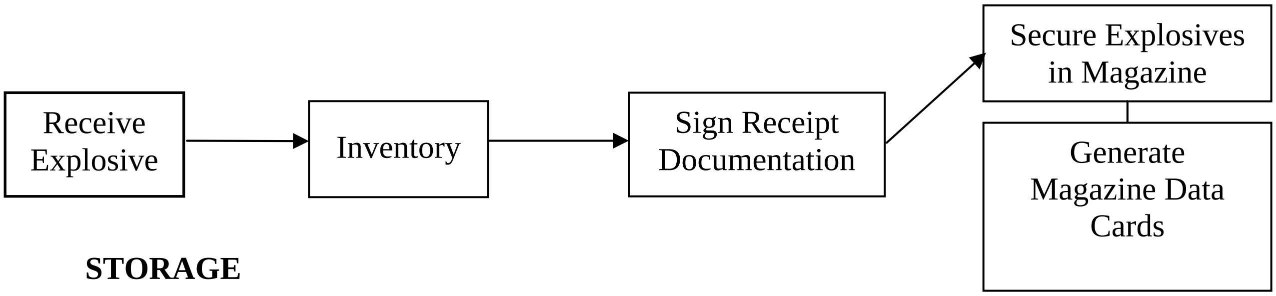
h. If it is determined that there is a discrepancy between the quantity delivered and quantity shipped, the following will occur:

  - Notify the Site Safety Officer.
  - Do not accept shipment.
  - Contact the Shipper to resolve the discrepancy.

Note: If discrepancy cannot be resolved, notify the Local Law Enforcement Agency, Bureau of Alcohol, Tobacco, and Firearms, WESTON Regional Safety Manager, PM, and the client COR.

Figure 1

Procedures for Receipt of Explosives



STORAGE

Explosive materials will be stored as follows:

a. Explosives will be stored in an explosive storage facility (magazine) provided by the client or that WESTON will construct for an explosives facility for the project. These explosive magazines will comply with OSHA, USACE EM 385-1-1, Department of the Army, Bureau of Alcohol, Tobacco, and Firearms, and any appropriate State regulations pertaining to explosive magazines.

b. The explosive magazine will be secured with a padlock having a case hardened shackle and at least five (5) tumblers and shall be protected with a cap constructed of at least No. 14 gage steel so as to prevent sawing or levering action on the lock or hasp.

c. In the event that the lock or facility shows signs or tampering or break-in, do not enter the magazine or touch the broken lock/door. Refer to Subsection on Loss, Theft, and Unauthorized Use of Explosives.

TRANSPORTATION

The transportation of explosives from the magazine to locations requiring demolition operations will be conducted in the following manner:

a. Vehicles transporting explosives from the magazine to locations requiring demolition operations will stay on all roads either improved or unimproved.

b. Speeds will be kept to 20 miles per hour or less depending on road conditions.

c. Radio communications will be maintained with the UXO Safety Officer.

d. Vehicles will have a safety inspection performed prior to loading explosives.

e. Vehicle will be equipped with a first aid kit and a minimum of two (2) each 2A10BC fire extinguishers.

f. Vehicle will be placarded during transport of explosives.

RECEIPT PROCEDURES

Prior to accepting any explosives, the procedures outlined above in the initial receipt procedures will be accomplished.

Only licensed and authorized blasters will be authorized to purchase, receive, access, issue, transport, and use explosives for this project.

Upon completion of each demolition operation, an ammunition consumption report will be completed. Upon expenditure of all explosives, the authorized person will certify in writing that the explosives were used for their intended purpose.

INVENTORY REQUIREMENTS

A physical inventory of all explosives will be accomplished in accordance with the following schedule:

- Whenever explosives are removed from the magazine.

- On a minimum weekly basis, when the magazine is not unlocked and opened.
- Whenever the door to the magazine is unlocked.

Exception: When opened for inspection by State or Federal Inspectors, an inventory need not be completed.

A running inventory will be completed using the Department of Army Form 3020-R Magazine Data Card or equivalent. If a discrepancy exists between the physical inventory and inventory records, the following steps will be taken:

- Notify the Safety/QC Officer
- Re-inventory explosives
- Inspect data cards for errors
- Reconcile data cards, physical inventory, and ammunition consumption reports

Note: If discrepancies continue to exist, see Subsection Loss, Theft, and Unauthorized Use of Explosives.

RETURN OF UNUSED EXPLOSIVES

All explosives not used for demolitions operations will be returned to the magazine at the end of the day. Magazine data cards will be annotated and an inventory completed in accordance with inventory requirements above.

DISPOSAL OF REMAINING EXPLOSIVES

Upon completion of all site activities, the client will be contacted with a request to dispose of all excess explosives. Upon approval from USACE, all explosives will be disposed of in accordance with appropriate demolition procedures.

LOSS, THEFT, AND UNAUTHORIZED USE OF EXPLOSIVES

These procedures apply if either of the following occurs:

- If during an inspection of the explosive magazine, it is determined that forced-entry has occurred:

  a. Do not enter the magazine.

  b. Do not handle or disturb items within the immediate vicinity.

  c. Secure the magazine by posting a guard to prevent further access.

  d. Notify the following individuals:

     i. WESTON Safety Officer
     ii. WESTON Project Manager
     iii. WESTON Division Safety Manager
     iv. WESTON Corporate EHS Director
     v. Client designated contacts

vi. Appropriate local law enforcement agency(s)
vii. Bureau of Alcohol, Tobacco, and Firearms
viii. State agencies as appropriate

e. Do not allow entry into the magazine by others until Law Enforcement Personnel arrive.

f. Immediately upon request of Law Enforcement Personnel perform physical inventory and reconcile on-hand explosives with magazine data cards.

g. Assist above individuals and agencies as needed.

- If during routine inventories discrepancies are discovered and cannot be reconciled, notify the personnel listed above.

EXPLOSIVES SITING PLAN

EXPLOSIVE STORAGE MAGAZINES

The explosive storage magazines to be used on this project are an ABC ATF Type 2 specification magazine with an attached Type 4 class BC cap box attached. Additionally, a IME/DOT truck box will be utilized for transport of the explosives and as a day box. The location of the magazine is depicted in figure 1.

Figure 2: Magazine Siting

PLANNED OR ESTABLISHED DEMOLITION AREAS

EXPLOSIVE REQUIREMENTS

Table 3 Explosive Quantities

ITEM	QUANTITY	CLASS
Boosters, Cast	TBD	TBD
Shaped Charges	TBD	TBD
Time Fuse	TBD	TBD
Non-electric Detonators	TBD	TBD
Detonating Cord	TBD	TBD
Fuse Igniters	TBD	TBD
NONEL	TBD	TBD

BLASTING PLAN

A blasting plan using the following Blasting Questionnaire/Plan or an equivalent Plan providing the information identified below must be developed, written reviewed and approved prior to any blasting:

BLAST QUESTIONNAIRE/PLAN

A. Preparation and Personnel

1. Is Blast Permit Required? (Y/N) __. Who is responsible for obtaining? __________. Has it been obtained? (Y/N) __.

2. Blaster in Charge:
Co-Supervisor:
Shot Logger:
Plan/information provided by:

Identified personnel are qualified according to client, blasting contractor, state and Federal standards? (Y/N)

Name: ________________ Signature:

B. Information to be provided/completed by Blaster before beginning.

1. Explosive

a. Name/Type of Explosive:
b. Size of charges:
c. Configuration of charges:
d. Initiation system to be employed: <u>Electrical Sequential Timer</u>
e. Number of shots:
f. Time between shots:
e. Initiation system acceptable for explosive, size and configuration of charges? (Y/N)

2. Procedures to control flyrock:

3. Vibration control procedures:

Structures of concern:	No.	Distance to closest	Control procedures

4. Misfire procedure.

   a. Wait 60 minutes
   b. Blaster-in-Charge's plan for correction:
      .
   c. Does the situation require contact with manufacturer? ___. If so, was contact made? ___ With whom?

What was direction given if any?

Blast Questionnaire/Plan

B. Shot completion documentation

1. Number of Charges Set:
2. Number of Shots Fired:
3. Number of Misfires:
4. All misfires corrected:
5. Seismograph documents vibration control effective on each shot?
6. Visual inspection of structures completed?
   a. Damage to Sewer?
   b. Damage to Building? __ If yes, describe.

Documentation Completed by:

Name: ______________________ Signature:

ATTACHMENT J

DRILLING SAFETY

1.6 DRILLING SAFETY GUIDE

INTRODUCTION

The organization where you work is interested in your safety, not only when you are working on or around a drill rig, but also ,when you are traveling to and from a drilling site, moving the drill rig and tools from location to location on a site, or providing maintenance on a drill rig or drilling tools. This safety guide is for your benefit.

Every drill crew should have a designated safety supervisor. The safety supervisor should have the authority to enforce safety on the drilling site. A rig worker's first safety responsibility is to listen to the safety directions of the safety supervisor.

Governmental Regulations

All local, state, and federal regulations or restrictions, currently in effect or effected in the future, take precedence over the recommendations and suggestions that follow. Government regulations will vary from country to country and from state to state.

The Safety Supervisor

The safety supervisor for the drill crew, in most cases, will be the drill rig operator.

- The safety supervisor should consider the "responsibility" for safety and the "authority" to enforce safety to be a matter of first importance.
- The safety supervisor should be the leader in using proper personal safety gear and set an example in following the rules that are being enforced on others.
- The safety supervisor should enforce the use of proper personal protective safety equipment and take appropriate corrective action when proper personal protective safety equipment is not being used.
- The safety supervisor should understand that proper maintenance of tools and equipment and general "housekeeping" on the drill rig will provide the environment to promote and enforce safety.
- Before drilling is started with a particular drill, the safety supervisor must be ensured that the operator (who may be the safety supervisor) has had adequate training and is thoroughly familiar with the drill rig, its controls, and its capabilities.
- The safety supervisor should inspect the drill rig at least daily for structural damage, loose bolts and nuts, proper tension in chain drives, loose or missing guards or protective covers, fluid leaks, damaged hoses, and or damaged pressure gauges and pressure relief valves.

- The safety supervisor should check and test all safety devices, such as emergency shutdown switches, at least daily and preferable at the start of a drilling shift. Drilling should not be permitted until all emergency shutdown and warning systems are working correctly. Do not wire ground, bypass or remove an emergency device.
- The safety supervisor should check that all gauges, warning lights, and control levers are functioning properly and listen for unusual sounds on each starting of an engine.
- The safety supervisor should ensure that all new drill rig workers are informed of safe operating practices on and around the drill rig and should provide each new drill rig worker with a copy of the organization's drilling operations safety manual, and, when appropriate, the drill rig manufacturer's operations and maintenance manual. The safety supervisor should ensure that each new employee reads and understands the safety manual.
- The safety supervisor should carefully instruct a crew worker in drilling safety and observe the new worker's progress towards understanding safe operating practices.
- The safety supervisor should observe the mental, emotional, and physical capability of each worker to perform the assigned work in a proper and safe manner. The safety supervisor should dismiss any worker from the drill site whose mental and physical capabilities might cause injury to the worker or coworkers.
- The safety supervisor should ensure that there is a first-aid kit and a fire extinguisher on each drill rig and on each additional vehicle, and ensure that they are properly maintained.
- The safety supervisor (and as many crew members as possible) should be well trained and capable of using first-aid kits, fire extinguisher, and all other safety devices and equipment.
- The safety supervisor should maintain a list of addresses and telephone numbers of emergency assistance units (ambulance services, police, hospitals, etc.) and inform other members of the drill crew of the existence and location of the list.

Individual Protective Equipment

For most geotechnical, mineral, and/or groundwater drilling projects, individual protective equipment should include a safety hat, safety shoes, safety glasses and close fitting but comfortable, without loose ends, straps, draw strings or belts, or otherwise unfastened parts that might catch on some rotating or translating component of the drill rig. Rings and jewelry should not be worn during a work shift.

Safety Head Gear

Safety hats (hard hats) should be worn by everyone working or visiting at or near a drilling site. All safety hats should meet the requirements of ANSI Z89.1. All safety hats should be kept clean and in good repair with the headband and crown straps properly adjusted for the individual drill rig worker or visitor.

Safety Shoes or Boots

Safety shoes or boots should be worn by all drilling personnel and all visitors to the drill site observing drilling operations within close proximity of the drill rig. All safety shoes or boots should meet the requirements of ANSI Z41.1.

Gloves

All drilling personnel should wear gloves for protection against cuts and abrasion, which could occur while handling wire rope or cable and from contact with sharp edge and burrs on drill rods and other drilling or sampling tools. All gloves should be close fitting and not have large cuffs or loose ties that can catch on rotating or translating components of the drill rig.

Safety Glasses

All drilling personnel should wear safety glasses. All safety glasses should meet the requirements of ANSI Z87.1.

Other Protective Equipment.

For some drilling operations, the environment or regulations may dictate that other protective equipment be used. The requirement for such equipment must be determined jointly by the management of the drilling organization and the safety supervisor. Such equipment might include face or ear protection or reflective clothing. Each drill rig worker should wear noise reducing ear protectors when appropriate. When drilling is performed in chemically-or radiologically-contaminated ground, special protective equipment and clothing may and probably will be required. The design and composition of the protective equipment and clothing should be determined as a joint effort of management and the client who requests the drilling services.

Housekeeping On and Around the Drill Rig

The first requirement for safe field operations is that the safety supervisor understands and fulfills the responsibility for maintenance and "housekeeping" on and around the drill rig.

- Suitable storage locations should be provided for all tools, materials, and supplies so that tools, materials, and supplies can be conveniently and safely handled without hitting or falling on a member of the drill crew or a visitor.
- Avoid storing or transporting tools, materials, or supplies within or on the mast (derrick) of the drill rig.
- Pipe, drill rods, casing, augers, and similar drilling tools should be orderly stacked on racks or sills to prevent spreading, rolling, or sliding.
- Penetration or other driving hammers should be placed at a safe location on the ground or be secured to prevent movement when not in use.

- Work areas, platforms, walkways, scaffolding and other accessways should be kept free of materials, debris and obstructions, and substances such as ice, grease, or oil that could cause a surface to become slick or otherwise hazardous.

- Controls, control linkages, warning and operation lights, and lenses should be stored free of oil, grease, and/or ice.

- Gasoline should not be stored in any portable container other than a non-sparking, red container with flame arrester in the fill spout and having the word "gasoline" easily visible.

Maintenance Safety

Good maintenance will make drilling operations safer. Maintenance should be performed safely.

- Wear safety glasses when performing maintenance on a drill rig or on drilling tools.

- Shut down the drill rig engine to make repairs or adjustments to a drill rig or to lubricate fitting (except repairs or adjustments that can only be made with the engine running). Take precautions to prevent accidentally starting of an engine during maintenance by removing or tagging the ignition key.

- Always block the wheels or lower the leveling jacks or both, and set hand brakes before working under a drill rig.

- When possible and appropriate, release all pressure on the hydraulic systems, the drilling fluid system, and the air pressure systems of the drill rig prior to performing maintenance. Reduce the drill rig and operating systems to a "zero energy state" before performing maintenance. Use extreme caution when opening drain plugs, radiator caps, and other pressurized plugs and caps.

- Do not touch an engine or the exhaust system of an engine following its operation until the engine and exhaust system have had adequate time to cool.

- Never weld or cut on or near a fuel tank.

- Do not use gasoline or other volatile, flammable liquids as a cleaning agent on or around a drill rig.

- Follow the manufacturer's recommendations for applying the proper quantity and quality of lubricants, hydraulic oils, and/or coolants.

- Replace all caps, filler plugs, protective guards or panels, and high pressure hose clamps, chains or cables that have been removed for maintenance before returning the drill rig to service.

Safe Use of Hand Tools

There are almost an infinite number of hand tools that can be used on or around a drill rig and in repair shops. "Use the tool for its intended purpose" is the most important rule of proper use. The following are a few specific and some general suggestions that apply to safe use of several hand tools often used on and around drill rigs:

- Wear safety glasses and require all others around you to wear safety glasses when using a hammer.
- Wear safety glasses and require all others around you to wear safety glasses when using a chisel.
- Keep all tools cleaned and orderly stored when not in use.
- Use wrenches on nuts - don't use pliers on nuts.
- Use screwdrivers with blades that fit the screw slot.
- When using a wrench on a tight nut - first use some penetrating oil, use the largest wrench available that fits the nut, when possible pull on the wrench handle rather than pushing, and when possible apply force to the wrench with both hands while both feet are firmly placed. Don't push or pull with one or both feet on the drill rig or the side of a mud pit or some other blocking-off device. Always assume that you may lose your footing - check the place where you may fall for sharp objects.
- Keep all pipe wrenches clean and in good repair. The jaws of pipe wrenches should be wire brushed frequently to prevent an accumulation of dirt and grease that would otherwise build up and cause wrenches to slip.
- Never use pipe wrenches in place of a rod holding device.
- Replace hook and heel jaws when they became visibly worn.
- Position your hands so that your fingers will not be smashed between the wrench handle and the ground or the platform when breaking tool joints on the ground or on the drilling platform; the wrench may slip or the joint may suddenly let go.

Clearing the Work Area

Prior to drilling, adequate site clearing and leveling should be performed to provide a safe working area for the drill rig and supplies. Drilling should not be commenced when tree limbs, unstable ground, or site obstructions cause unsafe tool handling conditions.

Start-up

- All drill rig personnel and visitors are instructed to "stand clear" of the drill rig immediately prior to and during starting of an engine.
- Make sure all gear boxes are in neutral, all hoist levers are disengaged, all hydraulic levers are in the correct nonactuating positions, and the cathead rope is not on the cathead before starting a drill rig engine.

- Start all engines according to the manufacturer's manual.

Safety During Drilling Operations

Safety requires the attention and cooperation of every worker and site visitor.

- Do not drive the drill rig from hole to hole with the mast (derrick), in the raised position.
- Before raising the mast (derrick), check for overhead obstructions. (Refer to Section 2.5.11 an Overhead and Buried Utilities.)
- Before raising the mast (derrick), ensure all drill rig personnel (with exception of the operator) and visitors are cleared from the areas immediately to the rear and the sides of the mast. All drill rig personnel and visitors should be informed that the mast is being raised prior to raising it.
- Before the mast (derrick) of a drill rig is raised and drilling is commenced, level, and stabilize the drill rig with leveling jacks and/or solid cribbing. The drill rig should be releveled if it settles after initial set-up. Lower the mast (derrick) only when the leveling jacks are down, and do not raise the leveling jack pods until the mast (derrick) is lowered completely.
- Before starting drilling operations, secure and/or lock the mast (derrick) if required according to the drill manufacturer's recommendations.
- The operator of a drill rig will only operate a drill rig from the controls. If the operator of the drill rig must leave the area of the controls, the operator should shift the transmission controlling the rotary drive into neutral and place the feed control lever in neutral. The operator should shut down the drill engine before leaving the vicinity of the drill.
- Throwing or dropping tools is not permitted. All tools should be carefully passed by hand between personnel or a hoist line should be used.
- Do not consume alcoholic beverages or other depressants or chemical stimulants prior to starting work on a drill rig or while on the job.
- If it is necessary to drill within an enclosed area, make certain that exhaust fumes are conducted out of the area. Exhaust fumes can be toxic, and some cannot be detected by smell.
- Clean mud and grease from your boots before mounting a drill platform, and use hand holds and railings. watch for slippery ground when dismounting from the platform.
- During freezing weather, do not touch any metal parts of the drill rig with exposed flesh. Freezing of moist skin to metal can occur almost instantaneously.
- Drain all air and water lines and pumps when not in use if freezing weather is expected.

- Cover all unattended boreholes or otherwise protect to prevent drill rig personnel, site visitors, or animals from stepping or falling into the hole. All open boreholes should be covered, protected, or backfilled adequately according to local or state regulations on completion of the drilling project.
- Do not "horse around" within the vicinity of the drill rig and tool and supply storage areas even when the drill rig is shut down.
- When using a ladder on a drill rig, face the ladder and grasp either the side rails or the rungs with both hands while ascending or descending. Do not attempt to use one or both hands to carry a tool while on a ladder. Use a hoist line and a tool "bucket" or a safety hook to raise or lower hand tools.

An elevated derrick platform should be used with the following precautions:

- When working on a derrick platform, use a safety belt and a lifeline. The safety belt should be at least 4 in. (100 mm) wide and should fit snugly but comfortably. The lifeline, when attached to the derrick, should be less than 6 ft (2 m) long. The safety belt and lifeline should be strong enough to withstand the dynamic force of a 250 lb (115 kg) weight (contained within the belt) falling 6 ft (2 m).
- When climbing to a derrick platform that is higher than 20 ft (6 m), use a safety climbing device.
- When a rig worker is on a derrick platform, fasten the lifeline to the derrick just above the derrick platform and to a structural member that is not attached to the platform or to other lines or cables supporting the platform.
- When a rig worker first arrives at a derrick platform, inspect the platform for broken members, loose connections and loose tools, or other loose materials.
- Securely attach tools to the platform with safety lines. Do not attach a tool to a line attached to your wrist or any other part of your body.
- When you are working on a derrick platform, do not guide drill rods or pipe into racks or other supports by taking hold of a moving hoist line or a traveling block.
- Do not leave loose tools and similar items on the derrick platform or on structural members of the derrick.
- Ensure that a derrick platform over 4 ft (1.2 m) above ground surface has toe boards and safety railings that are in good condition.
- When working on the ground or the drilling floor, avoid being under rig workers on elevated platforms, whenever possible.

Be careful when lifting heavy objects:

- Before lifting any object without using a hoist, make sure the load is within your personal lifting capacity. If it is too heavy, ask for assistance.

- Before lifting a relatively heavy object, approach the object by bending at the knees, keeping your back vertical and unarched while obtaining a firm footing. Grasp the object firmly with both hands and stand slowly and squarely while keeping your back vertical and unarched. In other words, perform the lifting with the muscles in your legs, not with the muscles in your lower back.

- If a heavy object must be moved some distance without the aid of machinery, keep your back straight and unarched. Change directions by moving your feet, not by twisting your body.

- Move heavy objects with the aid of hand carts whenever possible.

Drilling operations should be terminated during an electrical storm, and the complete crew should move away from the drill rig.

Overhead and Buried Utilities

The use of a drill rig on a site within the vicinity of electrical power lines and other utilities requires that special precautions be taken by both supervisors and members of the exploration crew. Electricity can shock, burn, and cause death.

- Locate, note, and emphasize all overhead and buried utilities on all boring location plans and boring assignment sheets.

- When overhead electrical power lines exist at or near a drilling site or project, consider all wires to be alive and dangerous.

- Watch for sagging power lines before entering a site. Do not lift power lines to gain entrance. Call the utility and ask them to lift or raise the lines or deenergize (turn off) the power.

- Before raising the drill rig mast (derrick) on a site in the vicinity of power lines, walk completely around the drill rig. Determine what the minimum distance from any point on the drill rig to the nearest power line will be when the mast is raised and/or being raised. Do not raise the mast or operate the drill rig if this distance is less than 20 ft (6 m), or if known, the minimum clearance stipulated by federal, state, and local regulations.

- Keep in mind that both hoist lines and overhead power lines can be moved toward each other by the wind.

- Move the drill rig with the mast (derrick) down to avoid contact with power lines.

- If there are any questions whatever concerning the safety of drilling on sites in the vicinity of overhead power lines, call the power company. The power company will provide expert advice at the drilling site as a public service and at no cost.

Underground electricity is as dangerous as overhead electricity. Be aware and always suspect the existence of underground utilities such as electrical power, gas, petroleum, telephone, sewer and water. Ask for assistance:

- If a sign warning of underground utilities is located on a site boundary, do not assume that underground utilities are located on or near the boundary or property line under the sign: call the utility and check it out. The underground utilities may be considerable distance away from the warning sign.
- Always contact the owners of utility lines or the nearest underground utility location service before drilling. Determine jointly with utility personnel the precise location of underground utility lines, mark and flag the locations, and determine jointly with utility personnel what specific precautions must be taken to ensure safety.

Safe Use of Electricity

Drilling projects sometimes require around-the-clock operations and, therefore, require temporary electrical lighting. In general, all wiring and fixtures used to provide electricity for drilling operations should be installed by qualified personnel in accordance with the National Electrical Code (NFP A70-1984) with consideration of the American Petroleum Institute's recommended practices for electrical installations for production facilities (API-RP-500B). Lights should be installed and positioned to ensure that the work area and operating positions are well lit without shadows or blind spots. The following specific recommendations emphasize the safe use of electricity during land-bored drilling operations:

- Before working on an electrical power or lighting system, lock out the main panel box with your own lock and keep the key on your person at all times.
- Install all wiring using high quality connections, fixtures and wire, insulated and protected with consideration of the drilling environment. Makeshift wiring and equipment should not be permitted.
- All lights positioned directly above working areas should be enclosed in cages or similar enclosures to prevent loose or detached lamps or vapor tight enclosures from failing on workers.
- Install all lights to produce the least possible glare or "blind spots" on tools, ladders, walkways, platforms, and the complete working area.
- Locate and guard all electrical cables to prevent damage by drill operations or by the movement of personnel, tools, or supplies.
- Ensure that all plug receptacles are the three-prong, U-blade, grounded type and have adequate current carrying capacity for the electrical tools that may be used.
- Ensure that all electric tools have three-prong, U-blade, ground wire plugs and cords.
- Do not use electrical tools with lock-on devices.

- Ensure that all electrical welders, generators, control panels, and similar devices are adequately grounded.

- Avoid attaching electrical lighting cables to the derrick or other components of the drill rig. If this must be done, use only approved fasteners. Do not "string" wire through the derrick.

- Do not use poles used to hold wiring and lights for any other purpose.

- Power should be turned off before changing fuses or light bulbs.

- When a drilling area is illuminated with electrical lighting, wear safety head gear that protects the worker's head, not only against falling or flying objects, but also against limited electrical shock and burn according to ANSI Z89.1 and Z89.2.

- Ensure that all electrical equipment is operated by trained, designated personnel.

- If you are not qualified to work on electrical devices or on electric lines, do not go near them.

React to Contact with Electricity

If a drill rig makes contact with electrical wires, it may or may not be insulated from the ground by the tires of the carrier. Under either circumstance, the human body, if it simultaneously comes in contact with the drill rig and the ground, will provide a conductor of the electricity to the ground. Death or serious injury can be the result. If a drill rig or a drill rig carrier makes contact with overhead or underground electrical lines:

- Under most circumstances, the operator and other personnel on the seat of the vehicle should remain seated and not leave the vehicle. Do not move or touch any part, particularly a metallic part, of the vehicle or the drill rig.

- If it is determined that the drill rig should be vacated, then all personnel should jump clear and as far as possible from the drill. Do not step off - jump off, and do not hang on to the vehicle or any part of the drill when jumping clear.

- If you are on the ground, you should stay away from the vehicle and the drill rig, do not let others get near the vehicle and the drill rig, and seek assistance from local emergency personnel such as the police or a fire department.

- When an individual is injured and in contact with the drill rig or with power lines, only rescue with extreme caution. If a rescue is attempted, use a long, dry, unpainted piece of wood or a long, dry, clean rope. Keep as far away from the victim as possible and do not touch the victim until the victim is completely clear of the drill rig or electrical lines.

- When the victim is completely clear of the electrical source and is unconscious and a heart beat (pulse) cannot be detected, cardiopulmonary resuscitation (CPR) should be begun immediately.

Safe Use of Wire Line Hoists, Wire Rope and Hoisting Hardware

The use of wire line hoists, wire rope, and hoisting hardware should be as stipulated by the American Iron and Steel Institute Wire Rope Users Manual.

- All wire ropes and fittings should be visually inspected during use and thoroughly inspected at least once a week for: abrasion, broken wires, wear, reduction in rope diameter, reduction in wire diameter, fatigue, corrosion, damage from heat, improper reeving, jamming, crushing, bird caging, kinking, core protrusion, and damage to lifting hardware. Wire ropes should be replaced when inspection indicates excessive damage according to the Wire Rope Users Manual. All wire ropes that have not been used for a period of a month or more should be thoroughly inspected before being returned to service.

- End fittings and connections consist of spliced eyes and various manufactured devices. All manufactured end fittings and connections should be installed according to the manufacturer's instructions and loaded according to the manufacturer's specifications.

- If a ball-bearing type hoisting swivel is used to hoist drill rods, swivel bearings should be inspected and lubricated daily to ensure that the swivel freely rotates under load.

- If a rod slipping device is used to hoist drill rods, do not drill through or rotate drill rods through the slipping device, do not hoist more than 1 ft (0.3 m) of the drill rod column above the top of the mast (derrick), do not hoist a rod column with loose tool joints, and do not make up, tighten, or loosen tool joints while the rod column is being supported by a rod slipping device. If drill rods should slip back into the borehole, do not attempt to brake the fall of the rods with your hands or by tensioning the slipping device.

- Most sheaves on exploration drill rigs are stationary with single part line. The number of parts of line should not ever be increased without first consulting with the manufacturer of the drill rig.

- Wire ropes must be properly matched with each sheave - if the rope is too large, the sheave will pinch the wire rope - if the rope is too small, it will groove the sheave. Once the sheave is grooved, it will severely pinch and damage larger sized wire rope.

The following procedures and precautions must be understood and implemented for safe use of wire ropes and rigging hardware:

- Use tool handling hoists only for vertical lifting of tools (except when angle hole drilling). Do not use tool handling hoists to pull on objects away from the drill rig; however, drills may be moved using the main hoist if the wire rope is spooled through proper sheaves according to the manufacturer's recommendations.

- When stuck tools or similar loads cannot be raised with a hoist, disconnect the hoist line and connect the stuck tools directly to the feed mechanism of the drill. Do not use hydraulic leveling jacks for added pull to the hoist line or the feed mechanism of the drill.

- When attempting to pull out a mired down vehicle or drill rig carrier, only use a winch on the front or rear of the vehicle and stay as far as possible away from the wire rope. Do not attempt to use tool hoists to pull out a mired down vehicle or drill rig carrier.
- Minimize shock loading of a wire rope apply loads smoothly and steadily.
- Avoid sudden loading in cold weather.
- Never use frozen ropes.
- Protect wire rope from sharp corners or edges.
- Replace faulty guides and rollers.
- Replace worn sheaves or worn sheave bearings.
- Know the safe working load of the equipment and tackle being used. Never exceed this limit.
- Periodically inspect and test clutches and brakes of hoists.
- Know and do not exceed the rated capacity of hooks, rings, links, swivels, shackles, and other lifting aids.
- Always wear gloves when handling wire ropes.
- Do not guide wire rope on hoist drums with your hands.
- Following the installation of a new wire rope, first lift a light load to allow the wire rope to adjust.
- Never carry out any hoisting operations when the weather conditions are such that hazards to personnel, the public, or property are created.
- Never leave a load suspended in the air when the hoist is unattended.
- Keep your hands away from hoists, wire rope, hoisting hooks, sheaves and pinch points as slack is being taken up, and when the load is being hoisted.
- Never hoist the load over the head, body, or feet of any personnel.
- Never use a hoist line to "ride" up the mast (derrick) of a drill rig.
- Replace wire ropes with ones that conform to the drill rig manufacturer's specifications.

Safe Use of Cathead and Rope Hoists

The following safety procedures should be employed when using a cathead hoist:

- Keep the cathead clean and free of rust and oil and/or grease. The cathead should be cleaned with a wire brush if it becomes rusty.

- Check the cathead periodically, when the engine is not running, or rope wear grooves. If a rope groove forms to a depth greater then 1/8 inch (3 mm), the cathead should be replaced.

- Always use a clean, dry, sound rope. A wet or oily rope may "grab" the cathead and cause drill tools or other items to be rapidly hoisted to the top of the mast.

- Should the rope "grab" the cathead or otherwise become tangled in the drum, release the rope and sound an appropriate alarm for all personnel to rapidly back away and stay clear. The operator should also back away and stay clear. If the rope "grabs" the cathead, and tools are hoisted to the sheaves at the top of the mast, the rope will often break, releasing the tools. If the rope does not break, stay clear of the drill rig until the operator cautiously returns to turn off the drill rig engine and appropriate action is taken to release the tools. The operator should keep careful watch on the suspended tools and should quickly back away after turning off the engine.

- Protect the rope from contact with all chemicals. Chemicals can cause deterioration of the rope that may not be visibly detectable.

- Never wrap the rope from the cathead (or any other rope, wire rope or cable on the drill rig) around a hand, wrist, arm, foot, ankle, leg, or any other part of your body.

- Always maintain a minimum of 18 inches of clearance between the operating hand and the cathead drum when driving samplers, casing or other tools with the cathead and rope method. Be aware that the rope advances toward the cathead with each hammer blow as the sampler or other drilling tool advances into the ground.

- Never operate a cathead (or perform any other task around a drill rig) with loose, unbuttoned, or otherwise unfastened clothing or when wearing gloves with large cuffs or loose straps or lacings.

- Do not use a rope that is any longer than necessary. A rope that is too long can form a ground loop or otherwise become entangled with the operator's legs.

- Do not use more rope wraps than are required to hoist a lead.

- Do not leave a cathead unattended with the rope wrapped on the drum.

- Position all other hoist lines to prevent contact with the operating cathead rope.

- When using the cathead and rope for driving or backdriving, make sure that all threaded connections are tight and stay as far away as possible from the hammer impact point.

- The cathead operator must operate the cathead standing on a level surface with good, firm footing conditions without distraction or disturbance.

Safe Use of Augers

The following general procedures should be used when starting a boring with continuous flight or hallow-stem augers:

- Prepare to start an auger boring with the drill rig level, the clutch or hydraulic rotation control disengaged, the transmission in low gear, and the engine running at low RPM.
- Apply an adequate amount of down pressure prior to rotation to seat the auger head below the ground surface.
- Look at the auger head while slowly engaging the clutch or rotation control and starting rotation. Stay clear of the auger.
- Slowly rotate the auger and auger head while continuing to apply down pressure. Keep one hand on the clutch or the rotation central at all times until the auger has penetrated about one foot or more below ground surface.
- Use the auger guide to facilitate the starting of a straight hole through hard ground or a pavement.

The operator and tool handler should establish a system of responsibility for the series of various activities required for auger drilling, such as connecting and - disconnecting auger sections, and inserting and removing the auger fork. The operator must ensure that the tool handler is well away from the auger column and that the auger fork is removed before starting rotation.

- Only use the manufacture's recommended method of securing the auger to the power coupling. Do not touch the coupling or the auger with your hands, a wrench, or any other tools during rotation.
- Whenever possible, use tool hoists to handle auger sections.
- Never place hands or fingers under the bottom of an auger section when hoisting the auger over the top of the auger section in the ground or other hard surfaces such as the drill rig platform.
- Never allow feet to get under the auger section that is being hoisted.
- When rotating augers, stay clear of the rotating auger and other rotating components of the drill rig. Never reach behind or around a rotating auger for any reason whatever.
- Use a long-handled shovel to move auger cuttings away from the auger. Never use your hands or feet to move cuttings away from the auger.
- Do not remove earth from rotating augers. Augers should be cleaned only when the drill rig is in neutral and the augers are stopped from rotating.

Safety During Rotary And Core Drilling

Rotary drilling tools should be safety checked periodically and replaced when necessary.

- Water swivels and hoisting plugs should be lubricated and checked for "frozen" bearings before use.
- Drill rod chuck jaws should be checked periodically and replaced when necessary.
- The capacities of hoists and sheaves should be checked against the anticipated weight to the drill rod string plus other expected hoisting loads.

Special precautions that should be taken for Safe rotary or core drilling involve chucking, joint break, hoisting, and lower of drill rods:

- Only the operator of the drill rig should brake or set a manual chuck so that rotation of the chuck will not occur prior to removing the wrench from the chuck.
- Drill rods should not be braked during lowering into the hole with drill rod chuck jaws.
- Drill rods should not be held or lowered into the hole with pipe wrenches.
- If a string of drill rods are accidentally or inadvertently released into the hole, an attempt should not be made to grab the falling rods with your hands or a wrench.
- In the event of a plugged bit or other circulation blockage, the high pressure in the piping and hose between the pump and the obstruction should be relieved or bled down before breaking the first tool joint.
- When drill rods are hoisted from the hole, they should be cleaned for safe handling with a rubber or other suitable rod wiper. Do not use your hands to clean drilling fluids from drill rods.
- If work must progress over a portable drilling fluid (mud) pit, no one should attempt to stand on narrow sides or cross members. The mud pit should be equipped with rough surfaced, fitted cover panels of adequate strength to hold drill rig personnel.
- Drill rods should not be lifted and leaned unsecured against the mast. Either provide some method of securing the upper ends of the drill rod sections for safe vertical storage or lay the rods down.

Safety During Travel

The individual who transports a drill rig on and off a drilling site should:

- Be properly licensed and should only operate the vehicle according to federal, state, and local regulations.

- Know the traveling height (overhead clearance), width, length, and weight of the drill rig with carrier and know highway and bridge load, width and overhead limits, making sure these limits are not exceeded with an adequate margin.

- Never move a drill rig unless the vehicle brakes are in sound working order.

- Allow for most overhang when cornering or approaching other vehicles or structures.

- Be aware that the canopies of service stations and motels are often too low for a drill rig mast to clear with the mast in the travel position.

- Watch for low hanging electrical lines, particularly at the entrances to drilling sites, restaurants, motels, or other commercial sites.

- Never travel on a street, road, or highway with the mast (derrick) of the drill rig in the raised or partially raised position.

- Remove all ignition keys when a drill rig is left unattended.

Loading and Unloading

When loading or unloading a drill rig on a trailer or a truck:

- Use ramps of adequate design that are solid and substantial enough to bear the weight of the drill rig with carrier - including tooling.

- Load and unload on level ground.

- Use the assistance of someone on the ground as a guide.

- Check the brakes on the drill rig carrier before approaching loading ramps.

- Distribute the weight of the drill rig, carrier, and tools on the trailer so that the center of weight is approximately on the centerline of the trailer and so that some of the trailer load is transferred to the hitch of the pulling vehicle. Refer to the trailer manufacturer's weight distribution recommendations.

- Secure drill rig and tools to the hauling vehicle with ties, chains, and/or load binders of adequate capacity.

Off-Road Movement

The following safety suggestions relate to off-road movement:

- Before moving a drill rig, first walk the route of travel, inspecting for depressions, stumps, gullies, ruts and similar obstacles.

- Always check the brakes of a drill rig carrier before traveling, particularly on rough, uneven, or hilly ground.
- Check the complete drive train of a carrier at least weekly for loose or damaged bolts, nuts, studs, shafts, and mountings.
- Discharge all passengers before moving a drill rig on rough or hilly terrain.
- Engage the front axle (for 4 x 4, 6 x 6, etc. vehicles or carriers) when traveling off highway on hilly terrain.
- Use caution when traveling side-hill. Conservatively evaluate side-hill capability of drill rigs, because the arbitrary addition of drilling tools may raise the center of mass. When possible, travel directly uphill or downhill. Increase tire pressures before traveling in hilly terrain (do not exceed rated tire pressure).
- Do not attempt to cross obstacles such as small logs and small erosion channels or ditches at an angle.
- Use the assistance of someone on the ground as a guide when lateral or overhead clearance is close.
- After the drill has been moved to a new drilling site, set all brakes and/or locks. When grades are steep, block the wheels.
- Never travel off-road with the mast (derrick) of the drill rig in the raised or partially raised position.

Tires, Batteries and Fuel

Tires on the drill rig must be checked daily for safety and during extended travel for loss of air, and they must be maintained and/or repaired in a safe manner. If tires are deflated to reduce ground pressure for movement on soft ground, the tires should be reinflated to normal pressures before movement on firm or hilly ground or on streets, roads, and highways. Under-inflated tires are not as stable on firm ground as properly-inflated tires. Air pressures should be maintained for travel on streets, roads, and highways according to the manufacturer's recommendations. During air pressure checks, inspect for:

- Missing or loose wheel lugs.
- Objects wedged between duals or embedded in the tire casing.
- Damage to or poorly fitting rims or rim flanges.
- Abnormal or uneven wear and cuts, breaks, or tears in the casing.

The repair of truck and off-highway tires should only be made with required special tools and following the recommendations of a tire manufacture's repair manual.

Batteries contain strong acid. Use extreme caution when servicing batteries.

- Service batteries in a ventilated area while wearing safety glasses.

- When a battery is removed from a vehicle or service unit, disconnect the battery ground clamp first.

- When installing a battery, connect the battery ground clamp last.

- When charging a battery with a battery charger, turn off the power source to the battery before either connecting or disconnecting charger loads to the battery posts. Cell caps should be loosened prior to charging to permit the escape of gas.
- Spilled battery acid can burn your skin and damage your eyes. Immediately flush spilled battery acid off of your skin with lots of water. Should battery acid get into someone's eyes, flush immediately with large amounts of water and see a medical physician at once.

- To avoid battery explosions, keep the cells filled with electrolyte, use a flashlight (not an open flame) to check electrolyte levels, and avoid creating sparks around the battery by shorting across a battery terminal. Keep lighted smoking materials and flames away from batteries.

Special precautions must be taken for handling fuel and refueling the drill rig or carrier.

- Only use the type and quality of fuel recommended by the engine manufacturer.

- Refuel in a well-ventilated area.

- Do not fill fuel tanks while the engine is running. Turn off all electrical switches.

- Do not spill fuel on hot surfaces. Clean any spillage before starting an engine.

- Wipe up spilled fuel with cotton rags or cloths - do not use wool or metallic cloth.

- Keep open lights, lighted smoking materials, and flames or sparking equipment well away from the fueling area.

- Turn off heaters in carrier cabs when refueling the carrier or the drill rig.

- Do not fill portable fuel containers completely full to allow expansion of the fuel during temperature changes.

- Keep the fuel nozzle in contact with the tank being filled to prevent static sparks from igniting the fuel.

- Do not transport portable fuel containers in the vehicle or carrier cab with personnel.

- Keep fuel containers and hoses in contact with a metal surface during travel to prevent the buildup of static charge.

First Aid

At least one member of the drill crew, preferably the drilling safety supervisor, should be trained to perform first aid. First aid is taught on a person-to-person basis, not by providing or reading a manual. Manuals should only provide continuing reminders and be used for reference. It is suggested that courses provided or sponsored by the American Red cross or a similar organization would best satisfy the requirements of first aid training for drill crews.

For drilling operations, it is particularly important that the individual responsible for first aid should be able to recognize the symptoms and be able to provide first aid for electrical shock, heart attack, stroke, broken bones, eye injury, snake bite, and cuts or abrasions to the skin. Again, first aid for these situations is best taught to drill crew members by instructors qualified by an agency such as the American Red Cross.

A first aid kit should be available and well maintained on each drill site.

Drill Rig Utilization

Do not attempt to exceed manufacturers' ratings of speed, force, torque, pressure, flow, etc. Only use the drill rig and tools for the purposes that they are intended and designed.

Drill Rig Alterations

Alterations to a drill rig or drilling tools should only be made by qualified personnel and only after consultation with the manufacturer. Drill Rig Inspection Checklist can be found in Section 3 of this Safety Officer Field Manual.

IMPORTANT:
Read Before Using

IMPORTANT :
Lire avant usage

IMPORTANTE:
Leer antes de usar

Operating/Safety Instructions
Consignes de fonctionnement/sécurité
Instrucciones de funcionamiento y seguridad

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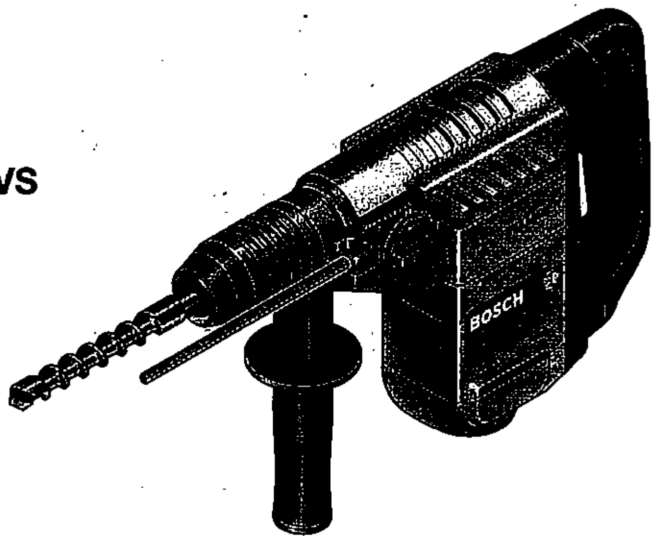


BOSCH

Consumer Information
Renseignement des consommateurs
Información para el consumidor

Toll Free Number: **Appel gratuit :** **Número de teléfono gratuito:**
1-877-BOSCH99 (1-877-267-2499) http://www.boschtools.com

For English
See page 2

Parlez-vous français?
Voir page 10

¿Habla español?
Ver página 18

Power Tool Safety Rules

⚠ WARNING **Read and understand all instructions.** Failure to follow all instructions listed below, may result in electric shock, fire and/or serious personal injury.

SAVE THESE INSTRUCTIONS

Work Area

Keep your work area clean and well lit. Cluttered benches and dark areas invite accidents.

Do not operate power tools in explosive atmospheres, such as in the presence of flammable liquids, gases, or dust. Power tools create sparks which may ignite the dust or fumes.

Keep by-standers, children, and visitors away while operating a power tool. Distractions can cause you to lose control.

Electrical Safety

Double Insulated tools are equipped with a polarized plug (one blade is wider than the other.) This plug will fit in a polarized outlet only one way. If the plug does not fit fully in the outlet, reverse the plug. If it still does not fit, contact a qualified electrician to install a polarized outlet. Do not change the plug in any way. Double Insulation ⧈ eliminates the need for the three wire grounded power cord and grounded power supply system. *Before plugging in the tool, be certain the outlet voltage supplied is within the voltage marked on the nameplate. Do not use "AC only" rated tools with a DC power supply.*

Avoid body contact with grounded surfaces such as pipes, radiators, ranges and refrigerators. There is an increased risk of electric shock if your body is grounded. If operating the power tool in damp locations is unavoidable, a Ground Fault Circuit Interrupter must be used to supply the power to your tool. Electrician's rubber gloves and footwear will further enhance your personal safety.

Don't expose power tools to rain or wet conditions. Water entering a power tool will increase the risk of electric shock.

Do not abuse the cord. Never use the cord to carry the tools or pull the plug from an outlet. Keep cord away from heat, oil, sharp edges or moving parts. Replace damaged cords immediately. Damaged cords increase the risk of electric shock.

When operating a power tool outside, use an outdoor extension cord marked "W-A" or "W." These cords are rated for outdoor use and reduce the risk of electric shock. Refer to "Recommended sizes of Extension Cords" in the Accessory section of this manual.

Personal Safety

Stay alert, watch what you are doing and use common sense when operating a power tool. Do not use tool while tired or under the influence of drugs, alcohol, or medication. A moment of inattention while operating power tools may result in serious personal injury.

Dress properly. Do not wear loose clothing or jewelry. Contain long hair. Keep your hair, clothing, and gloves away from moving parts. Loose clothes, jewelry, or long hair can be caught in moving parts. Keep handles dry, clean and free from oil and grease.

Avoid accidental starting. Be sure switch is "OFF" before plugging in. Carrying tools with your finger on the switch or plugging in tools that have the switch "ON" invites accidents.

Remove adjusting keys or wrenches before turning the tool "ON". A wrench or a key that is left attached to a rotating part of the tool may result in personal injury.

Do not overreach. Keep proper footing and balance at all times. Proper footing and balance enables better control of the tool in unexpected situations.

Use safety equipment. Always wear eye protection. Dust mask, non-skid safety shoes, hard hat, or hearing protection must be used for appropriate conditions.

Tool Use and Care

Use clamps or other practical way to secure and support the workpiece to a stable platform. Holding the work by hand or against your body is unstable and may lead to loss of control.

Do not force tool. Use the correct tool for your application. The correct tool will do the job better and safer at the rate for which it is designed.

Do not use tool if switch does not turn it "ON" or "OFF". Any tool that cannot be controlled with the switch is dangerous and must be repaired.

Disconnect the plug from the power source before making any adjustments, changing accessories, or storing the tool. Such preventive safety measures reduce the risk of starting the tool accidentally.

Store idle tools out of reach of children and other untrained persons. Tools are dangerous in the hands of untrained users.

Maintain tools with care. Keep cutting tools sharp and clean. Properly maintained tools, with sharp cutting edges are less likely to bind and are easier to control. Any alteration or modification is a misuse and may result in a dangerous condition.

Check for misalignment or binding of moving parts, breakage of parts, and any other condition that may affect the tools operation. If damaged, have the tool serviced before using. Many accidents are caused by poorly maintained tools. Develop a periodic maintenance schedule for your tool.

Use only accessories that are recommended by the manufacturer for your model. Accessories that may be suitable for one tool, may become hazardous when used on another tool.

Service

Tool service must be performed only by qualified repair personnel. Service or maintenance performed by unqualified personnel could result in a risk of injury. For example: internal wires may be misplaced or pinched, safety guard return springs may be improperly mounted.

When servicing a tool, use only identical replacement parts. Follow instructions in the Maintenance section of this manual. Use of unauthorized parts or failure to follow Maintenance Instructions may create a risk of electric shock or injury. Certain cleaning agents such as gasoline, carbon tetrachloride, ammonia, etc. may damage plastic parts.

Rotary Hammer Safety Rules

Hold tools by insulated gripping surfaces when performing an operation where the cutting tool may contact hidden wiring or its own cord. Contact with a "live" wire will make exposed metal parts of the tool "live" and shock the operator. *Do not drill, fasten or break into existing walls or other blind areas where electrical wiring may exist. If this situation is unavoidable, disconnect all fuses or circuit breakers feeding this worksite.*

Wear ear protectors when using the tool for extended periods. Prolonged exposure to high intensity noise can cause hearing loss.

Use a metal detector to determine if there are gas or water pipes hidden in the work area or call the local utility company for assistance before beginning the operation. Striking or cutting into a gas line will result in explosion. Water entering an electrical device may cause electrocution.

Always use the side handle for maximum control over torque reaction or kick-back. Never attempt to operate this tool with one hand. The slip clutch engages if you firmly control the tool during a torque reaction or kickback.

Always wear safety goggles or eye protection when using this tool. Use a dust mask or respirator for applications which generate dust. Safety goggles or eye protection will help deflect fragments of the material that may be thrown toward your face and eyes. Dust generated or gases released from the material you are cutting (i.e. asbestos insulated pipes, radon) may cause respiratory difficulties.

Use thick cushioned gloves and limit the exposure time by taking frequent rest periods. Vibration caused by hammer-drill action may be harmful to your hands and arms.

Position the cord clear of rotating bit. Do not wrap the cord around your arm or wrist. If cord becomes entangled with the spinning bit it could entrap you causing serious personal injury.

Position yourself to avoid being caught between the tool or side handle and walls or posts. Should the bit become bound or jammed in the work, the reaction torque of the tool could crush your hand or leg.

If the bit becomes bound in the workpiece, release the trigger immediately, reverse the direction of rotation and slowly squeeze the trigger to back out the bit. Be ready for a strong reaction torque. The hammer body will tend to twist in the opposite direction as the bit is rotating. (Note use only if your tool has reversing feature.)

Do not strike the bit with a handheld hammer or sledge hammer when attempting to dislodge a bound or jammed bit. Fragments of metal from the bit could dislodge and strike you or bystanders.

Never place the tool down until the bit or accessory have come to a complete stop.

Do not use dull or damaged bits and accessories. Dull or damaged bits have a greater tendency to bind in the workpiece.

When removing the bit from the tool avoid contact with skin and use proper protective gloves when grasping the bit or accessory. Accessories may be hot after prolonged use.

Do not run the tool while carrying it at your side. The spinning drill bit may become entangled with clothing and injury may result.

⚠ WARNING **Some dust created by power sanding, sawing, grinding, drilling, and other construction activities contains chemicals known to cause cancer, birth defects or other reproductive harm. Some examples of these chemicals are:**

- Lead from lead-based paints,
- Crystalline silica from bricks and cement and other masonry products, and
- Arsenic and chromium from chemically-treated lumber.

Your risk from these exposures varies, depending on how often you do this type of work. To reduce your exposure to these chemicals: work in a well ventilated area, and work with approved safety equipment, such as those dust masks that are specially designed to filter out microscopic particles.

Symbols

IMPORTANT: Some of the following symbols may be used on your tool. Please study them and learn their meaning. Proper interpretation of these symbols will allow you to operate the tool better and safer.

Symbol	Name	Designation/Explanation
V	Volts	Voltage (potential)
A	Amperes	Current
Hz	Hertz	Frequency (cycles per second)
W	Watt	Power
kg	Kilograms	Weight
min	Minutes	Time
s	Seconds	Time
⌀	Diameter	Size of drill bits, grinding wheels, etc.
n_0	No load speed	Rotational speed, at no load
.../min	Revolutions or reciprocation per minute	Revolutions, strokes, surface speed, orbits etc. per minute
0	Off position	Zero speed, zero torque...
1, 2, 3, ... I, II, III,	Selector settings	Speed, torque or position settings. Higher number means greater speed
0◢	Infinitely variable selector with off	Speed is increasing from 0 setting
➔	Arrow	Action in the direction of arrow
∿	Alternating current	Type or a characteristic of current
⎓	Direct current	Type or a characteristic of current
≂	Alternating or direct current	Type or a characteristic of current
⧈	Class II construction	Designates Double Insulated Construction tools.
⏚	Earthing terminal	Grounding terminal
⚠	Warning symbol	Alerts user to warning messages
RECYCLE 1.800.822.8837	Ni-Cad RBRC seal	Designates Ni-Cad battery recycling program

This symbol designates that this tool is listed by Underwriters Laboratories.

This symbol designates that this tool is listed to Canadian Standards by Underwriters Laboratories.

This symbol designates that this tool complies to NOM Mexican Standards.

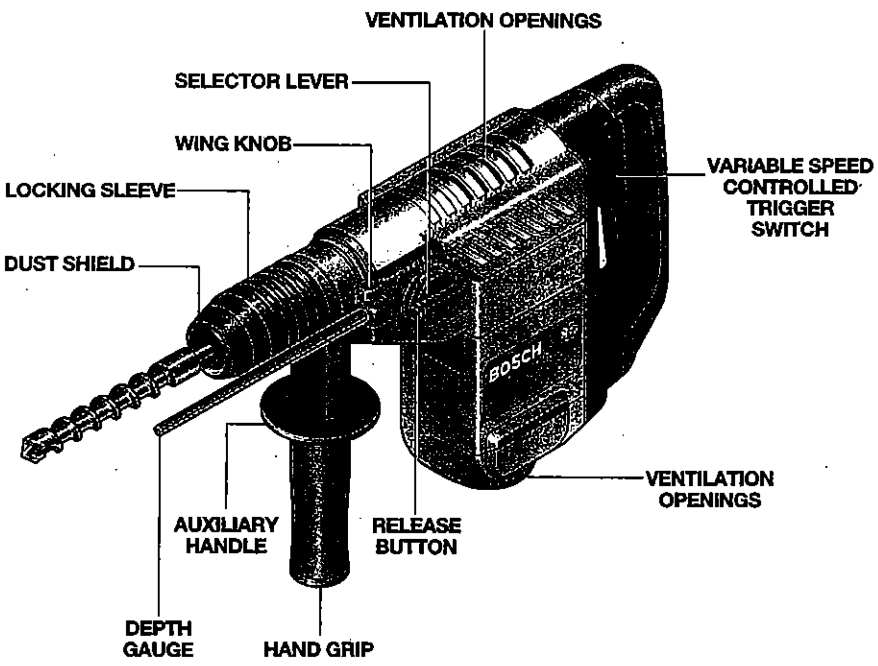
This symbol designates that this tool is listed by the Canadian Standards Association.

This symbol designates that this tool is listed by Underwriters Laboratories, and listed to Canadian Standards by Underwriters Laboratories.

⚠ WARNING **Disconnect the plug from the power source before making any assembly, adjustments or changing accessories.** Such preventive safety measures reduce the risk of starting the tool accidentally.

Rotary Hammer

FIG. 1



Model number	11236VS
Voltage rating	120V ∿ 50 - 60Hz
Amperage rating	7.5 A
No load speed	n_0 0-850/min
Shank style	SDS
Maximum Capacities:	
Carbide tipped bits	1-1/8"
Thin wall core bits	3"

VARIABLE SPEED CONTROLLED TRIGGER SWITCH

Your tool is equipped with a variable speed trigger switch. The tool speed can be controlled from the minimum to the maximum nameplate RPM by the pressure you apply to the trigger. Apply more pressure to increase the speed and release pressure to decrease speed. This accurate speed control enables you to drill without center punching. It also permits you to use as a power screwdriver. Accessories are available for driving screws as well as running bolts and nuts.

INSTALLING ACCESSORIES

Clean the insert shank end of the accessory to remove any debris, then lightly grease with a light oil or lubricant.

Insert accessory into the tool holder through the dust shield, while twisting and pushing inward until it locks automatically into place. Pull outward on the accessory to be certain it is locked into the tool holder.(fig. 2).

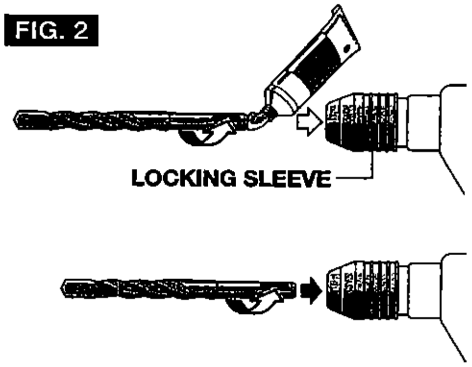
NOTE: The high efficiency available from the rotary hammers can only be obtained if sharp and undamaged accessories are used. The "cost" to maintain sharp and undamaged accessories is more than offset by the "time saved" in operating the tool with sharp accessories.

REMOVING ACCESSORIES

⚠ WARNING Accessories may be hot after use. Avoid contact with skin and use proper protective gloves or cloth to remove.

To remove an accessory, pull and hold locking sleeve backward and pull bit forward. All accessories should be wiped clean after removing.

FIG. 2



SELECTOR LEVER

The selector lever allows the tool to be set for various applications as listed in the following chart, (Fig. 3).

When using demolition or chipping bits such as bull points, chisels, spades, gouges, etc. the "Hammer Only" mode must be selected.

SELECTOR LEVER - "VARIO-LOCK"

The vario-lock can be set in any one of twelve positions (30° increments). Choose a position which is best suited for your operation. The Vario-Lock position is intended for use with chipping bits such as bull points, spades, gouges, etc.

Depress release button and turn the selector lever to the "vario-lock" setting. Next, rotate the locking sleeve, along with the accessory, to the desired position. Then turn the selector lever to the "hammer only" setting and slightly turn the locking sleeve to have it automatically lock into a definite position.

FIG. 3

Drilling Only used for drilling wood, steel, etc.

Drilling/Hammering: used for drilling with solid carbide bits and core bits

Hammering Only: used for chipping and demolition work

Vario-Lock: allows chisel to be set in one of 36 positions

CLUTCH

The tool has a internal pre-set slip clutch. The output spindle will stop rotating if the accessory binds and overloads the tool.

AUXILIARY HANDLE

The tool can be supported with the auxiliary handle , which can be swiveled 360°. To reposition and/or swivel the handle, loosen the hand grip, move the handle to the desired position along the barrel and securely retighten the hand grip.

DEPTH GAUGE

Your drilling depth can be pre-set and/or repeated by using the depth gauge.

Setting depth: After the auxiliary handle is installed, slide the depth gauge to desired depth and securely tighten wing knob.

"TOOL TIPS"

For the best penetration rates in concrete, run the tool with a steady pressure, but do not use excessive force as this will decrease the efficiency of the tool.

All grease packed hammers require a short period of time to warm up. Depending on the room temperature, this time may vary from approximately 15 seconds (90°F) to 2 minutes (32°F). A new hammer requires a break-in period before full performance is realized. This period may require up to 5 hours of operation.

A rotary hammer is likely to be the most expensive portable tool at the construction job. The long wear and efficient operation of the BOSCH hammers will more than justify the cost for tools of this type. As earlier pointed out, sharp accessories as well as clean air vents are necessary for efficient operation. Establish and follow a set maintenance program.

Maintenance

Service

⚠ WARNING **Preventive maintenance performed by unauthorized personnel may result in misplacing of internal wires and components which could cause serious hazard.** We recommend that all tool service be performed by a Bosch Factory Service Center or Authorized Bosch Service Station.

TOOL LUBRICATION

Your Bosch tool has been properly lubricated and is ready to use. It is recommended that tools with gears be regreased with a special gear lubricant at every brush change.

CARBON BRUSHES

The brushes and commutator in your tool have been engineered for many hours of dependable service. To maintain peak efficiency of the motor, we recommend every two to six months the brushes be examined. Only genuine Bosch replacement brushes specially designed for your tool should be used.

BEARINGS

After about 300-400 hours of operation, or at every second brush change, the bearings should be replaced at Bosch Factory Service Center or Authorized Bosch Service Station. Bearings which become noisy (due to heavy load or very abrasive material cutting) should be replaced at once to avoid overheating or motor failure.

Cleaning

⚠ WARNING **To avoid accidents always disconnect the tool from the power supply before cleaning or performing any maintenance.** The tool may be cleaned most effectively with compressed dry air. **Always wear safety goggles when cleaning tools with compressed air.**

Ventilation openings and switch levers must be kept clean and free of foreign matter. Do not attempt to clean by inserting pointed objects through openings.

⚠ CAUTION **Certain cleaning agents and solvents damage plastic parts.** Some of these are: gasoline, carbon tetrachloride, chlorinated cleaning solvents, ammonia and household detergents that contain ammonia.

Accessories

⚠ WARNING **If an extension cord is necessary, a cord with adequate size conductors that is capable of carrying the current necessary for your tool must be used.** This will prevent excessive voltage drop, loss of power or overheating. Grounded tools must use 3-wire extension cords that have 3-prong plugs and receptacles.

NOTE: The smaller the gauge number, the heavier the cord.

RECOMMENDED SIZES OF EXTENSION CORDS 120 VOLT ALTERNATING CURRENT TOOLS

Tool's Ampere Rating	Cord Size in A.W.G.				Wire Sizes in mm²			
	Cord Length in Feet				Cord Length in Meters			
	25	50	100	150	15	30	60	120
3-6	18	16	16	14	.75	.75	1.5	2.5
6-8	18	16	14	12	.75	1.0	2.5	4.0
8-10	18	16	14	12	.75	1.0	2.5	4.0
10-12	16	16	14	12	1.0	2.5	4.0	—
12-16	14	12	—	—	—	—	—	—

---

* Auxiliary Handle
* Carrying case

(*= standard equipment)
(**= optional accessories)

ATTACHMENT F. GEOPROBE

1. The GeoProbe, when operating and particularly while pulling the probe or when the probe encounters different consistency soils or the GeoProbe is used through asphalt or concrete, has both hydraulic and kenetic (gravity) stored hazardous energy. All appropriate guards must be in place. The coupling between the rig and probe must be heavy duty. Only qualified operators will be near the rig when probes are being pushed. Non-operators stay away, at least 15 feet, from the rear of the rig during operation.

2. There is also a pinch hazard between the probe and the drive head. Appropriate precautions, primarily awareness, guarding, if possible, and training are essential to prevent pinching.

ATTACHMENT K

BOATING

FLD 18 OPERATION AND USE OF BOATS

GENERAL

WESTON acknowledges the significant hazard that operating watercraft creates for our personnel, vendors and clients. This procedure describes the minimum requirements for WESTON personnel to be involved in activities or tasks that require the use of boats (watercraft). The following is an outline of the combinations of personnel that are possible in a boating related job:

1. Only WESTON Personnel
2. WESTON personnel and client and/or vendor personnel
3. Vendor personnel only

WESTON requires that a Pilot, Helmsman, or Captain of the vessel be identified and approved for all three of these personnel combinations involving watercraft. For tasks that require non-WESTON personnel to be present on a WESTON boat, the boat or other watercraft may need to be operated by an individual with a current U.S. Coast Guard (USCG) Captain's license and rating for the type of vessel being operated.

NOTE: *The local Coast Guard Regional Marine Safety Office (MSO) should be contacted to determine the need for a Captains license. Criteria to be assessed would include; location, type craft, tasks to be conducted, personnel involved and the basis for passengers to be onboard.*

APPROVALS

Use of watercraft requires the written approval of the Division Safety Manager (DSM) **and** a Boating Safety Review Committee Member. The DSM and Boating Safety Review Committee Member shall review and approve Health and Safety Plan tasks associated with the use of watercraft. Approved Boating Safety Review Committee Members are:

- James Davis
- Conrad Lehr
- Michael McCarley
- Shel McGee
- Paul Potvin
- Theodore Blackburn

A Pilot, Helmsman, or Captain shall be identified by name and approved by the DSM and a member of the Boating Safety Review Committee. The Pilot, Helmsman, or Captain shall prepare a float plan and file the float plan with the DSM, Safety Officer, and the Project Manager. The Float Plan may also be filed with the appropriate authority (U.S. Coast Guard). Pilot, Helmsman, or Captain qualifications and experience shall be defined at a minimum as follows:

- License and rating (Coast Guard and State or other) if required,
- Experience with type/size of boat being used
- Experience on body of water where the boat will be operating

REFERENCES

Related FLD OPS:

FLD02 - Inclement Weather
FLD05 - Heat Stress Prevention and Monitoring
FLD06 - Cold Stress
FLD07 - Wet Feet
FLD10 - Manual Lifting of Heavy Objects
FLD15 - Remote Areas
FLD19 - Working Over or Near Water
FLD32 - Fire Extinguisher Required and Requirements

Reference Guide to State Boating Laws (fifth edition)-USCG

PROCEDURE

This field operating procedure is intended as an overview and guide for boating operation and safety. This field operating procedure is much too brief to adequately prepare personnel to operate watercraft or work on the water. At a minimum, WESTON requires that WESTON personnel and Vendors who plan to operate watercraft take a course on Boating Skills and Seamanship offered by the Coast Guard Auxiliary, as well as any State-required training. Topics covered usually include sailing, marine engines, navigation, ropes and knots, locks and dams, and safe boat handling and operation.

Introduction

Watercraft are frequently used in WESTON field activities to gather environmental information and samples. The use of boats without adequate preparation and training can lead to accidents, injuries, and death.

Whether a passenger or Pilot, Helmsman, or Captain of the Boat used for environmental monitoring, all personnel have responsibilities for safety. All personnel working on boats need some basic information about boat safety equipment and preparation, and about routine boating procedures and emergency procedures. Even if an individual does not plan to pilot a boat, an accident may unexpectedly put him or her in command or in the water alone.

Three major areas of boating safety will be discussed in this field operating procedure:

1. Selection and preparation of the vessel and its equipment.

Coast Guard Notes:
A Coast Guard study of boating accidents shows that the main cause of fatalities to be boats capsizing due to someone standing up in the boat, improper loading of the boat, or ignoring weather warnings. Most boating fatalities resulted from boats capsizing. The second and third largest number of fatalities resulted from falls overboard, vessels sinking, and collisions.

Every person operating a boat is legally responsible for inspecting, equipping, and operating the boat in compliance with federal and state regulations and for any damage that may be caused by operation of the boat. The person in command of a boat is required to know the requirements for operation and navigation of the boat, the regulations that apply locally, and the mandatory rules of the road.

The rules of the road are the codes governing the lights to be carried by boats, the signals to be made, and the actions of one boat with respect to another when the risk of collision exists. International Rules of the Road for preventing collision at sea were first formalized in 1889 for navigation in international waters. The United States has adopted similar rules that must be followed in all United States waters. (The separate rules that have existed for the Great Lakes, the Mississippi River and its tributaries, and the intracoastal waterway and other inland waters are in the process of

2. Preparation of information and other items needed for the field trip.
3. Operation of the vessel under routine and emergency conditions.

Much of the information in this field operating procedure has been drawn from publications of the U.S. Coast Guard and the U.S. Coast Guard Auxiliary. Many other references are available, such as "Chapman Piloting – Seamanship & Small Boat Handling" by Elbert S. Maloney. Please refer to these sources for additional information.

Hazard Recognition

The hazards associated with the operation and use of watercraft include but are not limited to:

- drowning,
- heat stress,
- cold stress,
- hypothermia, and
- injuries from slips, trips, and falls.

The potential for back injuries due to improper lifting techniques also exists when working on boats. Carelessness, horseplay, or other unsafe acts that could cause injury to personnel when operating or using boats are prohibited.

There are also serious hazards associated with untrained, inexperienced personnel operating boats and/or boating equipment, lack of USCG-approved Personal Floatation Devices (PFD), and misuse of appropriate PPE , which could result in injury or death.

Some of the most serious and often neglected hazards associated with boating safety include:

- Weather – weather and weather forecasts need to be reviewed prior to departure and while boating. Changes in weather conditions can happen quickly and can create serious problems if caught unaware.
- Operating in unfamiliar waters – currents, subsurface obstructions, and navigation need to be included in float plan development
- Operating an unfamiliar vessel – different types of boats have different characteristics in handling and performance. The type of vessel must be both appropriate for the type of waters where the vessel will operate and for the type of work expected to be performed.

Documentation Requirements

Health and Safety Plan

A WESTON HASP is required for any work involving a boat or other watercraft. This HASP shall include specific descriptions of :

- Work to be performed from the watercraft,
- Body of water that will be involved,
- Type of boat to be used,
- Identity and qualifications & experience of the Pilot, Helmsman, or Captain and the crew.
- Definition of conditions such as weather and hours of operation where the boat will be prohibited from operating or will be required to stop work and return to port.

- Communication methods and frequency.
- Methods of navigation, charts and maps

Pre-Trip Hazard Assessment and Boating Checklist

The Pilot, Helmsman or Captain shall be responsible for completing a Daily Boating Pre-Trip Inspection Checklist (Refer to attachment "A") prior to each days operations. Any deficiencies noted shall be resolved prior to leaving the dock.

Registration

All boats must be registered and their numbers and validation stickers displayed. The certificate of registration must be onboard at all times when the boat is being operated.

NOTE: Livery boats under 26 feet in length, hired for less than seven days, need not carry the certificate, but must have copy of the lease or rental agreement on board, signed by the owner/representative and by the person renting the boat. The agreement must show the registration number and the period of time for which the boat is rented.

Navigation Charts

Up-to-date navigation charts, a GPS, and a compass should be taken and information should be obtained about any unusual navigation hazards that may be likely in the are, such as shoals, sandbars, rocks, or rapids.

Float Plans

The Pilot, Helmsman, or Captain shall prepare a float plan for each trip and file it with the DSM, Safety Officer and the Project PM who will be responsible to request a search if necessary. At a minimum, the Float Plan should include destination, time of return, who is on board, and a description of the boat (refer to Attachment E—Sample Float Plan).

The Coast Guard’s recommended format for a Float Plan provides space for recording:

1. Description of boat in detail, so the boat can be identified and its position can be estimated

2. Number of persons aboard and who they are

3. Radio type and frequencies available

4. Trip expectations, destination, and latest expected return time

5. Name and telephone numbers of Coast Guard or other agency to be notified if return is delayed beyond the latest expected return time.

Selection and Preparation of the Vessel

This section describes requirements for the selection and preparation of a vessel, compliance with WESTON operating procedures, boating safety regulations, and recommendations for achieving more than the minimum protection required.

Only watercraft that are considered to be stable in the environment of use should be used for environmental monitoring and sampling projects. Canoes and kayaks, due to their tipable nature, are not considered to be stable and should not be used unless specific approval is obtained from the responsible DSM. and a Boating Safety Review Committee member.

One convenient way to see if a watercraft is in compliance with the minimum safety requirements is to request a complimentary inspection from the local Coast Guard Auxiliary. A member of the Coast Guard Auxiliary will examine the watercraft for compliance with the federal regulations and additional recommendations that the Auxiliary considers desirable for safety. If the watercraft passes the inspection, a current Courtesy Examination decal will be placed on the watercraft. If the watercraft does not pass, a confidential report of deficiencies will be given to the watercraft owner.

All powered watercraft are required to be registered, usually with a number assigned by the state.

Equipment Needed or Required

Equipment needed or required on all motorboats includes a fire extinguisher, a signaling device, means of preventing accumulation of flammable fuel vapors, an approved PFD for each person onboard, visual distress signals, and lights if the vessel will be operated at any time before sunrise or after sunset. Refer to Attachment "B" for additional equipment discussion and Attachment "A" for an Daily Pre-trip Inspection/Equipment Checklist

Recommended Inspections

Before a boat is taken out on a field trip, it should be inspected carefully to see that the engine has an adequate fuel supply and is in good working order, that all navigation and communication equipment is working, and that all safety equipment is on board and accessible. In addition, all watercraft equipment is expected to be in good operating condition.

The Coast Guard Auxiliary publishes information that can be used to develop a pre-trip checklist for each specific type of boat. They also provide information that can be used to prepare guidelines for engine troubleshooting and for routine engine maintenance. The watercraft should not be operated unless a complete pre-trip watercraft inspection is conducted and there are no deficiencies detected.

Refueling Precautions

Gasoline is flammable and watercraft are very susceptible to damage from fire that special safety precautions must be taken. Four basic precautions are:

- keep all sources of ignition away from flammable vapors
- keep the nozzle of the fueling source in contact with the fill opening to prevent static sparks
- avoid overfilling tanks

- never fill portable fuel tanks in the boat. (Portable tanks should be filled on the dock or at another location.)

The precautions for fueling boats with inboard engines are usually more elaborate than for outboard motors because inboard engine fuel tanks cannot be filled remote from the boat and special ventilation equipment is needed.

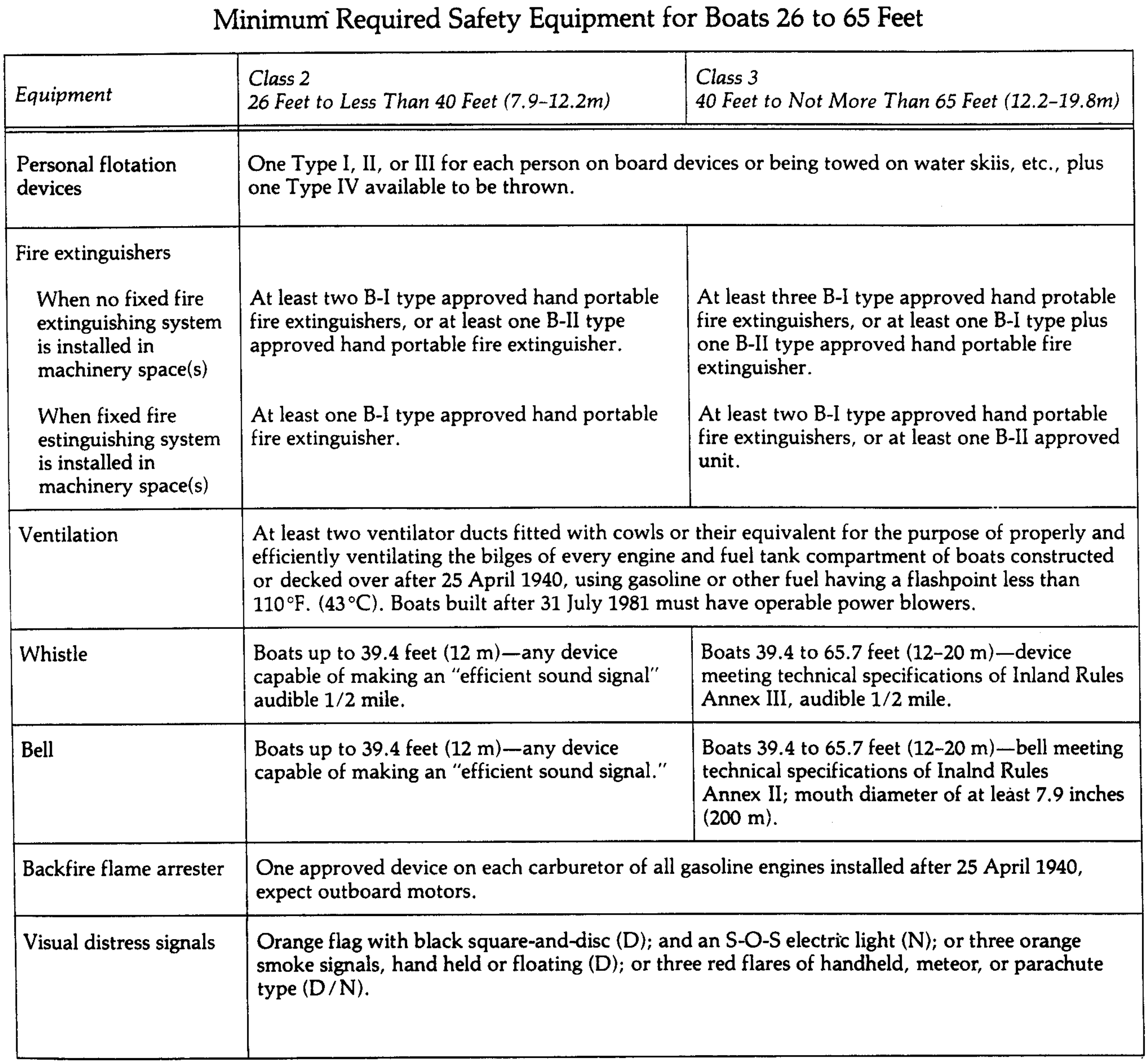
Equipment

All boats to be used on WESTON projects will be require to have, at a minimum, the equipment indicated below. Additional information on equipment, loading and boat handling is contained in Attachment B.

Minimum Required Safety Equipment for Boats to 26 Feet

<table>
<tr><th><i>Equipment</i></th><th><i>Class A</i>
<i>Less Than 16 Feet (4.9m)</i></th><th><i>Class 1</i>
<i>16 Feet to Less Than 26 Feet (4.9-7.9m)</i></th></tr>
<tr><td>Personal flotation devices</td><td>One Type I, II, III, or IV for each person.</td><td>One Type I, II, or III for each person on board or being towed on water skiis, etc., plus one Type IV available to be thrown.</td></tr>
<tr><td>Fire extinguishers</td><td colspan="2"></td></tr>
<tr><td>When no fixed fire extinguishing system is installed in machinery space(s)</td><td colspan="2">At least one B-I type approved hand portable fire extinguisher. Not require on outboard motorboats less than 26 feet (7.9 m) in length and not carrying passengers for hire if the construction of such motorboats will not permit the entrapment of flammable gases or vapors.*</td></tr>
<tr><td>When fixed fire extinguishing system is installed in machinery space(s)</td><td colspan="2">None</td></tr>
<tr><td>Ventilation</td><td colspan="2">At least two ventilator ducts fitted with cowls or their equivalent for the purpose of properly and efficiently ventilating the bilges of every engine and fuel tank compartment of boats constructed or decked over after 25 April 1940, using gasoline or other fuel having a flashpoint less than 110°F. (43°C). Boats built after 31 July 1981 must have operable power blowers.</td></tr>
<tr><td>Whistle</td><td colspan="2">Boats up to 39.4 feet (12 m)—any device capable of making an "efficient sound signal" audible 1/2 mile.</td></tr>
<tr><td>Bell</td><td colspan="2">Boats up to 39.4 feet (12 m)—any device capable of making an "efficient sound signal."</td></tr>
<tr><td>Backfire flame arrester</td><td colspan="2">One approved device on each carburetor of all gasoline engines installed after 25 April 1940, expect outboard motors.</td></tr>
<tr><td>Visual distress signals</td><td>Required only when operating at night or carrying six or fewer passengers for hire. Same equipment as for larger boats.</td><td>Orange flag with black square-and-disc (D); and an S-O-S electric light (N); or three orange smoke signals, hand held or floating (D); or three red flares of handheld, meteor, or parachute type (D/N).</td></tr>
</table>

*Dry chemical and carbon dioxide (CO_2) or the most widely used types, in that order. Other approved types are acceptable. Toxic vaporizing-liquid type fire extinguishers, such as those containing tetrachloride or chlorobromomethane, are not acceptable.



Minimum Required Safety Equipment for Boats 26 to 65 Feet

Equipment	*Class 2* *26 Feet to Less Than 40 Feet (7.9-12.2m)*	*Class 3* *40 Feet to Not More Than 65 Feet (12.2-19.8m)*
Personal flotation devices	One Type I, II, or III for each person on board devices or being towed on water skiis, etc., plus one Type IV available to be thrown.	
Fire extinguishers		
When no fixed fire extinguishing system is installed in machinery space(s)	At least two B-I type approved hand portable fire extinguishers, or at least one B-II type approved hand portable fire extinguisher.	At least three B-I type approved hand protable fire extinguishers, or at least one B-I type plus one B-II type approved hand portable fire extinguisher.
When fixed fire estinguishing system is installed in machinery space(s)	At least one B-I type approved hand portable fire extinguisher.	At least two B-I type approved hand portable fire extinguishers, or at least one B-II approved unit.
Ventilation	At least two ventilator ducts fitted with cowls or their equivalent for the purpose of properly and efficiently ventilating the bilges of every engine and fuel tank compartment of boats constructed or decked over after 25 April 1940, using gasoline or other fuel having a flashpoint less than 110°F. (43°C). Boats built after 31 July 1981 must have operable power blowers.	
Whistle	Boats up to 39.4 feet (12 m)—any device capable of making an "efficient sound signal" audible 1/2 mile.	Boats 39.4 to 65.7 feet (12-20 m)—device meeting technical specifications of Inland Rules Annex III, audible 1/2 mile.
Bell	Boats up to 39.4 feet (12 m)—any device capable of making an "efficient sound signal."	Boats 39.4 to 65.7 feet (12-20 m)—bell meeting technical specifications of Inalnd Rules Annex II; mouth diameter of at least 7.9 inches (200 m).
Backfire flame arrester	One approved device on each carburetor of all gasoline engines installed after 25 April 1940, expect outboard motors.	
Visual distress signals	Orange flag with black square-and-disc (D); and an S-O-S electric light (N); or three orange smoke signals, hand held or floating (D); or three red flares of handheld, meteor, or parachute type (D/N).	

Accidents

Various studies have shown the following to be the major causes of boating accidents:

- Overloading, overpowering, and improper trim.
- High speed turns, especially in rough water.
- Failure to keep a sharp lookout for obstructions.
- Going out in bad weather (or not starting for home soon enough when good weather turns bad).
- Standing in a moving boat.
- Having too much weight too high in the boat, as when someone sits on the deck of a small outboard.
- Leaks in the fuel system.
- Going too far offshore.

Each of these factors, and others not listed here, should be avoided. A carefully matched boat, motor, and propeller, operated in accordance with the law and with courtesy, will go a long way toward eliminating accidents. Always remember that the possibility of trouble always exists; be prepared to act in an emergency.

Man Overboard

If someone falls overboard, maneuver the boat's stern away from him. Shift into neutral immediately (kill the motor if you do not have a gearshift) and throw a buoyant cushion or life jacket near the victim (try to get it close, but do not aim directly at the victim). Make sure you are well clear of the person in the water before shifting into gear again.

Circle around quickly, selecting a course that will allow you to approach the person with the boat headed into the wind or waves. Approach him slowly, taking care to come alongside and not over him. Stop the motor before attempting to get the victim aboard.

When alongside, extend a paddle or boathook to him, or one end of a line. With the motor stopped, lead him around to the stern, where the freeboard is the lowest, if there is enough space at the transom for him to get aboard without contacting the motor. If this is not feasible, help the victim aboard over the side as far aft as possible. In either case, the use of a boarding ladder will be of help. To avoid a capsize while the victim is coming aboard, other passengers should shift their weight to the opposite side to maintain trim as much as possible. When helping a person aboard, hold him under the armpits and lift gently.

In Case of an Accident

Personnel involved in a boating accident are required to stop and give as much help as possible without seriously endangering their boat or passengers. Personnel must identify themselves and their boat to any person injured or to the owner of any property damaged.

Personnel witnessing an accident may now render assistance with reasonable assurance of freedom from liability. The Federal Boat Safety Act of 1971 contains a "good samaritan" section which provides that any person who renders assistance at the scene of a vessel accident will not be liable for civil damages from such action if he acts as a reasonably prudent man would have acted under the same circumstances.

When giving first aid, proceed slowly. More damage may be done by the well-meaning amateur than was caused by the actual injury. Remember, there are only three instances when speed in giving first aid is required:

1. when the victim has stopped breathing and has no pulse.
2. when there is arterial bleeding.
3. when the victim has been subjected to other injuries that may be life threatening.

The measures required in these instances are taught in standard first aid courses. An NOI is to be completed and submitted, as appropriate. If the incident results in the sinking of the vessel, or damage to the vessel, a Coast Guard report and NOI is to be submitted as soon as possible.

ATTACHMENT A

PRE-BOAT TRIP INSPECTION CHECKLIST

Boat Pre-trip Inspection Checklist

Date: / /
Name of inspector:
Type of vessel:
Type of engine(s):
Rated boat weight capacity:
Captain of the boat:
List of personnel who will be part of the trip:

BASICS

Is there a fire extinguisher on board (Type ABC)?	☐ YES	☐ NO*	
Is the fire extinguisher inspected?	☐ YES Date of inspection ___/___/_____	☐ NO*	☐ Not Applicable
Are lifejackets available for each person on board?	☐ YES Specify Type: ______	☐ NO*	
Has the first aid kit been inspected?	☐ YES Date of inspection ___/___/_____	☐ NO	
Is the first aid kit in a waterproof container?	☐ YES	☐ NO	
Indicate the emergency signaling devices on board (e.g., flares, mirrors, flags, etc.).	List:		
What electronics/navigational devices are you planning to use (e.g., radar, GPS, depth finder, compass, communications [e.g., 2-way radio, _________, marine radio, etc.], etc.)?	List:		
What body of water will the boat be operating in?	☐ river ☐ stream ☐ lake ☐ ocean ☐ pond	Name: Location:	________________ ________________
Are there any special conditions present (barge traffic, dam, adverse weather, operation near shipping lanes, near sand bars, etc…)	☐ YES	☐ NO	List:

BOAT

Is the boat registration inspection updated for the current year?	☐ YES	☐ NO*	
Are the fuel levels adequate?	☐ YES Fuel levels________	☐ NO*	
Are bail plugs (upper and lower) present on boat?	☐ YES	☐ NO*	
Is the motor size adequate for the boat (see boat specifications)?	☐ YES	☐ NO*	
Are there holes or cracks in the hull?	☐ YES*	☐ NO	
Is the bilge pump operational?	☐ YES	☐ NO*	
Do all engine(s) operate properly?	☐ YES	☐ NO*	
Are spare fuses available on board? (if req'd)	☐ YES	☐ NO	
Does the boat need to have an anchor?	☐ YES	☐ NO	
Is an anchor present?	☐ YES	☐ NO	
Is there enough rope on the anchor for the location, depth, and scope?	☐ YES Length of rope______	☐ NO	
If operating at night, are the navigational lights working?	☐ YES	☐ NO*	☐ Not Applicable
If operating at night, does the pilot, helmsman, or captain have prior experience operating in such conditions?	☐ YES	☐ NO*	
Overall, is the vessel sea-worthy? (If possible this determination should be made by Coast Guard personnel, prior to the trip.)	☐ YES	☐ NO*	
Will the dead weight (people + equipment) exceed the maximum weight requirements for the boat?	☐ YES*	☐ NO	

TRAILER

Is trailer in good condition?	☐ YES	☐ NO	☐ Not Applicable
Are the trailer lights working properly?	☐ YES	☐ NO	
Is the winch operating properly?	☐ YES	☐ NO	
Is the winch strap in good condition?	☐ YES	☐ NO	
Are the trailer rollers cracked?	☐ YES	☐ NO	
Are the trailer boat guides straight and in good condition?	☐ YES	☐ NO	
Do the tires have appropriate air pressure?	☐ YES	☐ NO	
Are the tires in good condition?	☐ YES	☐ NO	
Are the engines secured to or removed from the transom during transportation?	☐ YES	☐ NO	

SUPPLEMENTAL INFORMATION

WEATHER FORECAST

How will the pilot, helmsman, or captain and crew keep track of changing weather conditions?			
Will someone onshore track weather conditions also?	☐ YES	☐ NO	
How will that person remain in contact with the boat?			
For a small boat (under 21'), are the waves equal or greater than 2 feet (1' wave)?	☐ YES*	☐ NO	☐ Not Applicable
For a larger boat, are the waves equal or greater to 4 feet (2' wave)?	☐ YES*	☐ NO	☐ Not Applicable
For any boat, is the wind speed equal or greater than 15 knots?	☐ YES*	☐ NO	☐ Not Applicable

OTHER

Has a float plan been filed with the Project PM?	☐ YES Plan filed with ____________________	☐ NO
Is the operator licensed (with the State or with Coast Guard)?	☐ YES	☐ NO*
Are any members of the crew capable of operating the boat if the pilot, helmsman, or captain is incapacitated?	☐ YES	☐ NO*
Does the HASP describe the task(s) involved with the operation of boats?	☐ YES	☐ NO*

*If any answer followed by an asterisk is checked, justify task continuation if a "No" is checked.

I certify that I have inspected all the items on this checklist and that the information is accurate to the best of my knowledge.

Reviewer’s Signature: __________________________ Date: _____________

NOTE: Copy of checklist to be placed in Project file.

ATTACHMENT B

HANDLING AND EQUIPMENT DISCUSSION

Handling

Before getting underway, have all weight evenly distributed so that the boat will trim properly – level from side to side and slightly down at the stern, never down at the bow. Passengers should be seated toward the centerline of the craft and not hanging over the sides; with not too many forward or aft. If the load is concentrated near the bow or stern, the boat will plow or drag needlessly, reducing the safety margin and increasing fuel consumption. Proper trim is essential to proper performance.

In boarding from a pier, step into the boat as near to the center as possible, keeping body weight low. When boarding from a beach, come in over the bow. Keep lines tight or have someone steady the boat.

Never jump into a boat or step on the gunwale (edge of the hull). Pile gear to be taken aboard on the pier so that it can be easily reached from the center of the boat. Better still, hand it in to someone already aboard. It is the team leader's responsibility to determine that each boat, after loading, is within the maximum allowed load.

Trim the boat as well as possible before getting underway. In smaller craft, it is dangerous for passengers to change places or move while the boat is in motion. If movement becomes essential, slow or stop the boat first, remembering in rough weather to keep enough momentum to retain steerage control and to keep the craft headed into wind and waves. Have the person who must move keep low and near the boat's centerline.

Outboard craft are often operated at relatively high speeds and their stability becomes a matter of safety. Some hulls will run straight ahead quite steadily but have a tendency to heel excessively, or even flip over, when turned sharply. The faster a boat goes, the less keel it requires, and the more important it is to reduce speed before starting a turn. Never turn more sharply than necessary. Normal operation seldom requires a sudden, sharp, high-speed turn. Every outboard operator must carry one or more types of emergency signaling equipment, in good condition and ready for immediate use. If no distress equipment is on board, an outboard boatman in need of help can always signal by slowly and repeatedly raising and lowering his arms outstretched to each side while he stands in the craft (or from a kneeling position if rough water conditions make standing hazardous).

Whenever boating in unfamiliar waters, take advantage of "local knowledge:" watch the operation of boats piloted by skippers who are at home in these waters, and do not hesitate to ask questions about possible hazards.

Many persons who have not handled a small boat have the misconception that one can be maneuvered and stopped as easily as an automobile. This is not the case, however, much can be done with a boat if one takes it slowly and easily. The new boat operator should practice leaving from and returning to the pier, and other maneuvers, until he has developed both skill and confidence. Begin cautiously at first and gradually build up to the procedures of experienced operators.

Always slow down gradually rather than pulling the throttle back quickly. All boats have a stern wave that will catch up with and pass the craft if it comes to an abrupt stop. This can bring water into the boat, especially if it has a low-cut transom with no motor well.

All boating at night will be performed at reduced speeds. Personnel who become disoriented, or unsure of their position, should stop the boat until they can determine where they are.

Radio contact between crews should be more frequent; crew check-ins at set intervals will be mandatory.

Fire Extinguisher

Every motorboat will have a fire extinguisher suitable for putting out a fire of burning liquids or electrical equipment. Fire extinguishers must show approval by Underwriters' Laboratories, Inc. (UL) or another testing laboratory. For boats less than 26 feet in length, the required extinguisher has to have a rating of B-1.

Small extinguishers usually have very limited fire-fighting capability, and may be inadequate for a fire involving liquid fuel. WESTON recommends that new or replacement fire extinguishers be the dry chemical, of the largest capacity that will fit conveniently in the boat. (A 6-pound dry chemical fire extinguisher with a rating of 2A; 40B is commercially available.)

If WESTON has responsibility for a fueling location, WESTON requires that a special extinguisher be available at that location that is effective on spill fires (a foam-type that forms an aqueous film).

Signaling Devices for Navigation

Boats up to 39.4 feet are required to carry a whistle or horn that can be heard for at least one mile. The device can be operated by mouth, hand, or power. Longer boats have the same requirements except that the whistle or horn must be operated by power.

Preventing Accumulation of Fuel Vapors

Powered ventilation is needed for motorboats with enclosed spaces in which flammable fuel vapors may accumulate, such as engine and fuel tank compartments, in order to prevent explosion and fire. Special ventilation is not required in open boats in which flammable vapors are not likely to accumulate. (If gasoline is spilled in any boat, there will be an accumulation of flammable vapors in the boat until the vapors are removed by exhaust blowers or air circulation.)

Personal Flotation Devices

All boats less than 16 feet in length are required by law to carry at least one approved personal flotation device for each person onboard. Boats of greater length are required to carry at least one approved wearable personal flotation device for each person onboard, plus one throw-able flotation device. Five types of personal flotation devices are approved by the Coast Guard. Four of the types are acceptable for recreational boats and readily available: Types I, II, III, and IV. A Type V work-jacket is not approved for recreational boats. Of the four wearable types of approved flotation devices, only two Types I and II are designed to prevent the drowning of an unconscious person.

A Type I device is the familiar collar-type life jacket. It provides more than 20 pounds of buoyancy and is designed to deep the wearer afloat for extended periods of time in rough water. A Type I device is recommended for maximum protection. Type I devices are required on commercial vessels and on licensed passenger-carrying vessels. (Reflective tape is required on Type I devices on passenger-carrying vessels.)

A Type II device is more comfortable to wear than a Type I device, but has less buoyancy (15.5 pounds) and is less able to turn an unconscious person face upwards.

A Type III personal flotation device is designed to keep a conscious person in a vertical or slightly backward position, but not to turn an unconscious person over from a face downward position (even though it does have some turning ability). Buoyancy provided is 15.5 pounds minimum.

A Type IV personal flotation device is not designed to be worn but to be thrown to a conscious person in the water. Buoyancy provided is 16.5 pounds. One Type IV device is required for each boat 16 feet and over in length. Type IV devices are permitted as the minimum required in canoes, kayaks, and other vessels less than 16 feet in length.

A Type V personal flotation device is a wearable work jacket designed to deep a conscious person in a vertical or slightly backward position, but it is not designed to turn an unconscious person over from a face-downward position. Buoyancy provided is 27 pounds minimum. (Type V devices are not approved for use in recreational boats, and they usually cannot be purchased in stores that sell only recreational boats and equipment.)

WESTON personnel working on a boat are required to use either a Type I or II personal flotation device while underway. For cold weather operations, recommended devices are float coats or exposure suits, both Coast Guard approved. Other types of PFDs may be approved for use based upon location (i.e., ponds, lakes, etc.) and task activities (i.e., sampling, surveying, etc.) under a site-specific HASP and Float Plan.

Visual Distress Signals

Visual distress signals are needed for any boating activity where the need to signal for emergency help may arise. Personnel who are close to another boat can wave their outstretched arms up and down to signal distress. However, at distances farther from shore or other boats, another way may be needed to signal for help. By carrying approved visual distress signals, boaters can assure that they have a noticeable and effective way of attracting attention to secure prompt assistance in case of an emergency.

Since January 1981, visual distress signals have been required for all recreational boats except manually-propelled boats, boats less than 16 feet in length, open sailboats less than 26 feet in length,
boats on Western rivers, and boats participating in organized events such as races and regattas.

When a search is underway, the time it takes to locate a boat in difficulty or a person in the water can be reduced by the use of visual distress signals.

There are two types of signaling devices: non-pyrotechnic and pyrotechnic. Each device is approved for day use, for night use, or for both day and night. Visual distress signaling devices must carry the manufacturer's certification that they meet Coast Guard requirements.

Non-pyrotechnic devices include:

- An orange distress flag, 3-feet square with a black square and a black ball. This is accepted as a day signal only.
- An electric distress light, which must automatically flash the international SOS distress signal (three short flashes, three long flashes, and three short flashes) four to six times each minute. This is accepted as a night signal only. (An ordinary flashlight is not acceptable since it must be flashed manually and does not normally produce enough candle power.)

One flag and one electric distress light will meet the requirements for visual distress signals. These are best for small boats because there is less chance for fire and explosion than with pyrotechnic devices.

Pyrotechnic devices that meet the requirements include:

- Hand-held orange smoke distress signals (day use only)
- Floating orange smoke distress signals lasting 5 or 15 minutes (day use)
- Hand-held red flare distress signals (day or night use)

The minimum number of pyrotechnic devices required (because they are single-use devices, with limited burning time) is three for day use and three for night use, or three that can be used effectively either day or night.

Pistol-projected parachute red flare distress signals, which require suitable approved launching devices, can be used in the day or at night. Also approved for day or night use are self-contained rocket-propelled parachute red flares and red aerial pyrotechnic flare signals, which may need approved, suitable launching devices.

Visual distress signals are an important part of a boat's safety and survival gear. They should be in good condition and easily accessible. Pyrotechnic devices must be stored to protect them from water, puncturing and access by children. They must also be handled very carefully to prevent setting fire to the boat.

Pyrotechnic devices that have passed their expiration date (42 months from the date of manufacture) need to be replaced. The expiration date on pyrotechnic devices, if used, should be checked before the boat is launched.

Identification Lights

Every boat is required to be equipped with certain lights if it is on the water at any time after sunset and before sunrise. The purpose of these lights is to identify the boat's location so that collision can be avoided.

Vessels underway after sunset and before sunrise are required to display at least three lights: a green light and a red running light, each visible for one mile, and a white anchor light visible for two miles. (Details of location and visibility distance may vary, depending on the area in which the boat will be operating.)

The green light must be visible only from directly ahead of a boat and on the right or starboard side of the boat through an arc of 112½ degrees, or only as far back as an angle of 22½ degrees to the rear of a right angle from the centerline of the boat. In the corresponding sector on the left side of a vessel, from dead ahead to 2 points aft of the port beam, the vessel must display a red light.

Each vessel must display a white anchor light that can be seen from all directions. Two white lights are required for vessels operating in international waters, and two lights may be used by vessels in other waters. One white light must be visible through the combined arcs of the red and green lights and be mounted 1 meter (3.3 feet) higher than they are. The second white light must be visible from the rear of the boat, through the arc that is not covered by the front white light.

Under the rules governing all United States waters (except the Great Lakes until March 1983), motorboats from 26 feet up to 65 feet in length must have an additional white light in the forepart of the vessel that is visible for a distance of 2 miles through the same arc of visibility as the red and green lights (20 points).

The nautical jargon for the 112½ degree arc of visibility for the starboard green light is: "Visible from dead ahead to 2 points abaft the starboard beam." In nautical terminology, a circle of 360 degrees has 32 points, corresponding to the points of the compass, and each point equals 11¼ degrees of the circle. Another way of describing the arc of visibility would be to say that on a boat heading north, the green light would have to be seen by boats approaching from any direction between north and east-south-east.

The particular arc of 112½ degrees, or 10 points, represents the "Danger Zone" for the boat, the directions in which the boat must yield the right of way to other vessels. Any vessel that can see the green light on the boat can "Go," because it has the right of way.

In that sector of approach, you are in the <u>Give Way</u> vessel (or <u>Burdened</u> vessel). The other vessel is the <u>Stand On</u> vessel (or <u>Privileged</u> Vessel).

Personnel who expect to be out in a boat after dark in waters where large vessels, tugboats, or working boats may be encountered, need to learn exactly what lighting such vessels will display in order to avoid dangerous situations.

Additional Equipment Recommended

In addition to required equipment, other equipment is recommended for safe boating operations,

including an up-to-date chart of the area of operations, a compass for open waters, paddles or oars, a boat hook, and a bailing bucket or bilge pump.

The Coast Guard Auxiliary recommends that each boat carry a first aid kit, emergency water and food, an anchor and rope, a radio for monitoring weather information, and a radiotelephone for emergencies.

The Coast Guard Auxiliary also recommends that spare parts and tools be carried in case of engine trouble or an emergency. For outboard motorboats this includes:

- spare spark plugs
- starter cord
- shear pins
- cotter pins
- a propeller

For inboard motorboats, spare equipment includes:

- bilge pump
- carburetor drip pan
- backfire arrestor
- spark plugs
- coil
- fuel pump
- fuel filter element and gasket

- points and condenser
- propeller
- distributor or parts
- generator and starter brushes
- fuses
- V-belts
- spare oil

The anchor should be selected for the type of bottom where it will be used and be capable of holding the boat against wind and current. Since anchors hold better against a horizontal pull, a 3-foot length of chain is recommended to hold the top of the anchor down. The length of anchor rope should be seven times as the deep as the water.

Personal Gear

Personal gear should include appropriate footwear, clothing to provide protection from extremes of heat and cold, extra dry clothing, medication for motion sickness, if needed, and a water-resistant outer garment. If water temperatures below 60°F or 16°C are expected, wearing a float coat, wet suit, or exposure coveralls is recommended.

Sampling Apparatus and Equipment

Sampling apparatus and equipment should be weighed and the weight marked on an outside surface for convenience in balancing the load in a boat. It will also make it easier to calculate the total load being placed in a boat and to avoid overloading. In figuring the load on the boat, remember to add the estimated weight of samples to be gathered on the trip.

Preparation for Emergencies

Preparation for emergencies should include making sure that everyone in the boat can put on his or her personal flotation device quickly and correctly, and that everyone knows to stay with the boat if it should capsize. Preparation should also be made for any other emergency procedures. (If the passengers on the boat include non-swimmers, they should wear personal flotation devices when there is any likelihood that they may fall into the water.) A site-specific H&S meeting should be given immediately prior to conducting boat operations.

One of the Coast Guard requirements for personal flotation devices that are not worn is that they be readily accessible. They must not be in a locker or be obstructed by other gear.

Field personnel should plan how to conduct scheduled sampling activities with minimum disturbance of the balance of the boat or risk of capsizing or falling out of the boat. Planning should include any special precautions that may be needed (such as using a safety line on a piece of apparatus or on a person using sampling equipment).

In order to prevent capsizing or swamping, a boat must not be overloaded. The total load of passengers, motor, sampling apparatus and other gear should not exceed the weight limit stated on the capacity plate on the boat. It may be prudent to reduce the load in the boat if inclement weather, turbulent water conditions, or vigorous sampling activities are anticipated.

Getting Into and Loading a Boat

Getting into and loading a boat at a dock takes a little care and practice, because it is different from simply stepping down to another level. If you board a boat the wrong way, it may move away from the dock or it may tip precariously. Be sure that the boat is secured to the dock, then grasp one or both sides of the boat and step into the center of the boat. Stepping into the center of the boat, or as near the centerline as possible, reduces the chance of tipping the boat and losing your balance.

Loading gear into a boat also takes care and practice. Incorrect loading may cause the boat to tip and the gear may fall into the boat or the water.

It is always preferable to load a boat with another person. One person stands with both feet on the dock, passing the gear over and down to another person standing in the center of the boat.

Sampling apparatus, equipment and containers must be loaded into a boat in a safe manner so there is no damage or spill. In the boat, the load should be stashed equally on both sides fore and aft (front and back) with the weight distributed as evenly as possible.

All sampling gear, particularly any that is heavy, should be tied down or secured to keep it from moving around when the boat gets underway, turns, vibrates, or reacts to rough waters.

Although sampling activities may require standing up or leaning over the side of the boat, such actions should be done carefully and under controlled conditions, when the boat is <u>not</u> moving. When the boat is moving, personnel should sit on the seats provided. No one should ride on the bow or gunwales (sides) of the boat.

Personal flotation devices should be worn whenever there is a higher than normal risk of falling out of a boat, such as when the boat is moving at high speed or in rough water. (In some boating activities the safe practice would be to wear a personal flotation device at all times.)

ATTACHMENT C

WEIGHT CAPACITY CALCULATION

Weight Carrying Capacity

One of the most important safety requirements is to limit the weight of the total load on a boat to the rated capacity of the boat. Most boats built since 1972 have been required to display their load capacity on a plate mounted in the boat.

Capacity Considerations

a. Listed capacity of vessel:	_______________	Certified Capacity of the Vessel in Pounds	
b. # of People & Weight:	_______________	Approximate Weight of Personnel in Pounds	
c. Weight of Motor:	_______________	Listed Weight of Motor in Pounds	
d. Weight of Gear:	_______________	List Equipment and Weight	
………Fuel (Gallons/Pounds)…….	_______________	………………………………….	_______________
………………………………….	_______________	………………………………….	_______________
………………………………….	_______________	………………………………….	_______________
………………………………….	_______________	………………………………….	_______________
………………………………….	_______________	………………………………….	_______________
e.Total Weight of Gear/Equip:	_______________	Add items (c + d)	
e.Number/Volume of water samples:	_______________	List the number and Volume of Water Samples (in Gallons) to be collected	
f. Weight of Water Samples:	_______________	Multiply (# of Samples x Volume in Gallons x 8.33 lbs/gallon)	
g. Weight of Other Samples:	_______________	Estimate the number and weight of other samples	
h. Total Weight of Samples:	_______________	Add items (f + g)	
i.Weight of Personnel & Equip:	_______________	**Add items (b + e + h)**	
j. Capacity Factor:	_______________	**Insert a Capacity Reduction for Rough Weather**	
k. Planned Weight:	_______________	**Add (i +j)**	

If The Planned Weight in (k) is greater than the Certified Weight in (a), then the weight shall be adjusted be limiting equipment, personnel or samples as necessary to reduce the weight in the vessel.

In the combination capacity plate and certificate of compliance for an outboard motorboat, the first entry lists the manufacturer's rating of the maximum horsepower engine that is safe to use on the boat. The second entry lists the maximum number and weight of persons that can be carried and the third entry lists the maximum weight that can safely be carried by the boat (including persons, motor, and gear). Some boats may have two plates: a certificate of compliance and a separate capacity plate.

In order to avoid exceeding the load carrying capacity of a boat, it is necessary to know the number and total weight of all passengers and the weight of all the equipment and gear planned to be taken on board, including fuel, food, and environmental sampling apparatus. To this total weight must be added the estimated weight of the water or other samples to be collected and brought on board.

The recommended maximum weight shown on the capacity plate may be more than can be carried safely under some weather conditions and for some activities. For example, if rough water is expected, less weight should be carried so that the boat rides higher in the water and is less likely to be swamped by waves.

ATTACHMENT D

BOATING OPERATION UNDER ROUTINE AND EMERGENCY CONDITIONS

Operation of the Vessel under Routine and Emergency Conditions

Boating Operations

Operation of a boat used for WESTON field activities may be so routine that everyone knows how to operate the boat and is thoroughly qualified to operate it under all conditions. If that is not the case, the person in charge of the boat should familiarize a second person on board with the operation and navigation of the boat. Doing so ensures a backup person who can run the boat and get it back to port if the pilot becomes disabled.

Weather Conditions

Before leaving the dock, check the local weather forecast for the area and look for weather signals that may be displayed at marinas, municipal piers, lighthouses, or Coast Guard stations.

The U.S. Weather Bureau publishes charts giving the locations and telephone numbers of all Weather Bureau offices and the location and time schedule of all stations that broadcast marine weather information. The charts also show the location of all storm warning display stations. Charts for local areas can be obtained from the Government Printing Office.

A small craft warning indicates winds up to 38 miles per hour, or 33 knots, and /or sea conditions considered dangerous for small craft such as the ones used commonly in WESTON activities. The daytime signal is one triangular red pennant. Although most display sites do not post night signals, the night signal for a small craft warning is one red light displayed above one white light.

A gale warning, with winds within the range of 34 to 47 knots, or 39 to 54 miles per hour, is signaled by two triangular red flags.

A storm, which may have winds of 48 to 63 knots, or 55 miles per hour up to 73 miles per hour, is forecast when a single square red flag with a black center is displayed.

Two square red flags with black centers are displayed only to show the forecast of a hurricane or tropical cyclone, in which winds speeds of more than 74 knots can be expected.

In addition to getting weather information before beginning a boat trip, it is a good idea to keep track of weather conditions as they develop while the boating activity is underway. Pay attention to increases in wind speed or waves, changes in wind direction, or approach of storm clouds, listen for static on an AM radio, or monitor a weather radio.

Rules of the Road

Every person operating a boat is legally responsible for any damage the boat or its waste may cause. For example, creating an unnecessarily large wake can cause problems in a crowded anchorage or other area, and the boat operator may be held responsible for any damage caused by such a wake.

The person in command of a boat is required to have knowledge of the requirements for operation and navigation of the boat, and of the regulations that apply locally, including the mandatory rules of the road.

The rules of the road that must be followed by everyone operating a boat govern three major subjects: identification lights, rules for steering and signaling course, and signals in fog. The major emphasis in this section will be on rules for steering and signaling course.

Rules for steering and for signaling course are designed to prevent collision by defining which of two approaching vessels has the right-of-way, and what signals are used to quickly signal intent and agreement or disagreement.

The vessel that has the right-of-way is the privileged vessel, now referred to as the Stand On vessel. The Stand On vessel has a right to maintain its course and speed. It also has a duty to maintain its course and speed so that the other vessel can base its actions on known conditions. If a collision becomes imminent, the Stand On vessel no longer has the right-of-way or any privilege.

The vessel that does not have the right-of-way is the Give Way vessel, previously referred to as the "burdened" vessel. When this vessel approaches another closely enough so that collision is possible if both vessels continue, the Give Way vessel must slow, turn or take other positive action to avoid collision.

The steering rules for power vessels apply when two are in sight of each other and close enough so that a collision could occur if both vessels continue on the same course at the same speed.

When two vessels are meeting, crossing, or overtaking, which vessel has the right-of-way? What signals are used to communicate? The following discussion presents three different situations, recommended actions, and recommended signals.

Meeting Situation

When two vessels are approaching head, on or nearly so, in a meeting situation, neither has the right-of-way. If their courses are likely to result in a collision, both must alter their course to the starboard (right) so that each can pass safely to the port (left) of the other.

As a confirmation of its intention to take a particular course, a vessel will give a "course indicating signal" of one or two short blasts on a whistle or horn. In United States waters, the other vessel will signal its understanding and agreement by answering with the same signal, and its lack of understanding or agreement by sounding the danger signal, four short blasts. (In international waters no response is required, and the danger signal is five short blasts.)

One blast in a meeting situation signals intention to alter course to the starboard and to pass the other vessel port to port. Two blasts in the same situation signals intention to alter course to the port and to pass starboard to starboard.

Crossing Situation

When two vessels are approaching at an angle in a crossing situation, the vessel on the right has the right-of-way. As described earlier, your vessel must "give way" or yield the right-of-way to any vessel approaching from any direction on your right between dead ahead to two compass points abaft your starboard beam (the arc of 112½ degrees in which your vessel shows the green light at night). The Give Way vessel must slow or alter course to avoid collision, while the Stand On vessel maintains her course and speed. The U.S. signals are one short blast by the Stand On vessel to indicate intention to maintain course and speed, and an answering blast from the Give Way vessel to

indicate that she has heard and understood the signal the signal and will keep clear. If there is any doubt, the danger signal of four blasts should be sounded and both vessels must stop. Then the vessels must exchange signals until there is an agreement on the courses to be taken.

If you see the red light of a vessel which is crossing your course at night, that vessel has the right-of-way and your vessel must keep clear.

Overtaking Situation

If one vessel is overtaking another, the overtaking vessel is burdened and must be ready to give way until the overtaken vessel has been passed safely.

If the overtaking vessel wishes to pass to the starboard side of the other vessel (altering course to the starboard), the overtaking (Give Way) vessel gives one short signal on the whistle or horn. If she wishes to pass to the port side the overtaking vessel gives two short signals. The Stand On, or privileged, vessel (the one being overtaken) must either indicate agreement by repeating the signal given or disagreement by giving the danger signal.

If you see the white light of another vessel at night, but cannot see either the red or green lights, you are approaching the vessel from the rear and must follow the rules for overtaking another vessel.

Special Situation

In a narrow channel, keep to the right side of the channel if possible, and when nearing a bend where another vessel might not be seen, signal with a prolonged whistle blast of 4 to 6 seconds.

Large deep-draft ships, which may not be able to maneuver or stop easily, have the right-of-way in such situations.

Generally, right-of way must be given to fishing vessels, sailing vessels, and very large vessels.

Fog Signals

In orders to avoid collisions in fog or other conditions of poor visibility, the rules of the road require all vessels to sound fog, mist, falling snow or heavy rain, by day or by night.

A power vessel underway must should signal one prolonged blast on the whistle at least every minute. A vessel at anchor (outside of a specified anchorage area) must ring its bell or sound its horn or whistle rapidly for 5 seconds at a time and at least one time each minute.

Towing vessels underway must sound a series of three blasts in succession every minute, in a series consisting of one prolonged and two short blasts.

Navigation Aids

On the navigable waters of the United States a system of aids to navigation exist that boaters should be familiar with: buoys, markers and lights.

These navigation aids are provided to mark channels and obstructions for the convenience and safety of vessels, to provide direction, and to give information on exact position.

The basic system provides black rectangular buoys or markers with odd numbers on one side of the channel, and red triangular buoys or markers with even numbers on the other side. On rivers, the black rectangular shapes and odd numbers will be on the <u>left</u> or port side of the boat if it is traveling <u>up</u> the flow of the river.

When returning from the sea, going upstream, the red triangular shapes and the even numbers will be on the right or starboard side of the boat: "red right returning.". Conversely, if the red buoys are on the opposite side, the boat is traveling downriver and heading toward the sea.

In the Great Lakes, going westerly, or to the source of one of the lakes, corresponds to going upstream from the sea. When traveling in that direction, the black rectangular and odd will be on the port side (left), and the red triangular and even will be on the starboard side.

On the Intracoastal Waterway, "upstream" or "returning from the sea" is marked from New Jersey going south to the southernmost tip of Florida, and west to Texas. On the Pacific Coast, "upstream" is marked in the direction of travel from California to Alaska. Another way of viewing the system is that travel "clockwise" corresponds to "upstream."

Buoys and markers on the Intracoastal Waterway are marked with a yellow band, stripe, square or triangle. For example, a yellow band near the top of a black can buoy identifies it as being on the Intracoastal Waterway, as does a yellow square on a lighted black marker.

Regulatory markers may provide information or give warning, such as a boat speed restrictions.

In waters too deep for other types of navigation aides, Texas Tower structures and lightships provide warning and guidance to ships. Most of the lightships have been replaced by the Texas Towers.

Large navigational buoys have primary and standby generators for operation of a high-intensity light, a radio beacon and a fog signal. These 40-foot diameter buoys are replacing lighthouses at major harbor entrances. (They have meteorological monitoring apparatus for air and water temperature, wind speed and direction, and other data.)

Some buoys have an automated light, a fog horn, and a marine radio beacon.

Boat Handling

Even in calm water a boat does not handle like any land vehicle. It turns differently, starts differently, and stops differently. The Corporate Health and Safety Department recommends personnel take one of the boating skills courses offered by the Coast Guard Auxiliary and practice handling a boat under calm conditions.

Even personnel who have operated a boat may not have had training or experience in the type of boat used to perform work for WESTON, handling a boat under conditions where there is heavy traffic, narrow channels, swift current, or stormy weather. Training is recommended before difficult conditions arise. For example, the Boating Skills and Seamanship textbook and courses cover topics such as towing a disabled boat, operating on a river and going through locks, special hazards of dams, and navigating safely through waves that could capsize a vessel.

Boating Emergencies

Boating personnel need to understand two aspects of distress signals: when to use them and how to respond when others use them. If a boat capsizes, loses power in high winds or heavy seas, or collides with a fixed object or another boat, emergency help will be needed. If such an event occurs, or if a member of the team has a major medical emergency, call for help by any means available: horn, whistle, radio, or visual distress signals.

If a radio is onboard, should send a “Mayday” distress message on either VHF Channel 16 or 2182 kilohertz, following the recommended format. A Mayday message must include the following information:

1. Boat and call letters
2. Location
3. The nature of distress
4. The number of persons aboard and conditions of any injured
5. Estimated seaworthiness of the boat
6. Detailed description of the boat
7. Anything else that may help rescuers locate the boat

If the distressed boat is close enough to shore or other vessels for someone to see it, use the short-range distress signal or arm waving, as well as an orange smoke signal. (Do not stand up unless the water is calm.)

If no other vessel or source of assistance is close by, hoist a distress flag if one is onboard and can be seen, or if it is dark, use an electric distress light.

If only pyrotechnic distress signals are onboard, prepare to use them when someone is in a position to see them. In general, wait until another boat or an aircraft can be seen or heard, or it is reasonably sure that someone on shore is in position to see the signal. Use caution when using pyrotechnic devices not to set fire to the boat or its cargo.

If the boat capsizes, “ STAY WITH THE BOAT" Get into it if possible. Water conducts heat away from the body rapidly, and in 50 degree water, survival time may be as little as three hours.

Conserving body heat is important to extend survival time. To conserve body heat:

1. Wear the warmest personal flotation device available
2. DO NOT SWIM AWAY FROM THE BOAT
3. Get up out of the water as far as possible

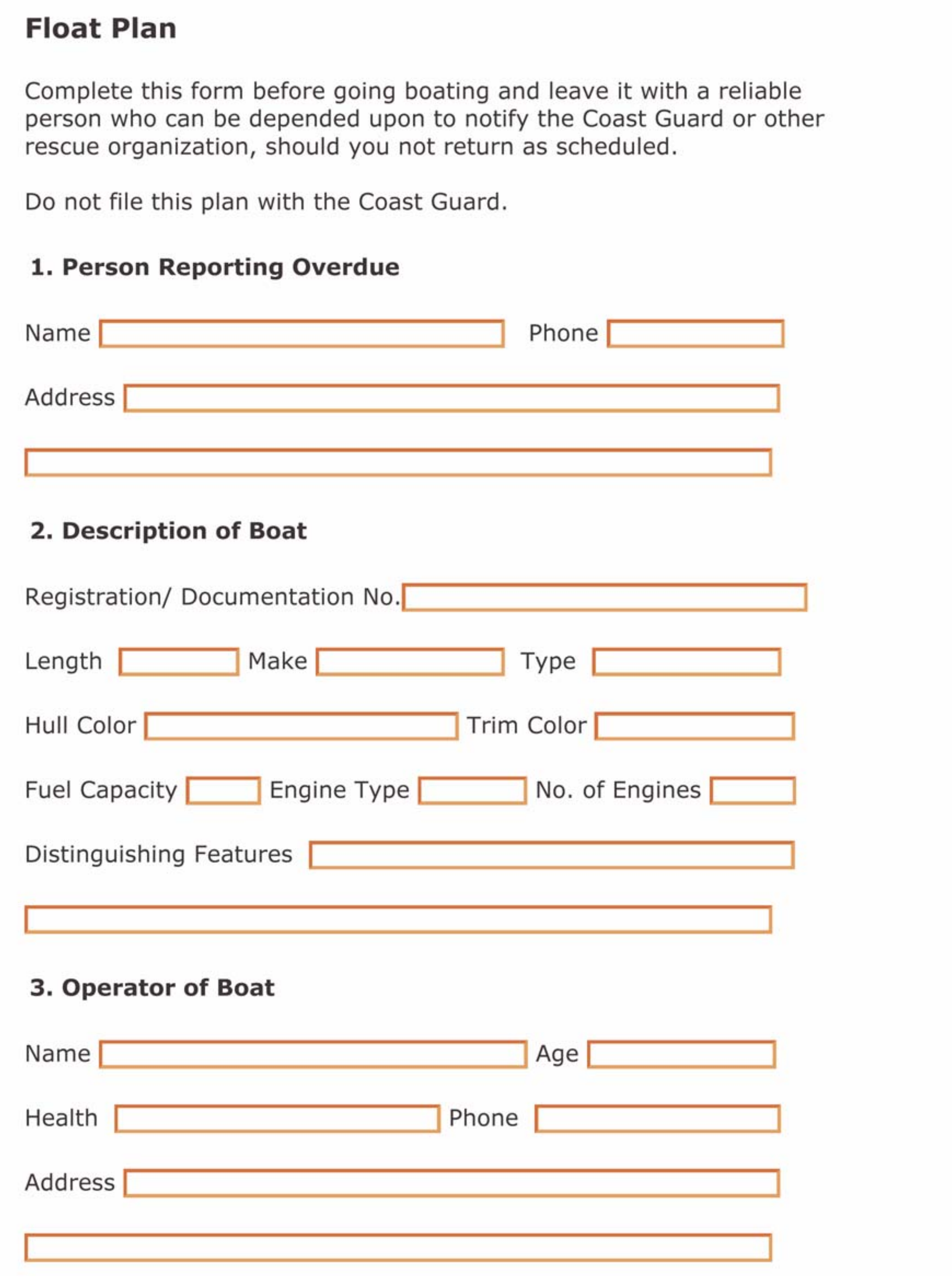
If it is not possible to get out of the water, assume the fetal position to reduce the escape of heat from the body. If there are several persons, huddle with the others, side-by-side in a circle. Do not swim for shore unless there is absolutely no chance of rescue. The boat is easier for rescuers to spot than an individual in the water.

A response to a distress signal should be made by anyone near enough to answer or assist.

Personnel in boats equipped with a radio should notify the nearest Coast Guard station on VHF marine Channel 16, or someone else on CB Channel 9, upon seeing or hearing a distress signal. Personnel in a position to assist without being endangered should do so. (The “Good Samaritan” clause in the Federal Boat Safety Act of 1971 protects from liability anyone who provides or arranges towage, medical treatment, or other assistance as an ordinary, reasonably prudent person would under the same or similar circumstances.)

ATTACHMENT E

BOATING SAFETY REGULATIONS
FEDERAL REQUIREMENTS
FLOAT PLAN



Float Plan

Complete this form before going boating and leave it with a reliable person who can be depended upon to notify the Coast Guard or other rescue organization, should you not return as scheduled.

Do not file this plan with the Coast Guard.

1. Person Reporting Overdue

Name Phone

Address

2. Description of Boat

Registration/ Documentation No.

Length Make Type

Hull Color Trim Color

Fuel Capacity Engine Type No. of Engines

Distinguishing Features

3. Operator of Boat

Name Age

Health Phone

Address

Operator's Experience

4. Survival Equipment (Check as Appropriate)

☐ #☐ PFDs

☐ Smoke Signals

☐ Paddles

☐ Raft or Dinghy

☐ Others

☐ Flares

☐ Flashlight

☐ Water

☐ EPIRB

☐ Mirror

☐ Food

☐ Anchor

☐ **Horn**

☐ **Whistle**

5. Marine Radio

☐ Yes ☐ No

Type

Freqs.

6. Trip Expectations

Depart from

Departure Date

Time

Going To

Arrival Date

Time

If operator has not arrived/returned by: Date

Time

call the Coast Guard or Local authority at the following number:

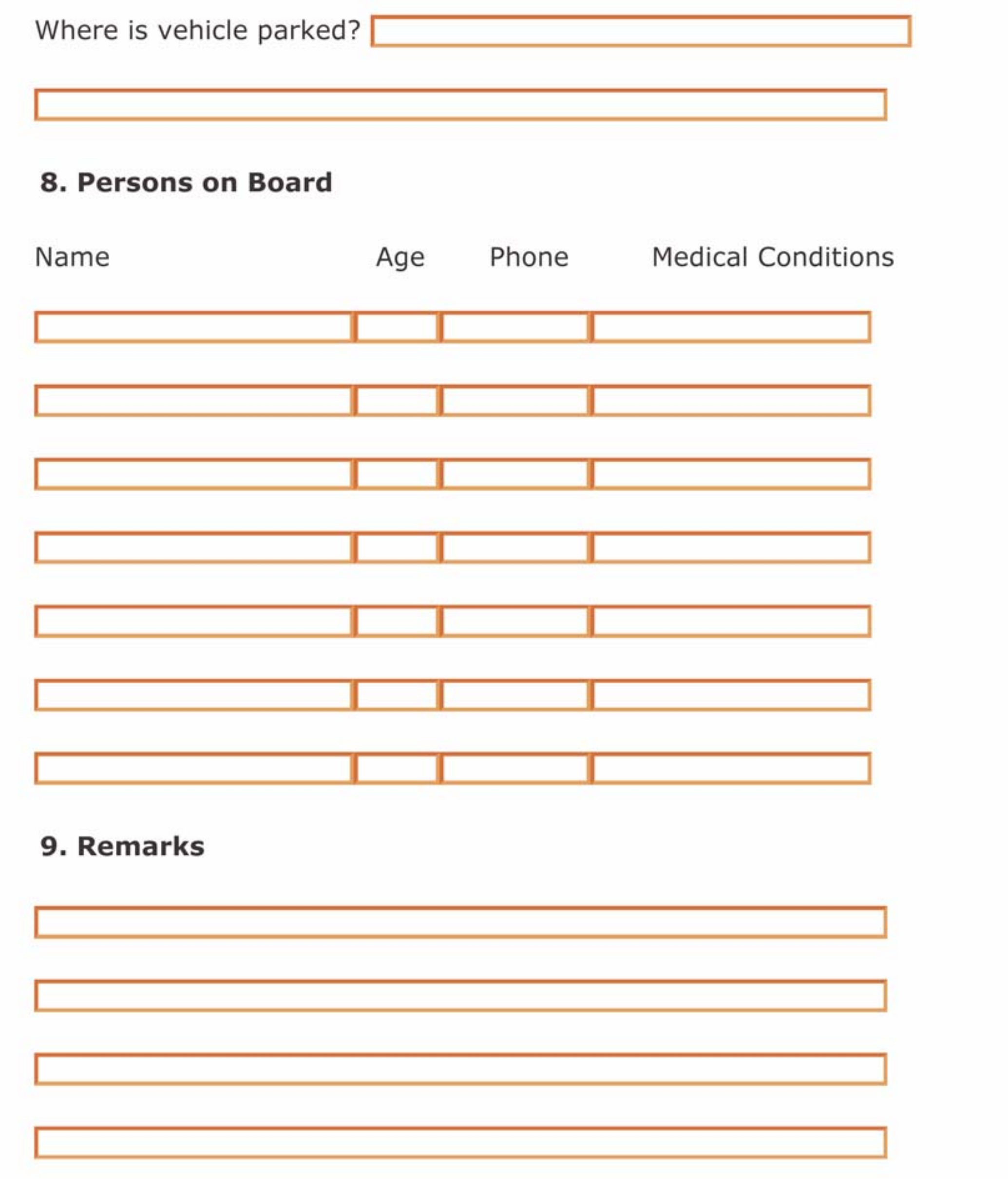
7. Vehicle Description

License No.

Make

Model

Color



Where is vehicle parked?

8. Persons on Board

Name	Age	Phone	Medical Conditions

9. Remarks

ATTACHMENT F

GLOSSARY OF BOATING TERMS

A

ABAFT - Toward the rear (stern) of the boat. Behind.
ABEAM - At right angles to the keel of the boat, but not on the boat.
ABOARD - On or within the boat.
ABOVE DECK - On the deck (not over it - see ALOFT).
AFT - Toward the stern of the boat.
AGROUND - Touching or fast to the bottom.
AHEAD - In a forward direction.
AIDS TO NAVIGATION (AtoN) - Artificial objects to supplement natural landmarks to indicate safe and unsafe waters.
ALOFT - Above the deck of the boat.
AMIDSHIPS - In or toward the center of the boat.
ANCHOR - A heavy metal device, fastened to a chain or line, to hold a vessel in position, partly because of its weight, but chiefly because the designed shape digs into the bottom.
ANCHORAGE - A place suitable for anchoring in relation to the wind, seas and bottom.
ASTERN - In back of the boat, opposite of ahead.
ATHWARTSHIPS - At right angles to the centerline of the boat; rowboat seats are generally athwartships.

△

B

BATTEN DOWN - Secure hatches and loose objects both within the hull and on deck.
BEACON - A lighted or unlighted fixed aid to navigation attached directly to the earth's surface. (Lights and daybeacons both constitute "beacons.")
BEAM - The greatest width of the boat.
BEARING - The direction of an object expressed either as a true bearing as shown on the chart, or as a bearing relative to the heading of the boat.
BELOW - Beneath the deck.
BIGHT - The part of the rope or line, between the end and the standing part, on which a knot is formed. A shallow bay.
BILGE - The interior of the hull below the floor boards.
BITTER END - The last part of a rope or chain. The inboard end of the anchor rode.
BLOCK - A wooden or metal case enclosing one or more pulleys and

having a hook, eye, or strap by which it may be attached.

BOAT - A fairly indefinite term. A waterborne vehicle smaller than a ship. One definition is a small craft carried aboard a ship.

BOAT HOOK - A short shaft with a fitting at one end shaped to facilitate use in putting a line over a piling, recovering an object dropped overboard, or in pushing or fending off.

BOW - The forward part of a boat.

BOW LINE - A docking line leading from the bow.

BOW SPRING LINE - A bow pivot line used in docking and undocking, or to prevent the boat from moving forward or astern while made fast to a pier.

BOWLINE KNOT - A knot used to form a temporary loop in the end of a line.

BOWSPRIT - A spar extending forward from the bow.

BRIDGE - The location from which a vessel is steered and its speed controlled. "Control Station" is really a more appropriate term for small craft.

BULKHEAD - A vertical partition separating compartments.

BUOY - An anchored float used for marking a position on the water or a hazard or a shoal and for mooring.

C

CABIN - A compartment for passengers or crew.

CAPSIZE - To turn over.

CAST OFF - To let go.

CATAMARAN - A twin-hulled boat, with hulls side-by-side.

CHAFING GEAR - Tubing or cloth wrapping used to protect a line from chafing on a rough surface.

CHANNEL - 1. That part of a body of water deep enough for navigation through an area otherwise not suitable. It is usually marked by a single or double line of buoys and sometimes by range markers. 2. The deepest part of a stream, bay, or strait, through which the main current flows. 3. A name given to a large strait, for example, the English Channel.

CHART - A map for use by navigators.

CHINE - The intersection of the bottom and sides of a flat or v-bottomed boat.

CHOCK - A fitting through which anchor or mooring lines are led. Usually U-shaped to reduce chafe.

CLEAT - A fitting to which lines are made fast. The classic cleat to which lines are belayed is approximately anvil-shaped.

CLOVE HITCH - A knot for temporarily fastening a line to a spar or piling.

COAMING - A vertical piece around the edge of a cockpit, hatch, etc. to prevent water on deck from running below.

COCKPIT - An opening in the deck from which the boat is handled.

COIL - To lay a line down in circular turns.

COMPASS - Navigation instrument, either magnetic (showing magnetic north) or gyro (showing true north).

COMPASS CARD - Part of a compass, the card is graduated in degrees, to conform with the magnetic meridian-referenced direction system inscribed with direction which remains constant; the vessel turns, not the card.

COMPASS ROSE - The resulting figure when the complete 360° directional system is developed as a circle with each degree graduated upon it, and with the 000° indicated as True North. True North is also known as true rose. This is printed on nautical charts for determining direction.
CURRENT - The horizontal movement of water.

△

D

DAYBEACON - A fixed navigation aid structure used in shallow waters upon which is placed one or more daymarks.
DAYMARK - A signboard attached to a daybeacon to convey navigational information presenting one of several standard shapes (square, triangle, rectangle) and colors (red, green, orange, yellow, or black). Daymarks usually have reflective material indicating the shape, but may also be lighted.
DEAD AHEAD - Directly ahead.
DEAD ASTERN - Directly aft or behind.
DEAD RECKONING - A plot of courses steered and distances traveled through the water.
DECK - A permanent covering over a compartment, hull or any part of a ship serving as a floor.
DISPLACEMENT - The weight of water displaced by a floating vessel.
DISPLACEMENT HULL - A type of hull that plows through the water, displacing a weight of water equal to its own weight, even when more power is added.
DOCK - A protected water area in which vessels are moored. The term is often used to denote a pier or a wharf.
DRAFT - The depth of water a boat draws.

△

E

EASE - To slacken or relieve tension on a line.
EBB TIDE - A receding tide.
EVEN KEEL - When a boat is floating on its designed waterline, it is said to be floating on an even keel.
EYE OF THE WIND - The direction from which the wind is blowing.
EYE SPLICE - A permanent loop spliced in the end of a line.

△

F

FAST - Said of an object that is secured to another.
FATHOM - Six feet.
FENDER - A cushion, placed between boats, or between a boat and a pier, to prevent damage.
FIGURE EIGHT KNOT - A knot in the form of a figure eight, placed in the end of a line to prevent the line from passing through a grommet or a block.

FLAME ARRESTER - A safety device, such as a metal mesh protector, to prevent an exhaust backfire from causing an explosion; operates by absorbing heat.
FLARE - The outward curve of a vessel's sides near the bow. A distress signal.
FLYING BRIDGE - An added set of controls above the level of the normal control station for better visibility. Usually open, but may have a collapsible top for shade.
FOLLOWING SEA - An overtaking sea that comes from astern.
FORE AND AFT - In a line parallel to the keel.
FORWARD - Toward the bow of the boat.
FOULED - Any piece of equipment that is jammed or entangled, or dirtied.
FOUNDER - hen a vessel fills with water and sinks.
FREEBOARD - The minimum vertical distance from the surface of the water to the gunwale.

△

G

GAFF - A spar to support the head of a gaff sail.
GALLEY - The kitchen area of a boat.
GANGWAY - The area of a ship's side where people board and disembark.
GEAR - A general term for ropes, blocks, tackle and other equipment.
GIVE-WAY VESSEL - A term, from the Navigational Rules, used to describe the vessel which must yield in meeting, crossing, or overtaking situations.
GRAB RAILS - Hand-hold fittings mounted on cabin tops and sides for personal safety when moving around the boat.
GROUND TACKLE - Anchor, anchor rode (line or chain), and all the shackles and other gear used for attachment.
GUNWALE - The upper edge of a boat's sides.

△

H

HARBOR - A safe anchorage, protected from most storms; may be natural or man-made, with breakwaters and jetties; a place for docking and loading.
HATCH - An opening in a boat's deck fitted with a watertight cover.
HEAD - A marine toilet. Also the upper corner of a triangular sail.
HEADING - The direction in which a vessel's bow points at any given time.
HEADWAY - The forward motion of a boat. Opposite of sternway.
HEAVE TO - To bring a vessel up in a position where it will maintain little or no headway, usually with the bow into the wind or nearly so.
HEEL - To tip to one side.
HELM - The wheel or tiller controlling the rudder.
HITCH - A knot used to secure a rope to another object or to another rope, or to form a loop or a noose in a rope.
HOLD - A compartment below deck in a large vessel, used solely for

carrying cargo.
HULL - The main body of a vessel.
HYPOTHERMIA - A life-threatening condition in which the body's warming mechanisms fail to maintain normal body temperature and the entire body cools.

△

I

INBOARD - More toward the center of a vessel; inside; a motor fitted inside the boat.

△

J

There are no boating terms under this heading.

△

K

KEDGE - To use an anchor to move a boat by hauling on the anchor rode; a basic anchor type.
KEEL - The centerline of a boat running fore and aft; the backbone of a vessel.
KETCH - A two-masted sailboat with the smaller after mast stepped ahead of the rudder post.
KNOT - A measure of speed equal to one nautical mile (6076 feet) per hour. A fastening made by interweaving rope to form a stopper, to enclose or bind an object, to form a loop or a noose, to tie a small rope to an object, or to tie the ends of two small ropes together.

△

L

LEEWARD - The direction away from the wind. Opposite of windward.
LEEWAY - The sideways movement of the boat caused by either wind or current.
LINE - Rope and cordage used aboard a vessel.
LOG - A record of courses or operation. Also, a device to measure speed.

LUBBER'S LINE - A mark or permanent line on a compass indicating the direction forward; parallel to the keel when properly installed.

△

M

MAST - A spar set upright to support rigging and sails.
MONOHULL - A boat with one hull.

MOORING - An arrangement for securing a boat to a mooring buoy or a pier.
MOORING BUOY - A buoy secured to a permanent anchor sunk deeply into the bottom.

△

N

NAUTICAL MILE - One minute of latitude; approximately 6076 feet - about 1/8 longer than the statute mile of 5280 feet.
NAVIGATION - The art and science of conducting a boat safely from one point to another.

△

O

OUTBOARD - Toward or beyond the boat's sides. A detachable engine mounted on a boat's stern.
OUTDRIVE - A propulsion system for boats with an inboard engine operating an exterior drive, with drive shaft, gears, and propeller; also called stern-drive and inboard/outboard.
OVERBOARD - Over the side or out of the boat.

△

P

PAINTER - A line attached to the bow of a boat for use in towing or making fast.
PAY OUT - To ease out a line, or let it run in a controlled manner.
PENNANT (sometimes PENDANT) - The line by which a boat is made fast to a mooring buoy.
PERSONAL FLOTATION DEVICE (PFD) - PDF is official terminology for life jacket. When properly used, the PDF will support a person in the water. Available in several sizes and types.
PIER - A loading/landing platform extending at an angle from the shore.
PILOTING - Navigation by use of visible references, the depth of the water, etc.
PITCH - 1. The alternate rise and fall of the bow of a vessel proceeding through waves; 2. The theoretical distance advanced by a propeller in one revolution; 3. Tar and resin used for caulking between the planks of a wooden vessel.
PITCHPOLING - A small boat being thrown end-over-end in very rough seas.
PLANING HULL - A type of hull shaped to glide easily across the water at high speed.
PORT - The left side of a boat looking forward. A harbor.
PROPELLER - A rotating device, with two or more blades, that acts as a screw in propelling a vessel.

△

Q

QUARTER - The sides of a boat aft of amidships.

QUARTERING SEA - Sea coming on a boat's quarter.

R

REEF - To reduce the sail area.

RIGGING - The general term for all the lines of a vessel.

RODE - The anchor line and/or chain.

ROLL - The alternating motion of a boat, leaning alternately to port and starboard; the motion of a boat about its fore-and-aft axis.

ROPE - In general, cordage as it is purchased at the store. When it comes aboard a vessel and is put to use, it becomes a line.

RUDDER - A vertical plate or board for steering a boat.

RUNNING LIGHTS - Lights required to be shown on boats underway between sundown and sunup.

S

SCOPE - The ratio of the length of an anchor line, from a vessel's bow to the anchor, to the depth of the water.

SCREW - A boat's propeller.

SEA ANCHOR - Any device used to reduce a boat's drift before the wind.

SECURE - To make fast.

SHACKLE - A "U" shaped connector with a pin or bolt across the open end.

SHEAR PIN - A safety device, used to fasten a propeller to its shaft; it breaks when the propeller hits a solid object, thus preventing further damage.

SHEET BEND - A knot used to join two ropes. Functionally different from a square knot in that it can be used between lines of different diameters.

SHIP - A larger vessel usually used for ocean travel. A vessel able to carry a "boat" on board.

SHOAL - An offshore hazard to navigation at a depth of 16 fathoms (30 meters or 96 feet) or less, composed of unconsolidated material.

SLACK - Not fastened; loose. Also, to loosen.

SLOOP - A single masted vessel with working sails (main and jib) set fore and aft.

SPLICE - To permanently join two ropes by tucking their strands alternately over and under each other.

SPRING LINE - A pivot line used in docking, undocking, or to prevent the boat from moving forward or astern while made fast to a dock.

SQUALL - A sudden, violent wind often accompanied by rain.

SQUARE KNOT - A knot used to join two lines of similar size. Also called a reef knot.

STANDING PART - That part of a line which is made fast. The main

part of a line as distinguished from the bight and the end.
STAND-ON VESSEL - That vessel which continues its course in the same direction at the same speed during a crossing or overtaking situation, unless a collision appears imminent. (Was formerly called "the privileged vessel.")
STARBOARD - The right side of a boat when looking forward.
STERN - The after part (back) of the boat.
STERN LINE - A docking line leading away from the stern.
STOW - To pack or store away; especially, to pack in an orderly, compact manner.
SWAMP - To fill with water, but not settle to the bottom.

T

TACKLE - A combination of blocks and line to increase mechanical advantage.
THWART - A seat or brace running laterally across a boat.
TIDE - The periodic rise and fall of water level in the oceans.
TILLER - A bar or handle for turning a boat's rudder or an outboard motor. **TOPSIDES** - The sides of a vessel between the waterline and the deck; sometimes referring to onto or above the deck.
TRANSOM - The stern cross-section of a square-sterned boat.
TRIM - Fore and aft balance of a boat.
TRIMARAN - A boat with three hulls.
TRIPLINE - A line fast to the crown of an anchor by means of which it can be hauled out when dug too deeply or fouled; a similar line used on a sea anchor to bring it aboard.
TRUE NORTH POLE - The north end of the earth's axis. Also called North Geographic Pole. The direction indicated by 000° (or 360°) on the true compass rose.
TRUE WIND - The actual direction from which the wind is blowing.
TURNBUCKLE - A threaded, adjustable rigging fitting, used for stays, lifelines and sometimes other rigging.

U

UNDERWAY - Vessel in motion, i.e., when not moored, at anchor, or aground.

V

V BOTTOM - A hull with the bottom section in the shape of a "V."
VARIATION - The angular difference between the magnetic meridian and the geographic meridian at a particular location.
VHF RADIO - A very high frequency electronic communications and direction finding system.

W

WAKE - Moving waves, track or path that a boat leaves behind when moving across the waters.
WATERLINE - A line painted on a hull which shows the point to which a boat sinks when it is properly trimmed.
WAY - Movement of a vessel through the water, such as headway, sternway, or leeway.
WHARF - A man-made structure bonding the edge of a dock and built along or at an angle to the shoreline, used for loading, unloading, or tying up vessels.
WINCH - A device used to increase hauling power when raising or trimming sails.
WINDWARD - Toward the direction from which the wind is coming. Opposite of leeward.

X

There are no boating terms under this heading.

Y

YAW - To swing off course, as when due to the impact of a following or quartering sea.
YAWL - A two-masted sailboat with the small mizzen mast stepped abaft the rudder post.

Z

There are no boating terms under this heading.

FLD 19 WORKING OVER OR NEAR WATER

Return to top

GENERAL

REFERENCES

Related FLD OPS:

FLD02 – Inclement Weather
FLD05 – Heat Stress Prevention and Monitoring
FLD06 – Cold Stress
FLD18 – Operation and Use of Boats
FLD22 – Heavy Equipment Operation
FLD23 – Crane/Lifting Equipment
FLD24 – Aerial Lifts/Manlifts
FLD25– Working at Elevation

PROCEDURE

Hazards associated with working around water include drowning, frostbite, hypothermia, and or injury from falling into the water. Heat stress hazards may also be present.

Carelessness, horseplay, or other unsafe acts could cause injury to personnel working over or near water.

There are also hazards associated with untrained personnel operating equipment.

Lack of personal protective equipment (PPE)or misuse of PPE could result in injury or death.

Recognition and Hazard Assessment

Proper precautions should be taken at all times when personnel are working over or near water. Whenever there is a body of water in close proximity to a work location, the proper safety procedures should be implemented. Requirements for equipment or procedures will be based on an evaluation of work tasks, drowning, and injury potential.

New field team members should be thoroughly indoctrinated in safe work practices pertinent to the work to which they are assigned.

Prevention and Protection Program

When working over or near water where there is potential for drowning, engineering controls such as installation of guardrails, toeboards, and other PPE such as safety line systems, shall be used to prevent personnel from falling into the water. In addition, flotation devices must be worn and other lifesaving devices must be present. Personal flotation devices (PFDs) should be designed to float unconscious or helpless persons face up.

Safety nets:

1. Safety nets must be provided when workplaces are more than 25 feet above the ground or water surface, or other surfaces where the use of ladders, scaffolds, catch platforms, temporary floors, safety lines, or safety belts are impractical.

   a) Where safety net protection is required, operations shall not be undertaken until the net is in place and has been tested.

   b) Nets shall extend 8 feet beyond the edge of the work surface where employees are exposed and shall be installed as close under the work surface as practical, but in no case more than 25 feet below such work surface. Nets shall be hung with sufficient clearance to prevent user's contact with the surfaces or structures below. Such clearances shall be determined by impact load testing.

2. It is intended that only one level of nets be required for bridge construction.

3. The mesh size of nets shall not exceed 6 inches by 6 inches. All new nets shall meet accepted performance standards of 17,500 foot-pounds minimum impact resistance, as determined and certified by the manufacturer, and shall bear a label of proof test. Edge ropes shall provide a minimum breaking strength of 5,000 pounds.

4. Forged steel safety hooks or shackles shall be used to fasten the net to its supports.

5. Connections between net panels shall develop the full strength of the net. Where work locations are such that a reaching pole is infeasible, ring buoys with at least 90 feet of line must be available within 200 feet. A lifesaving skiff should be readily available where large water bodies or worker clothing or equipment burdens would make a ring buoy ineffective.

First aid supplies should be aboard all lifesaving craft or readily accessible and arrangements for ambulance service should be made as location changes.

Personnel should be discouraged from jumping to or from any craft which is not secured, and from jumping between craft when a gangplank should be used.
Fall protection should be provided when working over or near water where there is a potential for falling or slipping into the water.

In areas subject to tidal flow or rising water levels, the SHSC will monitor the water level to ensure that employees will not be trapped between a work area and the water level.

Standard Operating Procedures

Equipment and procedures will conform to U.S. Coast Guard (USCG) and/or Occupational Safety and Health Administration (OSHA) requirements and applicable local regulations.

Personnel working over or near water shall be provided with USCG-approved PFDs (life jackets or buoyant work vests), which shall be worn whenever there is potential drowning hazard. PFDs should be designed to float unconscious or helpless persons face up.

Prior to and after each use, PFDs and life preservers shall be inspected for defects which would alter their strength or buoyancy (e.g., rips, tears, holes). All defective units shall be removed from the site and replaced. At no times will defective units be used.

USCG-approved life rings (rope attachment not required) and ring buoys (rope attachment required) should have attached at least 90 feet of 3/8-inch solid braid polypropylene rope or equal. The life rings or ring buoys shall be readily available for emergency rescue operations. Distance between ring buoys shall not exceed 200 feet. One ring buoy or life ring shall be provided on each lifesaving skiff.

Lights conforming to 16 CFR 161.012 will be required whenever there is a potential need for life rings to be used after dark. Lights on life rings are required only in locations where adequate general lighting (e.g., floodlights) is not provided.

At least one lifesaving skiff shall be immediately available at locations where employees are working over or adjacent to water. Personnel trained in launching and operating the skiff shall be readily available during working hours. Skiffs shall be kept afloat or ready for instant launching. At a minimum, skiffs shall be equipped as follows:

- Four oars (two if the skiff is motor powered).
- Oarlocks attached to gunwales or the oars.
- One ball-pointed boat hook.
- One ring buoy with 90 feet of 3/8-inch solid braid polypropylene rope or equivalent line attached.
- PFDs equaling the skiff rating for the maximum number of personnel allowed on board.
- First aid kit.

In locations where waters are rough or swift, or where manually-operated boats are not practical, a power boat suitable for the waters shall be provided and equipped for lifesaving.

The maximum number of passengers and weight that can safely be transported shall be posted on all launches, motorboats, and skiffs. This number shall not be exceeded and in no case shall the number of passengers (including crew) exceed the number of PFDs aboard. Outboard motors and skiffs shall meet the minimum flotation requirements of the USCG. A certification tag affixed to the hull is satisfactory evidence of compliance. An efficient whistle or signal device shall be provided on all powered vessels to give signals required by the navigation rules applicable to the waters on which the vessel is operated.

Any vessel, except those easily boarded from the water, shall provide at least one portable or permanent ladder of sufficient length to rescue a person overboard.

Fixed ladders over 20 feet high shall have attached safety climbing devices for the attachment of safety belts, or shall be enclosed in a safety cage.

A person in the water shall be considered a person overboard and appropriate action taken.

All general safety precautions will be adhered to when working over or near water to prevent accidents caused from careless behavior or horseplay.

Only personnel who are trained in the operation of marine equipment (e.g., boats, barges) will be allowed to operate the equipment.

Ramps for access of vehicles or personnel to or between barges shall be of adequate strength, provided with guard rails, well-maintained and properly secured. In the case of personnel access, a safe walkway may be substituted for the ramp. All routes of access and passageways shall be kept free of ice, snow, grease, mud, and other obstructions. Nonslip surfaces shall be provided on all working decks, stair treads, ship ladders, platforms, catwalks, and walkways, particularly on the weather side of all doorways opening on deck.

Guardrails, bulwarks, or taut cable guardlines shall be provided for deck openings, elevated surfaces, and similar locations where persons may fall or slip. They shall be at least 42 inches high and have an intermediate rail.

If a Jacob's ladder is used, it will be of the double-rung or flat-tread type. It will be well-maintained and properly secured. The ladder will either hang without slack from its lashings or be pulled up entirely. When the upper end of the access-way rests on or is flush with the top of the bulwark (side of the ship above the upper deck), steps, properly secured and equipped with at least one hand rail approximately 33 inches in height, shall be provided between the top of the bulwark and the deck.

Obstructions will not be laid on or across gangways. The access-way will be adequately illuminated for its full length. All attempts will be made to place the access-way in a position that the load will not pass over personnel.

Any obstruction in a passageway that restricts normal passage shall be posted with warning signs or distinctively marked. Employees shall not be permitted to pass fore and aft, over or around the deck loads unless there is a safe passage. Decks and other working surfaces will be maintained in a safe condition and adequate safe walkways will be maintained for passage around the deck. All deck fittings and other obstructions that present stumbling hazards shall be painted yellow or marked with yellow trim.

Personnel will not walk along the sides of covered barges with coamings (raised frame to keep out water) more than 5 feet high unless there is a 3-foot clear walkway, a grab rail, or a taut handline.
Unless railings or other suitable protection exists, all personnel will use suitable protection against falling and/or drowning.

Floating Cranes

Barge-mounted cranes, designed and constructed as a unit, shall be rated by the manufacturer.

All barge-mounted cranes shall be on barges of sufficient size to limit list under load to approximately 5 degrees. The rated load of the crane shall not exceed the original capacity specified by the manufacturer.

Work shall be halted when significant wave action exists.

A load-radius chart and boom angle or radius indicator shall be provided within the operator's view. When load ratings are reduced to stay within the barge list limits, a new load rating chart shall be provided.

Floating cranes and floating derricks in use shall meet the requirements for design, construction, testing, installation, maintenance, and operation discussed in American National Standards Institute (ANSI) B30.8, Safety Code for Floating Cranes and Floating Derricks. Draglines shall meet power Crane and Shovel Association Standard #4. Performance tests shall demonstrate the strength stability, capability, and adequacy of power brakes clutches and controls in accordance with the following table.

PERFORMANCE TEST FOR FLOATING CRANES

Safe Working Load	Test Load
Up to 20 Tons	125% of working load
20 to 50 tons	Working load plus 5 tons
Over 50 tons	110% of working load

Truck and crawler cranes shall be securely attached to the barge. When stability of the barge is not a factor and control barriers are provided, limited travel may be authorized by the designated authority.

The rated load of a barge-mounted mobile crane shall not exceed the original capacity specified by the manufacturer.

Attachment 1 – Boating Health and Safety Issues

Operation and Use of Boats

A jon boat will be utilized to conduct fish and sediment sampling within the Raritan River and water bodies within the Raritan Arsenal during the time period from 11 July through the end of August 2005. The hazards associated with the operation and use of boats includes drowning, heat stress, cold stress, hypothermia, and/or injuries from slips, trips and falls. The potential for back injuries due to improper lifting techniques also exists when working with boats. The jon boat maximum load and capacity are clearly marked. All boats less than sixteen feet in length are required by law to carry at least one personal flotation device (Coast Guard approved Type I or II) for each person aboard. A whistle or other device capable of making an "efficient sound signal" audible for at least ½ mile will be on the boat while in use.

A float plan will be prepared prior to use of the jon boat. In addition, a Boating Pre-Trip Inspection Checklist, Equipment Checklist, and Capacity Worksheet will be completed each day of boat operation (or as required in accordance with FLD 18. The float plan will include destination, time of return, personnel onboard the sampling boat, and a description of the boat.

Working Near Water

The fish and sediment sampling will be conducted in the Raritan River along the northern shoreline and also within shallow water bodies within the Raritan Arsenal. Proper precautions will be taken at all times when working over or near water (either in a boat or in waters). The jon-boat will be used wherever the water depth allows for access. Hip waders or other means will be used to access areas that are inaccessible by boat (either due the depth or width of the water body). Whenever there is a body of water in close proximity to a work location the proper safety procedures should be implemented. Requirements for equipment or procedures will be based upon an evaluation of work tasks, drowning, and injury potential. Hazards associated with working around water include drowning, frostbite, hypothermia, and/or injury due to slips, trips, and falls.

Boating Hazard Analysis

Operation and Use of Boats (Raritan River and water bodies within the Raritan Arsenal)	The jon boat will be visually inspected prior to use. Personal floatation devices (Type I or Type II) will be provided for each person on the boat. Also a whistle and bailer will be located on the boat during operation. Daylight hours only. Charts (if available) to be reviewed prior to operation in water body. See FLD 18. Navigation and speed charts will be followed in water bodies.
Working Near Water	Proper precautions will be taken at all times when personnel are working over or near water. See FLD 19.
Electro fishing and seining equipment	Field personnel will follow appropriate procedures for use of electro fishing and seining equipment.
Inclement weather, including rain, lightning, and cold stress.	Personnel shall be dressed according to weather conditions; personnel working in rain shall follow FLD 02. Outdoor work will be suspended during thunderstorms.

STANDARD OPERATING PROCEDURE FOR FISH COLLECTION

TASK: Fish Collection

Methods which may be used during this project to capture fish include hand seines, gill nets, trotlines, and electroshockers. The primary hazards associated with these collection methods include: working near or over water, rough or uneven terrain, an electrical shock.

Hand seines will be operated by two or more individuals, and consist of a long, wall-like collecting net with a float line at the top and a lead line at the bottom. Seine nets will be used in shallow water where fish can be captured by surrounding an area and pulling the seine ashore to enclose the catch.

Seines will not be used in water with snags or other obstructions, and tend to roll up when pulled over weeds. Nets are difficult to pull in areas of high flow because of water resistance. Therefore, prior to attempting to seine a collection area, the area will be investigated to determine the feasibility, the efficiency, and the safety of using this collection method. Because of the hazards associated with collecting fish by this method, the following precautions should be taken:

- Because the water depth is variable, prior to starting wading activities, the depth in a particular area shall be determined to minimize the potential for submersion.

- Because chest waders and/or hip boots will be required, appropriate precautions shall be taken. When filled with water, even partially, waders become heavy and pose a serious threat to the individual wearing them. Therefore, no sampling team personnel will venture into areas where submersion is likely. A belt fitted snugly around the top of the waders may also be worn to limit the ability of water to enter the boots. Safety lines may also be required, depending on conditions.

- The type of bottom may affect the field crew's footing and its ability to work efficiently and safely. If necessary sure grip devices, such as creepers or carpeting may be added to the soles of boots to improve traction.

- The accessibility of field locations shall be considered in the field planning. Proximity of vehicle access will be determined beforehand for ease of equipment portage and to allow prompt access by response personnel in the event of an emergency,. It is required that the team leader be familiar with access roads and trails available in each area.

- Obstructions such as submerged rocks, trees, and floating objects affect the safety of boat use on lakes and waterways. Awareness of their locations is also significant in use of nets, trotlines, and instruments with the potential for snagging. Visual reconnaissance of areas for possible obstructions shall be made and their positions noted.

Trotlines may be used to selectively harvest bottom feeding fish specimens. Trotlines consist of long, heavy cords with multiple baited hooks attached by sections of monofilament line. Trotlines may be anchored by means of anchors or other weights attached to the ends of the trotlines or by tying the ends to stakes, limbs, or other immovable objects along the shoreline. The ends of the trotline sets will be marked by buoys and/or flagging tape to identify their location. The principal hazards associated with the deployment of trotlines are entanglement with the cordage and punctures from the hooks. Because of these hazards, the following precautions shall be observed:

- Trotlines will be deployed only in area of low current velocities to minimize the potential for drifting (or loss) of the trotlines from their intended locations.

- Trotline sets will be identified by flagging or buoys to minimize the risk associated with entanglement by members of the sampling team.

- Facility personnel will restrict access to the stream to only members of the sampling team for the duration of the trotline sets.

- Sampling team members will use caution in baiting, setting, handling, and harvesting the trotlines to minimize the potential for puncture wounds.

- Because the trotline hooks will be baited with materials such as commercial tub bait or chicken livers, the potential for infection resulting from puncture wounds exists. First aid equipment will be available to allow any puncture wounds to be immediately cleaned and disinfected.

The primary method that will be used to capture fish will be electroshocking. It should be noted that all electrofishing gear can develop electrical currents that are potentially harmful or lethal to man. Operators must be familiar with proper usage, potential involved, and safety procedures. Because of these hazards the following precautions shall be observed:

- The operator of an electrofisher must understand that the chance of receiving an electrical shock is multiplied when dealing with electric currents in or near water more than any other place.

- The Coffelt electrofishers have a high voltage output and certain safety precautions must be observed to provide safe operation and prevent possible dangerous shock. When operating the electrofisher the operator should never contact the anode. This situation could complete a path through the body for the electric current and cause a possible lethal shock. To prevent shocks from occurring the following equipment shall be used:

  - Non-leaking chest high waders. Wet boots can conduct electricity. If the waders become wet inside,

  - Non-leaking rubber electricians gloves that reach the elbow or higher. Wet gloves can conduct electricity. If the gloves become wet inside, electrofishing activities will be halted until and the gloves are thoroughly dry or replacement gloves are donned.

- The following are some do's and don'ts for electrofishing:

- Do always make sure that all personnel are clear of the area surrounding the anode before turning on the power.

- Don't continue to electrofish if your boots or gloves become damp or wet.

- Do make sure that the anode and cathode electrodes make a good connection with the output cable and that both electrodes are in contact with the water.

- Don't operate an electrofisher if you have any prior heart condition/history or if you have been under abnormal strain which may weaken your heart.

- Do review and know how to administer first aid treatment for electrical shock.

Because of the relatively high potential for hazard, all electrofishing equipment will be examined and approved for use, for reliability of safety devices and proper performance of the unit by a qualified technician prior to use in the field. It is the responsibility of the Site Safety Officer and Project Team Leader to verify that such equipment has been examined and approved for use prior to use. All maintenance and safety checks shall be recorded and kept by the SSO. Periodic checks will be determined by frequency of use.

ATTACHMENT L

PERSONNEL AND QUALIFICATIONS

First Aid / CPR Ceritified

Extension	Employee	CPR Expires	First Aid Expires
5857	Amin, Prabal	**9/30/2006**	**9/30/2006**
5841	Asch, Jill		**2/7/2007**
5850	Brown, Ryan		**9/13/2006**
5892	Brownell, Thomas		**9/13/2006**
5860	Clifford, Laura	**8/18/2006**	**8/18/2006**
5859	Fischer, Arthur		**9/13/2006**
5893	Garrison, Alanna		**9/16/2006**
5869	Gaughan, Daniel		**9/16/2006**
5826	Gilliland, Gerry		**9/13/2006**
5883	Lynes, Jeffrey		**9/13/2006**
5882	Mello, Gilberto		**9/13/2006**
5804	Pollack, Greg		**9/13/2006**
5812	Snyder, Scott		**9/13/2006**

PAUL BOVITZ

Qualifications Summary

- Over 20 years of professional experience.
- Seventeen years of technical experience in ecological assessment and natural resources management in public, private, and academic sectors, engaging in both theoretical and applied aspects of ecological research and encompassing a variety of geographic regions, habitats, and taxa.
- Preparation of ecological risk assessment studies, environmental impact statements, dredged material management plans, feasibility studies, permitting documents, and wetland restoration plans.
- Field supervisory experience, expert testimony, proposal preparation, client negotiation, and budget management.
- International experience in ecological assessment.

Registration

Certified Professional Wetland Scientist, Society of Wetland Scientists (1995)

Fields of Competence

Ecological risk assessment; environmental impact assessments under NEPA; wetland restoration, including functional assessment and permitting; remedial investigation and site remediation; stormwater management and non-point source pollution impacts; and dredged material management, including feasibility studies, permitting, and management plans.

Credentials

M.S., Ecology—Rutgers University (1992)
B.S., Wildlife Biology—Colorado State University (1982)
Society of Ecotoxicology and Environmental Chemistry
The Wildlife Society
Society of Wetland Scientists
Society of American Military Engineers
Habitat Evaluation Procedures (HEP) Training (2002)
Invited Panel Member, New Jersey Comparative Risk Assessment Project, NJDEP (2002)
40-Hour Hazardous Waste Site Training Course, OSHA 29 CFR 1910.120(e)(3), WESTON (1990)
8-Hour Hazardous Waste Refresher Course, OSHA 29 CFR 1910.120(e)(8), WESTON (2003)
Site Health and Safety Coordinator Course, OSHA 29 CFR 1910.120(e)(4), WESTON (1993)
Bloodborne Pathogens Training Course, OSHA 29 CFR 1910.1030, WESTON (2003)

Employment History

1990-Present	WESTON
1988-1990	The Hudson Partnership, Inc.

Employment History (Continued)

1985-1988	Rutgers University
1984-1985	Digital Equipment Corp., Inc.
1983	Mariah Associates, Inc.
1982-1983	Colorado State University
1981-1982	U.S. Fish and Wildlife Service
1980	Colorado State University
1980	Colorado Division of Wildlife
1979-1980	Colorado Cooperative Wildlife Research Unit
1979	U.S. Fish and Wildlife Service
1978	U.S. Forest Service [1-78 to 8-78; Salida, CO; Wildlife/Forestry Intern]

Key Projects

Ecological Risk Assessment, Edison, NJ, U.S. Army Corps of Engineers (USACE), New England Division, Task Manager. Directed baseline ecological risk assessment of the former Raritan Arsenal, a 3,500-acre site in Edison, NJ. Directed an extent of contamination study of surface water and sediment, and prepared a physical characterization report for the Phase II remedial investigation/feasibility study (RI/FS) for the site, which described contaminant migration patterns and potential bioavailability of surface water and sediment. Directed screening level risk assessment (SLRA) of all media used to identify contaminants of potential concern, and integrated it with site-specific ecological data from the site to develop a conceptual model of ecological exposure pathways. Conducting initial small mammal and fisheries sampling to identify ecological receptors. Presently working on the work plan for the baseline ecological risk assessment for the site, which involves evaluation of over 30 areas of concern divided among eight different drainage areas.

Project Management, Various Locations, USACE, New York District, Biological, Environmental, and Cultural Resources (BECR) Contract, Project Manager. Managed several projects, including environmental site assessments under the hazardous, toxic, radioactive waste (HTRW) and Defense Environmental Restoration Program – Formerly Used Defense Site (DERP-FUDS) programs, community relations plans for site cleanups, wetland mitigation studies and plans, and assessment of environmental impacts.

Environmental Impact Assessment, Meadowlands Mills Development, USACE, New York District, Project Manager. Directed preparation of draft and final environmental impact statements (EISs) on behalf of the USACE, New York District, evaluating impacts of a proposed 206-acre wetland fill project in the Hackensack Meadowlands District as part of a larger proposal to build a mixed-use regional retail/office/entertainment center ("megamall"). Critical technical issues evaluated by WESTON included compliance with Section 404(b)1 guidelines and National Environmental Policy Act (NEPA); the accuracy of the Indicator Value Assessment method as a means of functional assessment of wetlands on the site; the derivation of appropriate mitigation ratios for the site; the potential success of the applicant's mitigation plan in offsetting potential development impacts; and the evaluation of wildlife habitat, including threatened and endangered species, avian studies, water quality, flood storage and hydrological and hydraulic

Key Projects (Continued)

modeling, management of contaminated sediment, and other wetland values under existing and proposed alternative conditions.

Ecological Restoration, Wall Township, NJ, Confidential Client, Project Manager. Project manager for site cleanup of a forested wetland contaminated with polychlorinated biphenyls (PCBs). Responsible for delineation of the extent of contamination, assisting with development and negotiation of a remedial action work plan acceptable to the New Jersey Department of Environmental Protection (NJDEP), and preparation of wetland restoration plans and permit application documents for the excavation and restoration of 6.5 acres of forested wetlands impacted by PCB contamination. The wetland permit application for excavation and restoration is currently under NJDEP review.

Ecological Risk Assessment, Suffolk, VA, Former Nansemond Ordnance Depot, Task Manager. Directed preparation of a screening level ecological risk assessment for remaining areas of concern on the former military site that are contaminated by metals and organic compounds. Currently preparing a work plan for a baseline ecological risk assessment that will assess risks from metals and organic contaminants to the ecological communities present, including the Horseshoe Pond and Main Burning Ground areas.

Ecological Risk Assessment/Wetlands Mitigation, New Jersey, Precision Roll Products, Inc., Principal Scientist. Directed preparation of a baseline ecological risk assessment and derivation of ecologically based site cleanup criteria for remediation of forested wetland soils contaminated with metals and PCBs. Negotiated site cleanup levels and risk management decisions with NJDEP based on risk assessment results. Directed preparation of necessary wetland and stream encroachment permit applications and wetland/stream restoration plans for the site, which included excavation and restoration of Black Ditch, a contaminated lagoon, and three forested wetland areas on-site.

Remedial Investigation, Feasibility Study and Natural Resources Damage Assessment, Corfu, NY, Confidential Client, Principal Scientist. Conducted baseline remedial investigation of saline impacts from a pipeline rupture that resulted in a brine spill over 3.5 acres of forested wetlands in western New York. Collected sufficient samples to delineate the extent of saline contamination in the wetland, sampled adjacent potable wells, measured salinity levels in surface water, and prepared a report summarizing the extent of project impacts. Subsequently evaluated remedial alternatives from the perspectives of regulatory requirements, long-term likelihood of success, logistical considerations, and costs. Prepared a natural resources assessment summarizing the extent of damages from the loss of trees at the site, and different methods of ascertaining damages.

Dredged Material Management Plan Preliminary Assessment and Feasibility Study, Baltimore Harbor and Approach Channels, Maryland and Virginia, USACE, Baltimore and Norfolk Districts, Principal Scientist. Assisted with identification and analysis of dredge material placement alternatives, habitat restoration sites, and beneficial reuse options for the Port of Baltimore, Maryland. Coauthored sections of the Dredged Material Management Plan (DMMP), with specific focus on the Virginia Approach Channels. Major project tasks included

Key Projects (Continued)

communication and coordination with federal, state, and local regulatory agencies; evaluation of existing data (e.g., historical reports, bathymetry, sediment characteristics and chemistry, aerial photographs, degraded wetlands, fisheries data, benthic surveys, and water quality data); identification of potential beneficial-use placement sites; and development of a matrix of placement alternatives.

Feasibility Study and Integrated Environmental Assessment, New Jersey Intracoastal Waterway, New Jersey, USACE, Philadelphia District, Project Scientist. As coauthor of the combined feasibility study/EA document, assisted with identification of dredge material placement alternatives, habitat restoration sites, and beneficial reuse options for maintenance dredging of approximately 70 miles of New Jersey's Intracoastal Waterway. Major project tasks included evaluation of existing data (e.g., land use, bathymetry, aerial photographs); coordination with regulatory agencies; and identification of viable habitat creation, restoration, and enhancement opportunities to improve degraded ecological conditions on historic dredge spoils sites within the project area. Prepared text sections on ecological benefits and impacts.

Baseline Ecological Inventory, Essential Fish Habitat (EFH) Investigation and Wetland Restoration, Delaware River, PA, Confidential Client, Task Manager. Directed a baseline aquatic resources survey for a 50-acre area adjacent to an oil refinery consisting of tidal mudflat, adjacent tidal emergent wetlands, and open water areas. The study consisted of a year-long investigation of sediment quality, fisheries, benthos, and other aquatic resources in the immediate vicinity of the refinery to be used as a basis for evaluating potential environmental impacts associated with different dredged material management alternatives presently under consideration at the site. The study involved collection of over 20,000 fish using a variety of methods, as well as characterization of benthic macroinvertebrate community structure, ecological screening of sediment analytical data, and comparison of fish stomach contents to available benthos as a measure of habitat quality using the Benthic Resources Assessment Technique (BRAT) model developed by USACE. Analyzed results and presented them to reviewing agencies in a final report. The baseline data will also be used to develop conceptual design plans for a proposed tidal wetland creation project.

Risk Assessment, Nyanza Superfund Site, Sudbury, MA, USACE, Project Manager. Directed preparation of a baseline ecological and human health risk assessment addressing potential risks to Sudbury River biota from organic compounds and metals present in groundwater. Initially prepared a SLRA that identified contaminants of concern in groundwater entering the river. Subsequently worked with reviewing agencies on behalf of USACE to develop a work plan/study design to address toxicity of groundwater using bioassay tests. Subsequently analyzed the data and prepared a report that formed the basis of a follow-up work plan to address in situ toxicity of groundwater entering the river via pore water. Integrated results with hydrogeological data to develop a conceptual model of ecological exposure, and prepared a final report used by USACE and EPA Region 1 to evaluate risk management alternatives regarding contaminated groundwater at the site.

Key Projects (Continued)

Remedial Investigation/Risk Assessment (RI/RA), Housatonic River Superfund Site, MA, U.S. Environmental Protection Agency (EPA), Principal Scientist. Assisted in study design and coauthored soil, sediment, and surface-water sampling plans for RI of PCB-contamination along a 30-mile stretch of the Housatonic River. Developed sediment sampling methodology using hand-held corers to a depth of 4 feet, and directed its implementation. Prepared sampling plans for collection of biota tissue (e.g., frogs and soil invertebrates) for use in the risk assessment, including literature reviews of PCB effects. Directed field activities for collection of frog tissue. Assisted in field processing fish tissue for over 900 individual fish caught along the river.

Environmental Impact Assessment (EIA) and Permitting, Philadelphia, PA, Metro Machine Corporation, Project Manager. Conducted an assessment of potential environmental impacts from a proposed 100,000 cubic yard (yd^3) dredging project at the Philadelphia Naval Yard. Prepared permitting documents, interfaced with federal and state regulatory agencies, and successfully received applicable permits. Conducted an evaluation of disposal alternatives for dredged material, and received approval for disposition of the material at a confined disposal facility operated by USACE.

EIA and Ecological Restoration, Clarkstown, NY, Town of Clarkstown, Principal Scientist. Conducted wetland delineation and assessment of environmental impacts associated with dredging a section of the Hackensack River, including floodplain effects and wildlife habitat impacts. Developed stream bank stabilization/restoration plan, and provided input/ recommendations regarding nature trail construction and recreational potential of the riverine corridor.

EIA and Permitting, Biogenesis Soil Washing Pilot Demonstration Project, Permitting Coordinator. Evaluated environmental impacts and obtained necessary permitting documents for a pilot-scale soil washing facility for treatment of contaminated dredged material from the New York-New Jersey Harbor.

Risk Assessment/Wetlands Mitigation, New Jersey, Confidential Client, Task Manager. Directed ecological risk assessment of two approximately 30-acre forested wetland sites and one 5-acre site impacted by paint waste from a former manufacturing facility. The sites encompass several streams within the same watershed that have been contaminated with metals and organic compounds. Prepared ecological and human health risk assessment portions of the Phase I RI report, and made recommendations regarding remedial design alternatives.

EIA and Permitting, Bronx, NY, American Marine Rail, Principal Scientist. Conducted assessment of environmental impacts associated with dredging and construction of a proposed marine transfer solid waste handling facility on the East River. Prepared sampling and analysis plan for sediments to be dredged, evaluation of potential aquatic habitats and estuarine biota affected, final report, and environmental assessment (EA) for the facility. Coordinated with regulatory review agencies (USACE and New York City Department of Environmental Protection [NYCDEP]).

Key Projects (Continued)

Environmental Permitting and Compliance, New York, Consolidated Edison, Principal Scientist. Researched, developed, and prepared Corporate Environmental Procedures, General Environmental Instructions, and Technical Bid Specifications for the client's corporate environmental policy. Prepared corporate documents summarizing regulatory issues and corporate procedures in several areas: wetlands and dredging impacts and permitting; fish and wildlife impacts; and State Pollutant Discharge Elimination System (SPDES) permitting, including construction dewatering, and pesticide application.

Ecological Restoration, Clarkstown, NY, Town of Clarkstown, Principal Scientist. Conducted investigation of watershed impacts on Swartout Lake, an approximately 24-acre lake within a suburban/rural environment. Conducted lake sampling, survey of aquatic vegetation and habitat types, and watershed analysis, including impacts of non-point source pollution sources. Provided recommendations regarding lake restoration.

Brownfields Development, Staten Island, NY, Confidential Client, Principal Scientist. Conducted a field wetlands delineation and preliminary environmental survey to identify issues and provide recommendations pertaining to future development of an industrial site, including stormwater management and wetlands restoration along a tidal creek.

Environmental Impact Assessment, New York City, New York City Department of Sanitation (NYCDOS), Task Manager. Prepared or directed the preparation of several documents in support of the 6 NYCRR Part 360 permit application for the Fresh Kills Landfill. Provided technical direction and preparation of the natural resources and water resources sections of the draft EIA, including supervision of staff in data collection, analysis, and review; interpretation of data and impacts analysis; client/agency negotiation; and authoring report sections. Provided direction/preparation of the draft and final surface-water quality/wetland sections of several major permitting documents. These tasks involved extensive data interpretation and summary of results of water quality and sediment data, including relationships between surface-water quality and contaminant hydrogeology; study design for environmental monitoring; review of water quality modeling results and integration with surface-water quality data; preparation and review of reports for consistency with federal, New York State, and New York City regulations; and integration of report sections with other disciplines (e.g., human health risk assessment, land use, landfill engineering, and surficial geology).

Ecological Assessment, Tennessee, EPA/Environmental Response Team (ERT). Directed field ecological assessment of contaminant risks at a former charcoal producing facility. Studies focused on effects of polynuclear aromatic hydrocarbons (PAHs) and metals on soil invertebrates and small mammals in order to determine cleanup levels.

Ecological Assessment, New Jersey, EPA/ERT, Task Leader. Developed standard operating procedures (SOPs) for small mammal trapping and tissue processing for use by EPA.

Ecological Assessment, Tennessee, EPA/ERT, Task Leader. Conducted ecological risk assessment modeling of contaminant risks using the Hazard Quotient Method at a former landfill site. Identified contaminants of concern and indicator species, derived lowest-observed-effect

Key Projects (Continued)

level (LOEL) data from the literature, and determined potential toxicological effects in order to establish site soil cleanup levels.

Wetland Assessment/Mitigation, New Jersey, EPA/ERT, Project Team Member. Provided development and oversight of a wetlands mitigation plan for the Zshiegner Refining Company Superfund site. Characterized site vegetation, delineated wetlands, and helped develop site soil removal and revegetation plan.

Ecological Assessment, Wisconsin, EPA/ERT, Subtask Leader. Developed sampling design and directed extent of contamination study of surficial soils at a former wood-treating facility. Collected baseline data for ecological risk assessment.

Ecological Assessment, Connecticut, EPA/ERT, Task Leader. Coordinated field activities for an emergency response investigation focusing on the risks of asbestos and PCB contamination to local residents in the Town of Stratford. Acted as liaison with several federal agencies and their support teams, and supervised the collection and screening of soil samples. Monitored subcontracted surveying team, and assisted with the development of a base map of areas investigated.

Ecological Assessment, Colorado, EPA/ERT, Senior Field Team Member. Conducted an assessment of freshwater wetlands potentially affected by groundwater contamination from an abandoned industrial facility, and performed a vertebrate species inventory for use in determining if the site qualified for National Priorities List (NPL) ranking. In addition, assisted with the collection of groundwater data.

Ecological Assessment, Michigan, EPA/ERT, Task Leader. Prepared a quality assurance (QA) work plan and supervised the dissection, processing, and analysis of muskrat tissues collected from a potentially contaminated stretch of the Kalamazoo River. Tissue was analyzed for histopathology, metals, PCBs, and semivolatile organic compounds (SVOCs).

Ecological Assessment, New Jersey, EPA/ERT, Task Leader. Directed an off-site extent of contamination study of arsenic contamination in the vicinity of a former chemical plant facility to determine health risks to the public. Sampled surface and subsurface soils, as well as groundwater within residential areas potentially affected by runoff from the site. Presented results in a final report to EPA.

Ecological Assessment, Maryland, EPA/ERT, Task Leader. Prepared and implemented an emergency response plan for the biomonitoring of white phosphorus release from sediment at the Aberdeen Proving Ground (APG) from a major storm event. The plan was implemented in March 1993 to determine if white phosphorus was released into the water column following a winter storm and if it was available for uptake by a representative fish species (sheepshead minnow). An in situ technique was used for this purpose. Interpreted results and presented conclusions in a final report to EPA. This plan has since been used as a contingency plan for any major storms affecting the APG area.

Ecological Assessment, New Jersey, EPA/ERT, Task Leader. Directed a broad-scale field investigation of the terrestrial and aquatic impacts of lead contamination at a former smelting

Key Projects (Continued)

facility. Developed and implemented the work plan, and directed a field crew in the collection of data on soils, water, and target biota (small mammals, fish, and frogs). Used an in situ technique to measure the bioaccumulation of lead in two species of earthworms. Additional responsibilities included statistical analysis and interpretation of contaminant data, interpretation of results, and preparation of a final report to EPA for use in determining ecologically relevant remedial levels. In a follow-up study, evaluated soil slated for removal using the Toxicity Characteristic Leaching Procedure (TCLP) to determine if soils met Resource Conservation and Recovery Act (RCRA) criteria.

Ecological Assessment, Utah, EPA/ERT, Subtask Leader. As part of a larger integrative study, conducted an inventory of small mammals present in a wetland adjacent to a former silver mine. Directed field crew members in the collection of specimens and subsequent necropsy work to determine if gross pathological effects were evident in indigenous populations. In addition, assisted with a vegetative inventory of the site. Prepared results in a final report to EPA/ERT for use in evaluating the potential ecological risks posed by the site.

Ecological Assessment, Washington, EPA/ERT, Subtask Leader. Directed an inventory of small mammal populations in a landfill area within a tidal wetland adjacent to Puget Sound. Collected and analyzed data aimed at describing the resident small mammal and bird communities of the site. In addition, prepared a site vegetation map.

Ecological Assessment, New York, EPA/ERT, Project Team Leader. Assisted with the design and analysis of seed germination and root elongation studies to measure the effectiveness of bioremediation techniques for treatment of creosote-contaminated soils.

Ecological Assessment, New Jersey, EPA/ERT, Task Leader. Directed a field ecological assessment of the impacts of contamination on the bog community at the Burnt Fly Bog Superfund site. Responsibilities included assisting EPA/ERT in study design; directing a field crew in the collection of small mammals, vegetation, and soils; analyzing and interpreting results; and presenting the findings in a report to EPA/ERT to be used in site remedial recommendations.

Risk Assessment Modeling, New York, EPA/ERT, Subtask Leader. Working independently, adapted a food chain model described in the literature to predict the effects of contamination on four selected target vertebrate species (black duck, great-blue heron, muskrat, and red-winged blackbird) inhabiting a freshwater marsh. Derived model inputs from the literature, calibrated the model, and presented the results in a report to EPA/ERT for use in site remedial recommendations.

Ecological Assessment, New Mexico, EPA/ERT, Senior Field Team Member. Collected data on small mammals, vegetation structure, and soils for use in an ecological risk assessment of lead contamination at the CalWest Superfund site.

Ecological Assessment, New Jersey, EPA/ERT, Senior Field Team Member. Conducted a study of the impacts of contamination on a freshwater tidal marsh at the Kin-Buc Landfill Superfund site, and later directed an extended investigation of the lower Raritan River watershed.

Key Projects (Continued)

Assisted with the development of a field sampling design for the collection of muskrats and sediment samples. Collected, dissected, and processed muskrats for tissue analysis. Reviewed histopathological results, and assisted with data interpretation and report review.

Ecological Assessment, Wisconsin, EPA/ERT, Senior Field Team Member. Collected soil and water samples used to determine the extent of contamination and sediment toxicity in a freshwater marsh at the OECI Superfund site. Directed field activities during one phase of the project, and prepared a report for EPA/ERT based on Geosoft contour mapping of site contamination.

Ecological Assessment, Delaware, EPA/ERT, Task Leader. Assisted EPA/ERT with study design and decision-making flow chart to ascertain potential effects of contamination from a chemical facility on a freshwater tidal marsh at the Halby Chemical Superfund site. Directed a field crew in the collection of sediments for analysis and toxicity testing. Prepared a final report for use by EPA/ERT in determining future activities on-site.

Emergency Response/Ecological Assessment, Minnesota, EPA/ERT, Task Leader. Provided field support to EPA/ERT in determining the extent and potential impacts of submerged drums found in Lake Superior. Used a remotely operated vehicle (ROV) to determine the number, extent, and condition of submerged drums found off-shore. Presented the results in a technical report submitted to EPA.

Ecological Assessment, Ohio, EPA/ERT, Senior Field Team Member. Collected small mammals and soils, mapped vegetative cover types, and delineated wetlands at the Ormet Superfund site. Assisted with report preparation.

Wetland Delineation/Assessment, New Jersey, EPA/ERT, Task Leader. Co-directed a wetland delineation of an area adjacent to the Lone Pine Landfill Superfund site using the federal jurisdictional procedure. Conducted a functional wetland assessment of surrounding wetlands using the Wetland Evaluation Technique (WET) modeling procedure. Provided remedial and mitigation recommendations to EPA/ERT.

Ecological Assessment/Site Characterization, Various Locations, EPA/ERT, Field Team Member/Senior Field Team Member. Participated in site characterization projects geared at evaluating potential threats to human health. Responsibilities included direction of field staff; establishing and implementing field sampling designs; data collection using screening measurements or techniques such as immunoassay test kits, X-ray fluorescence (XRF) spectrometry, portable magnetometer, Hach kits, etc.; as well as sample collection from the following matrices: surface and subsurface soils, soil gas, surface water, and groundwater. Experienced in a variety of geographic areas throughout the continental United States.

Wetland Delineation/Assessment, New Jersey, Probst Enterprises, Inc., Project Manager. Directed a large-scale wetlands delineation of a 3,000-acre site in the Pine Barrens region. Collated natural resources data assembled from several agencies with satellite and aerial photographs, collected field data to determine the wetlands boundary and state resource classification, and to make land use recommendations.

Key Projects (Continued)

EIA/Review, Walkill, NY, Town of Walkill, Task Manager. Reviewed data on wetlands, wildlife, stormwater management, and vegetation impacts; and provided critical comments for the development of a shopping mall.

EIA, New York, Saccardi and Schiff, Inc., Project Manager. Evaluated wildlife habitat and provided a vegetation cover map for use in an environmental impact statement (EIS) for a proposed health care center in the Long Island Pine Barrens.

Ecological Assessment, New York, RPPW, Inc., Project Manager. Evaluated wildlife habitat, prepared a vegetation cover map, and conducted a wetlands delineation for use in an EIS for a proposed residential development on a 200-acre deciduous forested site.

Ecological Assessment, New York, RPPW, Inc., Project Manager. Evaluated wildlife habitat for an endangered turtle and migratory bird species, prepared a vegetation cover map, and conducted a wetlands delineation for use in an EIS for a proposed residential development in an urban forested area.

Wetland Delineations/Assessments, New Jersey and New York, Multiple Clients, Project Manager. Conducted or assisted with wetland delineations at more than 80 sites. Authored proposals, directed field work, managed budgets, prepared reports for clients, met with regulatory agencies, advised clients, prepared regulatory permits, and negotiated collections.

EISs, New Jersey, Multiple Clients, Project Manager. Prepared EISs for municipal and state agencies on several projects. Collected or assisted with the collection of data on traffic impacts, air pollution, vegetation, wildlife, wetland impacts, and infrastructure impacts. Modeled noise impacts from highway improvements.

Ecological Studies, New Jersey, Rutgers University, Research Associate. Working independently, designed study, trapped and mistnetted bird species, and monitored their movements and behavior using radiotelemetry to test hypotheses regarding the adaptive significance of communal roosting. Analyzed data and presented results in a thesis.

Wildlife Damage Assessment, New Jersey, Confidential Client, Research Associate. Assisted in the field collection of data on populations of three species of toads and assessed potential agricultural damage impacts. Censured toads by direct observation, pitfall trapping, and mark-recapture techniques.

Environmental Education, New Jersey, Rutgers University, Educator. Taught general biology laboratory principles and assisted with the development of new curricula for university underclassmen. Led a variety of age groups, ranging from elementary school to college groups, on field trips to the university experimental field station. Assisted with field vegetation sampling used for long-term monitoring of ecological succession of old field habitat.

Ecological Assessment, New Mexico, Mariah Associates, Inc., Research Associate. Conducted habitat evaluation studies and censuring for evidence of endangered black-footed ferrets in an area proposed for coal mining. Executed nightlong spotlight checks for ferrets over a 15-square-mile area and searched prairie dog colonies for evidence of ferret intrusion.

Key Projects (Continued)

Ecological Studies, Kenya, East Africa, Natural Resource Ecology Laboratory/Colorado State University (NREL/CSU), Research Associate. Supervised field crew in the collection of data on soils, hydrology, vegetative productivity, community structure, and plant physiology. Results were input into a model of ecosystem energy and nutrient flow used to study the grazing ecology of pastoral nomads inhabiting semiarid savanna regions.

Natural Resources Management, Colorado, U.S. Fish and Wildlife Service (FWS), Research Assistant. Assisted in the development of a nationwide computer-based information system on in-stream flow considerations affecting freshwater fish habitat. Contacted agency personnel nationwide, prepared abstracts of technical articles, and entered them into a database.

Ecological Studies, New Mexico, NREL/CSU, Field Team Member. Collected data on vegetative cover, productivity, and soils as part of a study on the effects of fire on deer and elk populations in Bandelier National Monument.

Ecological Studies, Colorado, Colorado Division of Wildlife, Research Assistant. Collected data on vegetative productivity as part of a long-term study on the nutritional ecology of sagebrush to large herbivores.

Ecological Assessment, Colorado, Colorado Cooperative Wildlife Research Unit (CCWRU), Research Assistant. Interpreted LANDSAT satellite imagery and mapped vegetation types for use in the development of habitat evaluation models for the northern Rocky Mountain region.

Ecological Assessment, Wyoming, FWS and Shosone-Arapahoe Tribes, Contract Biologist. Conducted an intensive vegetative inventory and animal census of a big game winter range on the Wind River Indian Reservation. Used a variety of vegetation sampling techniques to characterize community structure, evaluate grazing impacts, and assess habitat quality for ungulates.

Ecological Studies, Wyoming and Montana, CCWRU, Research Assistant. Sampled vegetation using a variety of techniques and conducted measurements of other habitat variables for use in the development of wildlife habitat evaluation models for eight indicator species in the northern Great Plains region.

Ecological Studies, Colorado, U.S. Forest Service (USFS), Intern. Assisted with censuring and behavioral observations of an introduced mountain goat population in the Sawatch Range. Responsibilities included hiking to and camping in remote areas, collecting data through a spotting scope, and filing monthly reports.

Natural Resource Management, Colorado, USFS, Intern. Assisted with the administration, planning, and public relations of winter recreation programs. Collected hydrological data and censured elk populations. Assisted with a mark-recapture study of bighorn sheep.

Publications and Presentations

Kim, P.Y., P. Bovitz, B. Vanderveer, M. Donohue, K. Munney, and M. Sprenger. 1994. "The

Publications and Presentations (Continued)

Use of Chemical, Histopathological, and Toxicity Evaluations To Investigate a Wildlife Kill." Society of Environmental Toxicology and Chemistry 15th Annual Meeting, Denver, CO.

Bovitz, P. and M. Sprenger. 1993. "A Bioaccumulation Study of Earthworms at a Superfund Site." Society of Environmental Toxicology and Chemistry 14th Annual Meeting, Houston, TX.

Sprenger, M., K. Kracko, and P. Bovitz. 1993. "An Ecological Risk Assessment for Lead Ingested by Biota at a New Jersey Superfund Site." Society of Environmental Toxicology and Chemistry 14th Annual Meeting, Houston, TX.

Sprenger, M., R. Bennett, R. Knight, and P. Bovitz. 1991. "Assessment of Contaminant Migration into a Delaware Tidal Marsh." Society of Environmental Toxicology and Chemistry 12th Annual Meeting, Seattle, WA.

Bovitz, P., G. Buchanan, and M. Sprenger. 1991. "A Food Chain Model of Cadmium Accumulation in a Tidal Freshwater Marsh." Society of Environmental Toxicology and Chemistry 12th Annual Meeting, Seattle, WA.

Munney, K. and P. Bovitz. 1991. "The Use of Muskrats as Bioindicators of Environmental Contamination." Society of Environmental Toxicology and Chemistry, 12th Annual Meeting, Seattle, WA.

Beltman, D., M. Sprenger, R. Henry, P. Bovitz, and M. Huston. 1991. "Screening Field Bioassessment Tools at a Hazardous Waste Site." Society of Environmental Toxicology and Chemistry 12th Annual Meeting, Seattle, WA.

Munney K. and P. Bovitz. 1991. "An Ecological Investigation of PCBs and Metals Contamination in a New Jersey Freshwater Tidal Marsh." Water Environment Federation Annual Conference, Toronto, ON.

P. Bovitz. 1988. "Communal Roosting Behavior in American Robins and European Starlings as Related to Foraging Considerations." First International Conference of Behavioral Ecology, Vancouver, BC.

WESTON SOLUTIONS, INC.

THIS CERTIFIES THAT

PAUL BOVITZ

HAS COMPLETED THE

8-Hour Hazwoper Refresher Training Course

In accordance with 29 CFR 1910.120 (e)(8) completed on 1/19/2005 in Edison, NJ

Conrad W Lehr, CET

TRAINING MANAGER
Conrad W. Lehr, CET

WESTON SOLUTIONS
Restoring Resource Efficiency

George M Crawford CIH

INSTRUCTOR
George M. Crawford CIH

ROY F. WESTON, INC · 1400 WESTON WAY · WEST CHESTER, PA · 19380

04P-0755

WESTON SOLUTIONS, INC.

THIS CERTIFIES THAT

PAUL BOVITZ

HAS COMPLETED THE

Bloodborne Pathogens Training Course (Refresher)

In accordance with 29 CFR 1910.1030 completed on 1/19/2005 in Edison, NJ

Conrad W Lehr, CET
TRAINING MANAGER
Conrad W. Lehr, CET

WESTON SOLUTIONS
Restoring Resource Efficiency

George M Crawford CIH
INSTRUCTOR
George M. Crawford CIH

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04P-0755

Qualisys
4501 Circle 75 Parkway, Suite C-3250
Atlanta, GA 30339
Phone: 770-226-9944
Fax: 770-541-0293

Applicant/Employee:

Bovitz, Paul

ID: 008232

Company: Weston Solutions, Inc.
1400 Weston Way
West Chester PA 19380

Exam Date: 02/24/2005

Clinic: Qualisys # Q

Location: EDC-Edison, NJ

MEDICAL SURVEILLANCE CERTIFICATION

The above applicant/employee's medical examination has been reviewed to determine whether he/she meets the criteria contained in your protocol and job descriptions as supplied to Qualisys, and the regulations noted below.

Please Note that areas in which he/she did not meet your criteria are explained on Page 2 of this report. Before instituting work restrictions based on these findings, you may wish to consider any accommodations that may be applicable. If further evaluations or testing are requested by Qualisys, appropriate clearances will be issued after receipt of the requested information. Any attached medical information should be treated as Confidential Medical Information in accordance with Section 102C of the Americans with Disabilities Act.

Examination Type: 42020 Clearance Extension Review
FITNESS FOR DUTY:

☒ **No significant medical impairments noted. May be assigned duties consistent with skills and training.**

☐ **Clearances May Be Given or Added When Further Information Is Received (See Page 2).**

THIS APPLICANT/EMPLOYEE IS MEDICALLY CLEARED FOR:

RESPIRATORS (29 CFR 1910.134)	***OSHA (29 CFR) and DOT (49 CFR)***
☒ **Negative Pressure (NPR)**	☐ **DOT Clearance (391.41)**
☒ **Self-Contained (SCBA)**	☒ **Hazardous Waste (1910.120)**
☒ **Supplied or Powered Air (SAPR/PAPR)**	☐ **Asbestos (1910.1001 / 1926.1101)**

Previous Exam Clearances Extended Through 5/12/2006.

Evaluation Date: 2/25/05

E D Walker
Everett D. Walker, M.D.

All Immunizations For An Individual

09/28/05

Name **Bovitz, Paul**
SSN **030-52-9403**
Dept **OU91084**

ID **008232**
DOB **09/29/58**

Date	Type	Description	Status	
09/07/05	TD	Tetanus & Diphtheria Vaccinati	C	

WESTON FIT TEST RECORD

NAME (print) Paul Bovitz **DATE** 9-13-05

EMPLOYEE NO. 8232 **YOUR WORK LOCATION** EDC

NAME of TEST ADMINISTRATOR (print) Alanna Garrison

(Circle all responses)

~~Qualitative Fit Te~~st Protocol Administered
[✓ Irritant Smoke] **Bitrex**

Negative Pressure Mask(s)

Type of Mask: full face
Manufacturer: MSA **[✓ Pass]/Fail** **Pass/Fail**
Model: ultra twin
Size: L

Positive Pressure Mask(s)

Type of Mask:
Manufacturer: **Pass/Fail** **Pass/Fail**
Model:
Size:

Comments:

Clean Shaven? [✓ **YES**] / **NO** **Spectacle kit required?** **YES** [✓ **NO**]

I hereby certify that the above-named individual has been qualitatively fit tested, that all WESTON fit test procedures have been completed and that the above information reflects the results of the test.

Test Administrator Signature: AM garrison

The fit test documented by this form is intended for use in conjunction with a fully implemented respiratory protection program as required by 29 CFR 1910.134. This fit test in no way certifies that the individual being fit tested will use the respirator as it is designed or according to manufacturer's directions. Proper use of respiratory protection is the responsibility of the individual and the individual's employer. The fit test has been conducted by an individual who has received instruction in fit testing and is authorized to perform the test. Should the individual being fit tested have a significant weight gain or loss, have facial or dental surgery, suffer injury that changes facial structure, or be assigned another brand and model of respirator, the designated respirator may not fit properly, the fit test is invalidated, and the person should be fit tested again before further respirator use. This fit test applies only to the respirator(s) size, model, and manufacturer indicated on the form.

RISKS AND LIABILITY

Any individual engaged in activities requiring the use of a respirator faces the risk of health impairment. Fit testing cannot completely eliminate risk and injuries that may occur despite successful completion of the fit test. Fit testing simply determines that at the time of the test, the particular respirator fit properly. This fit test has been administered in accordance with OSHA 29 CFR 1910.134 regulations. Weston Solutions, Inc. does not make any warranties, either expressed or implied, concerning the proper use or function of respiratory protection used by the individual subsequent to this fit test. In no event shall Weston Solutions, Inc. be liable for any loss of special, incidental, consequential, or other damages caused by subsequent use of respiratory protection.

Test Subject Signature:

RYAN H. BROWN

Qualifications Summary

- Over 7 years of professional experience.
- Environmental/ecological assessments. Evaluation and restoration of aquatic habitats.
- Preparation of ecological risk assessment studies, EIAs, permitting, dredging studies, and technical reports.
- Quantitative data management, statistical analysis, and interpretation.
- Fisheries collection techniques, aquatic biota sampling, and aquatic habitat assessment experience.
- Taxonomic experience with fish, macroinvertebrates, and zooplankton.
- Mapping capabilities include working knowledge of GPS and GIS.
- Oversight and health and safety.

Registration

Construction Quality Management for Contractors, USACE (2002)

Fields of Competence

Aquatic ecology; fisheries ecology; aquatic habitat evaluation/assessment; ecological risk assessment; wetland/estuarine restoration and construction; dredged material management; environmental toxicology; technical report preparation; data management; site health and safety.

Credentials

M.S., Fisheries and Aquatic Ecology—University of Minnesota (1998)
B.A., Marine and Freshwater Science—Colgate University (1996)
40-Hour Hazardous Waste Site Training Course, OSHA 29 CFR 1910.120(e)(3), Industrial Hygienics Corp. (2001)
Project Management Training, WESTON (2003)
8-Hour Hazardous Waste Refresher Course, OSHA 29 CFR 1910.120(e)(8), WESTON (2005)
10-Hour Construction Safety Training, OSHA 29 CFR 1926, WESTON (2002)
8-Hour Managers and Supervisors Course (SHSC), OSHA 29 CFR 1910.120(e)(4), WESTON (2002)
Hazardous Waste Management and Shipping for Environmental Professionals, Eduware (2002)
First Aid and CPR Training, Medic First Aid (2004)
Society of Military Engineers (SAME)
Society of Environmental Toxicology and Chemistry (SETAC)
Estuarine Research Federation (ERF)
American Fisheries Society (AFS)

Employment History

2001-Present	WESTON
1999-2001	Aquatec Biological Sciences
1998-1999	EPA/NOAA Chesapeake Bay Program
1998	Mackworth Environmental Management

Key Projects

Baseline Ecological Assessment, Former Raritan Arsenal, Edison, NJ, U.S. Army Corps of Engineers (USACE), New England/New York District, Project Scientist. Planned and conducted a multi-media Baseline Ecological Risk Assessment at a 3,000+ acre former Arsenal with multiple parameter class contamination. Managed field collections, analytical services (including low-level tissue analysis), data analysis, and report generation. Activities include sampling of soil, sediment, and surface water, as well as collection of small mammals, earthworms, frogs, fish, fiddler crabs, and plant tissue samples. Soil and sediment bioassays were conducted utilizing modified methodologies with specific endpoints. Extensive negotiation conducted with multiple reviewing agencies.

Sediment / Soil Characterization and Dredging Permitting, Norfolk Naval Shipyard - Pier 3 and Dry Dock 8, Virginia, U.S. Navy, Senior Project Scientist. Planned and conducted subsurface soil sampling to characterize soil and potentially sediment to be removed from beneath existing pier and dry dock surfaces or beneficially reused as part of activities to reconstruct an existing pier. Provided screening and data analysis of constituents found in the sampled soil and developed cost and volume estimates for soil removal options. Prepared specifications drawings for multiple hazardous waste streams (e.g., TCLP lead, asbestos, and PCBs) as well as general environmental controls. Assisted with preparation of permits (USACE/VMRC/VADEQ Joint Permit, Federal Coastal Consistency Determination, etc.) necessary to conduct the reconstruction activities associated with the pier renovation.

Wetland Mitigation Banking Site Identification Study, Port Authority of New York and New Jersey, Senior Project Scientist. Performed a siting study on behalf of the Port Authority to identify potential mitigation bank construction project sites in central New Jersey and Staten Island, New York that could be used to offset the impacts of ongoing and future Port Authority projects (including the New York Harbor Deepening project). Potential sites were screened and ranked by multiple parameters size, location, suitability for a mitigation bank, assessed real estate value, ownership, site use, type of wetland community, accessibility, and elevation range. A summary report was prepared including recommendations for preferred sites and restoration potential.

Feasibility Study - Dredged Material Placement Investigation, Long Island Intracoastal Waterway, New York, U.S. Army Corps of Engineers (USACE), New York District, Senior Project Scientist. Assisted with identification of dredge material placement alternatives, habitat restoration sites, and beneficial reuse options for maintenance dredging of approximately 34 miles of New York's Long Island Intracoastal Waterway. Major project tasks included evaluation of existing data (e.g., land use, infrastructure, aerial photographs, historical and current NOAA charts). Assisted with identification of viable habitat creation, restoration, and enhancement opportunities to improve degraded ecological conditions on historic dredge spoils sites and potentially upgrade water quality in the project area. Assisted with development of a web-based GIS site selection model that incorporated multiple site selection criteria simultaneously.

Dredged Material Management Plan, Preliminary Assessment (PA), and Feasibility Study (FS), Baltimore Harbor and Approach Channels, Maryland and Virginia, U.S. Army

Key Projects (Continued)

Corps of Engineers (USACE), Baltimore and Norfolk Districts, Senior Project Scientist. Identified and analyzed dredge material placement alternatives, habitat restoration sites, and beneficial reuse options for the Port of Baltimore, Maryland. Also helped develop a Dredged Material Management Plan (DMMP) with specific focus on the Virginia approach channels. The DMMP study will be evaluated through the preparation of a tiered Environmental Impact Statement (EIS) and will identify, evaluate, screen, prioritize, and ultimately, optimize placement alternatives resulting in the recommendation of a plan for the placement of dredged materials for at least the next 20 years. Major project tasks included communication and coordination with federal, state, and local regulatory agencies, evaluation of existing data (e.g., historical reports, bathymetry, sediment characteristics and chemistry, aerial photographs, degraded wetlands, fisheries data, benthic surveys, and water quality data), identification of potential beneficial-use placement sites, and development of a matrix of placement alternatives.

Fish Passage Feasibility Evaluation, Rahway River Water Supply Dam, Rahway, New Jersey, Senior Project Scientist. Prepared a Fish Passage Feasibility Evaluation for the Rahway River Water Supply Dam in Rahway, New Jersey (NJ) with the objective of assessing the feasibility of conceptual fish ladder design alternatives aimed toward the restoration of anadromous and catadromous fish passage at the dam. Results of the feasibility study indicated two types of fish passage alternatives. Additional tasks to be conducted include a preliminary river assessment including an essential fish habitat evaluation, fish spawning habitat evaluation, and aquatic biological inventory In addition, site-specific river data will be collected for use in hydrological models to estimate various flow scenarios posed by the river and associated impacts to the proposed fish ladder.

Wetland Restoration/Construction and Slope Stabilization, Fresh Kills Landfill, Staten Island, NY, Project Scientist. Provided technical assistance and oversight during transplanting of over 800 wetland plants (*Iva frutescens, Baccharus halimifolia,* and *Spartina alterniflora*) as well as slope stabilization of over 1,000 feet of eroding shoreline. Assisted with design and technical approach and field direction construction of a tidal estuarine wetland mitigation project to compensate for the habitat lost during shoreline stabilization. Communicated with clients and subcontractors on a regular basis and assisted with requests for information. Wrote technical specifications for details such as goose exclusion fencing, *Phragmites australis* control and removal, and wetland planting and monitoring. Conducted monitoring and prepared biweekly and annual monitoring reports.

Ecological Risk Assessment, Former Nansemond Ordnance Depot, Suffolk, VA, U.S. Army Corps of Engineers (USACE), Baltimore District, Project Scientist. Assisted with reporting of an ecological field reconnaissance focusing on determining potential receptors of contamination in both aquatic and terrestrial habitats. Prepared the work plan for the baseline ecological risk assessment that addressing sources of risk to the ecological communities present at the site. Planned and conducted collection of sediment, benthic macroinvertebrates, amphibians, and small mammals in support of ecological risk assessment data collection. Currently preparing the BERA report.

Key Projects (Continued)

Contaminated Sediment Treatment Technology Evaluation, An-Shun Site, Tainan, Taiwan, Senior Project Scientist. Prepared a summary and screening of contaminated sediment treatment technologies for project-specific sediment remediation project within a contaminated sea-water lagoon. Multiple remediation technologies were reviewed and evaluated based on the know contamination types and estimated volume of sediment to determine those technologies best suited for remediation of the contaminated sediment. Case studies were also provided to elucidate strengths and weaknesses of the technologies in real world, full scale applications.

Feasibility Study and Integrated Environmental Assessment, New Jersey Intracoastal Waterway, New Jersey, U.S. Army Corps of Engineers (USACE), Philadelphia District, Project Scientist. Assisted with identification of dredge material placement alternatives, habitat restoration sites, and beneficial reuse options for maintenance dredging of approximately 70 miles of New Jersey's Intracoastal Waterway. Major project tasks included evaluation of existing data (e.g., land use, bathymetry, aerial photographs); coordination with regulatory agencies including New Jersey Department of Environmental Protection (NJDEP), U.S. Fish and Wildlife Service (USFWS), and National Marine Fisheries Service (NMFS); and development of GIS maps for potential restoration sites. Assisted with identification of viable habitat creation, restoration, and enhancement opportunities to improve degraded ecological conditions on historic dredge spoils sites and potentially upgrade water quality in the project area. Also continued development of a GIS-based site selection model that incorporated multiple site selection criteria simultaneously.

Ecological Risk Assessment, Nyanza Superfund Site, Sudbury, MA, U.S. Army Corps of Engineers (USACE), New England District, Project Scientist. Assisted with preparation of a baseline ecological and human health risk assessment addressing potential risks to Sudbury River biota from organic compounds and metals present in groundwater. Analyzed the data from in situ and laboratory bioassay tests designed to address groundwater toxicity, and prepared a report that formed the basis of a follow-up work plan to address in situ toxicity of groundwater entering the river via pore water. Planned and conducted benthic macroinvertebrate sampling to further investigate effects of contaminated groundwater. Integrated results with hydrogeological data to develop a conceptual model of ecological exposure, and presently authoring majority of the Final Toxicity Evaluation of Groundwater report, Nyanza Superfund Site, that will be used to develop a cleanup strategy for groundwater at the site.

Environmental Impact Assessment (EIA), Meadowlands Mills Development, U.S. Army Corps of Engineers (USACE), New York District, Project Scientist. Assisted in preparation of a draft and final environmental impact statement (EIS) on behalf of the USACE, New York District, evaluating impacts of a proposed 206-acre wetland fill project in the Hackensack Meadowlands District as part of a larger proposal to build a mixed-use regional retail/office/entertainment center ("megamall"). Critical technical issues evaluated by WESTON included compliance with Section 404(b)1 guidelines and National Environmental Policy Act (NEPA); the accuracy of the Indicator Value Assessment method as a means of functional assessment of wetlands on the site; the derivation of appropriate mitigation ratios for the site; the potential success of the applicant's mitigation plan in offsetting potential development impacts;

Key Projects (Continued)

and the evaluation of wildlife habitat, including threatened and endangered species, avian studies, water quality, flood storage and hydrological and hydraulic modeling, management of contaminated sediment, and other wetland values under existing and proposed alternative conditions.

Fisheries Collection/Fish Consumption Advisory Analysis, Gibbsboro, NJ, Confidential Client, Project Fisheries Scientist. Designed, planned, and conducted a study to determine whether a fish consumption advisory was necessary at a 10-acre lake with known sediment and surface water metals contamination. Boat electro-fishing and trot-lining were employed to collect specimens of largemouth bass, common carp, and brown bullhead. Fillet tissue was obtained and analyzed, and results were compared to literature values and regional background levels. The final report determined no advisory was necessary. The report and determination were accepted by the New Jersey Department of Environmental Protection (NJDEP)

Slope Stabilization and Wetland Transition Zone Restoration, Linden, NJ, Merck and Company, Inc., Project Engineer/Site Health and Safety Officer. Provided engineering, and health and safety monitoring on a slope stabilization and wetland transition zone revegetation construction project. Project activities included clearing and grubbing, soil placement and grading, slope construction, and seeding and planting. Over 25,000 cubic yards of soil were placed on-site, and over 750 feet of exposed slope were stabilized along a patch of high diversity and value tidal wetlands along the Rahway River. Permanent seeding as well as design and vegetative restoration of over 500 wetland transitional plants was conducted on the entire site.

Screening Level Ecological Assessment, Former Raritan Arsenal, Edison, NJ, U.S. Army Corps of Engineers (USACE), New England/New York District, Project Scientist. Authored the Problem Formulation Statement and Screening Level Ecological Risk Assessments for the site. Planned and performed ecological assessment of terrestrial and aquatic habitats, and potential receptors of contamination at the former Raritan Arsenal site. Prepared ecological field reconnaissance report for the screening level ecological risk assessment (SLERA) for the site, which described potential contaminant pathways in terrestrial and aquatic habitats. Assisted with preparation of the human health component of the risk assessment as well.

Baseline Ecological Inventory, Essential Fish Habitat (EFH) Investigation and Wetland Restoration, Delaware River, PA, Confidential Client, Project Scientist. Assisted with a baseline aquatic resources survey for a 50-acre area adjacent to an oil refinery consisting of tidal mudflat, adjacent tidal emergent wetlands, and open water areas. The study consisted of a year-long investigation of sediment quality, fisheries, benthos, and other aquatic resources in the immediate vicinity of the refinery to be used as a basis for evaluating potential environmental impacts associated with different dredged material management alternatives presently under consideration at the site. The study involved collection of over 20,000 fish using a variety of methods, as well as characterization of benthic macroinvertebrate community structure, ecological screening of sediment analytical data, and comparison of fish stomach contents to available benthos as a measure of habitat quality using the Benthic Resources Assessment

Key Projects (Continued)

Technique (BRAT) model developed by USACE. The baseline data will also be used to develop conceptual design plans for a proposed tidal wetland creation project.

Baseline Ecological Evaluation, Multiple Sites, Long Island Sound, CT, Confidential Client, Senior Project Scientist. Conducted baseline ecological evaluations for two approximately 50-acre sites located adjacent to Long Island Sound. The evaluations consisted of review of existing analytical, topographical, soils, and historical use data, along with the current ecological setting. Potential ecological receptors and potential contamination pathways were investigated and documented across site habitats and related to contamination to provide an estimate of potential ecological risks.

Tidal Wetland Delineation, Former Inwood Wastewater Treatment Plant, Inwood, NY, Senior Project Scientist. Conducted an examination of existing wetland data conducted, including review of soil survey, wetland and topographic map resources. Conducted a formal tidal wetlands delineation in accordance with New York State Department of Environmental Conservation (NYDEC) regulations. Prepared necessary documentation for the filing of a Wetland Verification Request with NYSDEC.

Shuttle Columbia Recovery, Superfund Technical Assessment and Response Team (START) EPA Region 6, START 2, Corsicana, TX, Equipment Manager. Duties included inventory control for digital cameras, PDAs, global positioning system (GPS) units, and personal protective equipment (PPE), processing evidence at the end of daily collections, and conducting daily health and safety briefings. Field duties include locating debris; logging debris onto evidence tag and into logbook; and entering related data into handheld computer (PDA). Data include latitude/longitude, evidence and picture number, type of debris, and comments relating to debris.

Oversight, Tri-Cities Barrel Site, Fenton, NY, U.S. Environmental Protection Agency (EPA), Region 2, Oversight Scientist. Conducted EPA oversight of monitoring well installation, test pit excavation, and soil sampling at 191 locations. Also collected split samples during soil sampling activities using EPA Contract Laboratory Program (CLP) requirements.

Biological, Environmental, and Cultural Resources (BECR) Contract, New Jersey, U.S. Army Corps of Engineers (USACE), New York District, Project Scientist. Assisted on projects including environmental site assessments (ESAs) under the hazardous, toxic, radioactive waste (HTRW) and DERP-FUDS programs, community relations plans for site cleanups, wetland mitigation studies and plans, and assessment of environmental impacts.

Soil Sampling, Wall Township, NJ, Confidential Client, Project Scientist. Led team that performed in situ post-excavation sampling to determine extent of contamination and hence, limits of excavation. Efforts led to a significant decrease of previously delineated excavation boundary. Also assisted in the pre-excavation soil sampling. Utilized global positioning system (GPS) to survey in all the soil sample locations. Wrote part of the Remedial Action Report following excavation, post-excavation sampling, and backfilling.

Key Projects (Continued)

National Pollutant Discharge Elimination System (NPDES) Discharge Permit Renewal, Killington, VT, Killington Ski Resort, Fisheries/Aquatic Ecologist. Conducted benthic macroinvertebrate sampling for discharge permit renewal. Supervised three technicians during collection, preservation, identification, and grid-sorting of benthic macroinvertebrates for community structure comparison according to the EPA Rapid Bioassessment Protocols, as well as calculation of numerous indices. Fish were collected using a backpack electro-fishing unit.

Aquatic Ecosystem Assessment, Neponset Reservoir, Foxboro, MA, Menzie-Cura and Assoc., Fisheries/Aquatic Ecologist. Identified zooplankton from multiple lakes and ponds, and generated quantitative data for analysis of the abundance, distribution, diversity, and community structure of the zooplankton and fish communities in the study reservoir, as well as the multiple reference water bodies. Fish were collected for tissue analysis using a boat-mounted electro-fishing unit. Data analysis and report were incorporated into a larger risk assessment.

Fisheries Collection, Nashua River, Nashua, NH, Confidential Client, Fisheries/Aquatic Ecologist. Conducted fish tissue sampling for remedial investigation, human health, and ecological risk assessment. Collected, identified, and prepared fish tissue for contaminant analysis. Fish were collected using boat-mounted and backpack electro-fishing units.

Fisheries Collection/Assessment, Kennebec River, Madison, ME, Confidential Client, Fisheries/Aquatic Ecologist. Conducted fish sampling for Federal Energy Regulatory Commission (FERC) dam re-licensing. Collected, identified, and enumerated fish for community structure comparison, and also collected fish for tissue analysis. Captained boat-mounted electro-fishing unit that was used to collect thousands of fish during nighttime electro-fishing.

Stream Restoration, Brown's Creek, Minneapolis, MN, University of Minnesota, Research Associate. Conducted aquatic habitat survey and restoration activities in the last wild trout creek in Minneapolis, MN. Fish electro-fishing for native trout was conducted prior to and after restoration activities. Parameters such as fish communities, macroinvertebrate communities, water quality, and sediment load were measured, both before and after restoration activities. Restoration activities included removal of beaver dams, installation of hard and soft engineering devices, and permanent monitoring stations.

Exotic Species/Aquatic Food Web Investigation, Moosehead Lake, ME, Research Associate. Investigated the abundance and distribution of an exotic pelagic invertebrate (*Mysis relicta*) in the largest lake in Maine. The impact of the exotic invertebrate population on the food web dynamics and ultimately the resident piscivorous salmonids was examined. Zooplankton species composition and population dynamics were also examined in relation to food web interactions.

Multiple Laboratory Analyses, Burlington, VT, Multiple Clients, Laboratory Technician. Conducted and assisted with numerous aquatic ecological laboratory analyses and tests including multiple toxicity tests, chlorophyll a determinations, micronutrient analyses, microbiological analyses of water samples, and taxonomic identifications.

Fisheries Collections, Northwestern Maine, Maine Department of Inland Fisheries and Wildlife, Fisheries Technician Intern. Conducted multiple fisheries collections throughout the

Key Projects (Continued)

Moosehead Lake Region. Assisted with stream electro-fishing for native Atlantic salmon parr using a bankside electro-fishing unit. Assisted with remote high mountain pond survey of native brook trout status using experimental gill nets. Assisted with fall trap netting of Atlantic salmon for annual population status analysis. Assisted with summer deep-water (100 foot +) gillnetting for annual lake trout population analysis and forage habit study.

WESTON SOLUTIONS, INC.

THIS CERTIFIES THAT

RYAN BROWN

HAS COMPLETED THE

8-Hour Hazwoper Refresher Training Course

In accordance with 29 CFR 1910.120 (e)(8) completed on 5/19/2005 in Edison, NJ

Conrad W Lehr, CET

TRAINING MANAGER
Conrad W. Lehr, CET

WESTON SOLUTIONS
Restoring Resource Efficiency

INSTRUCTOR
Alanna Garrison Safety Officer

ROY F. WESTON, INC · 1400 WESTON WAY · WEST CHESTER, PA · 19380

04P-0755

WESTON SOLUTIONS, INC.

THIS CERTIFIES THAT

RYAN BROWN

HAS COMPLETED THE

Bloodborne Pathogens Training Course (Refresher)

In accordance with 29 CFR 1910.1030 completed on 5/19/2005 in Edison, NJ

Conrad W Lehr, CET

TRAINING MANAGER
Conrad W. Lehr, CET

WESTON SOLUTIONS
Restoring Resource Efficiency

INSTRUCTOR
Alanna Garrison Safety Officer

ROY F. WESTON, INC · 1400 WESTON WAY · WEST CHESTER, PA · 19380

04P-0755

Qualisys
4501 Circle 75 Parkway, Suite C-3250
Atlanta, GA 30339
Phone: 770-226-9944
Fax: 770-541-0293

Applicant/Employee:

Brown, Ryan

ID: 017-04-4

Company: Weston Solutions, Inc.
1400 Weston Way
West Chester PA 19380

Exam Date: 10/28/2005

Clinic: Qualisys # Q

Location: EDC-Edison, NJ

INTERIM SURVEILLANCE CERTIFICATION

> *Please Note that areas in which he/she did not meet your criteria are explained on Page 2 of this report. Before instituting work restrictions based on these findings, you may wish to consider any accommodations that may be applicable. If further evaluations or testing are requested by Qualisys, appropriate clearances will be issued after receipt of the requested information. Any attached medical information should be treated as Confidential Medical Information in accordance with Section 102C of the Americans with Disabilities Act.*

Examination Type: 42020-Clearance Extension Review
FITNESS FOR DUTY:

Based on a review of the interim history, the following clearances are extended:

☒ **May be assigned duties consistent with skills and training.**

☐ **Clearances may be given or added when further information is received (See page 2).**

THIS APPLICANT/EMPLOYEE IS CLEARED FOR:

RESPIRATORS (29 CFR 1910.134)	***OSHA (29 CFR) and DOT (49 CFR)***
☒ **Negative Pressure (NPR)**	☐ **DOT Clearance (391.41)**
☒ **Self-Contained (SCBA)**	☒ **Hazardous Waste (1910.120)**
☒ **Supplied or Powered Air (SAPR/PAPR)**	☐ **Asbestos (1910.1001 / 1926.1101)**

Previous Exam Clearances Expire On 11-04-06.

Evaluation Date: 11/1/05

E D Walker
Everett D. Walker, M.D.

WESTON FIT TEST RECORD

NAME (print) Ryan Brown **DATE** 11/23/05

SOC. SECURITY NO. ____________ **YOUR WORK LOCATION** EDC

NAME of TEST ADMINISTRATOR (print) A. Garrison

(Circle all responses)

Qualitative Fit Test Protocol Administered

[✓ **Irritant Smoke**] **Bitrex**

Negative Pressure Mask(s)

Type of Mask: full face
Manufacturer: MSA
Model: Ultra Twin
Size: Large

[✓ **Pass**]/**Fail** **Pass/Fail**

Positive Pressure Mask(s)

Type of Mask: ____________
Manufacturer: ____________
Model: ____________
Size: ____________

Pass/Fail **Pass/Fail**

Comments:

Clean Shaven? [✓ YES] / NO **Spectacle kit required?** YES / [✓ NO]

I hereby certify that the above-named individual has been qualitatively fit tested, that all WESTON fit test procedures have been completed and that the above information reflects the results of the test.

Test Administrator Signature: AM Garrison

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RISKS AND LIABILITY

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Test Subject Signature: ____________

Revised 01/2000

WESTON SOLUTIONS, INC.

THIS CERTIFIES THAT

RYAN BROWN

HAS COMPLETED THE

8-Hour Site Manager and Supervisor Training (SHSC)

completed on 5/1/2002 at Edison, NJ

Conrad W Lehr, CET
TRAINING MANAGER
Conrad W. Lehr, CET

WESTON SOLUTIONS
Restoring Resource Efficiency

George M Crawford CIH
INSTRUCTOR
George M. Crawford CIH

ROY F. WESTON, INC · 1400 WESTON WAY · WEST CHESTER, PA · 19380

04P-0755

GERALD V. GILLILAND, P.G.

Qualifications Summary

- Eighteen years of experience in hazardous waste site characterization for EPA, DOD, and industrial clients.
- HRS Expert and Senior Technical Manager for the EPA Region 2 Site Assessment Team (SAT).
- Author of HRS Packages for the following NPL sites: Peter Cooper; Lehigh Valley Railroad; Mohonk Road Industrial Plant; Martin Aaron, Inc.; Peter Cooper Corp (Markhams); Lawrence Aviation Industries, Inc.; Old Roosevelt Field Contaminated GW Area; White Swan Cleaners/Sun Cleaners Area Ground Water Contamination; Diaz Chemical Corporation; Peninsula Boulevard Groundwater Plume; and Hopewell Precision Area Contamination.
- Geosciences Group Leader managing eight staff members.

Registration

Registered Professional Geologist in the State of Tennessee (ID No. TN2653) since 1992
Professional Geologist in the Commonwealth of Pennsylvania (License No. PG001914G) since 1995
Licensed Subsurface Evaluator in the State of New Jersey (License No. 0017102) since 1997

Fields of Competence

Hazardous waste site characterization, including Hazard Ranking System (HRS) applications; subsurface investigations; soil and rock classification; monitoring well installation and hydrogeological analysis; analytical data interpretation; quality assurance/quality control; report preparation; technical and editorial review.

Credentials

B.S., Geology, University of Delaware (1985)
Graduate Studies, Environmental Engineering, Stevens Institute of Technology, 3.75 GPA (1992-1996)
OSHA Hazardous Waste Operations (40-hour), NUS Corp. (1987)
OSHA Hazardous Waste Supervisor, IT Corporation (1992)
Level B Refresher, WESTON (2004)
Ionizing Radiation Awareness, WESTON (2004)
OSHA Annual 8-Hour HAZWOPER and Bloodborne Pathogens Refreshers, WESTON (2005)
Hazard Ranking System (HRS) Training, EPA (1993)
HRS Documentation Record and PREscore, EPA (1993)
Using the HRS in Planning Site Assessments, EPA (2001)
2003 National Site Assessment Symposium, EPA (2003)
Planning and Using Data for Site Assessment (PUDSA), EPA (2003)
Using Rapid Analytical Results for On-Site Decision Making During Site Inspections, EPA (2003)
SuperScreen and QuickScore, EPA (2003)
2004 National Site Assessment Symposium, EPA (2004)
Understanding and Implementing the Eligible Response Site Guidance, EPA (2004)

Credentials (Continued)

Vapor Intrusion into Indoor Air: Guidance, Comments, and Developing Responses for the Improved Protection of Human Health, EPA (2004)
Pollution, Risk Assessment, and Remediation in Groundwater Systems Seminar, City College of New York (1987)
Write for Action Seminar: the P.O.W.R. Method, The ThinkWorks (1990)
Environmental Measurements and QA Seminar, NJDEP (1992)
Total Quality Management Orientation Seminar, IT Corporation (1994)
Environment 2000 Seminar, Stevens Institute of Technology (1995)
Hazardous Waste Management and Shipping for Environmental Professionals Seminar, EduWhere (2001)
Managing Uncertainty for Environmental Decision Making, USDOE (2001)
Dangerous Goods Shipping Procedures Manual Training, WESTON (2002)
Regulatory (NJDEP) Training in Underground Storage Tanks, New Jersey Society of Professional Engineers (2000) and Cook College-Rutgers University (2002)
NJDEP's Technical Guidance for Indoor Air Vapor Intrusion, Severn Trent Laboratories, Inc. (2004)
IS-195: Basic Incident Command System, FEMA (2004)

Employment History

2001-Present	WESTON
1996-2001	Tetra Tech EMI
1989-1996	IT Corporation
1986-1989	NUS Corporation

Key Projects

HRS Packages, Various Sites, EPA, New York, NY, Technical Manager. Directed the completion of four high-quality final HRS Packages over a 4-month timeframe (typical timeframe for one HRS Package from assignment to finalization is 6 to 8 months), including primary authorship of two of the reports. In October 2003, EPA Region 2 asked Weston to complete draft Site Narratives and HRS Packages for the following four sites by Christmas: Diaz Chemical Corporation, Cidra Ground Water Contamination, Peninsula Boulevard Ground Water Plume, and Pesticide Warehouse I. The Region was planning to propose all four sites for the National Priorities List (NPL) on the next update in February 2004. On November 3, 2003, EPA stepped up the schedule and requested the NPL Site Narratives for all four sites by November 6, 2003. Weston completed the task by the requested date, and the Region was able to present the draft NPL Site Narratives for all four sites to EPA Headquarters. Weston subsequently submitted draft HRS Documentation Packages for all four sites by the middle of December, in time for a December 18, 2003 Technical Assistance meeting at the EPA Region 2 office in New York. Weston worked closely with the Region and its QA contractor over the next six weeks to finalize the NPL Site Narratives, HRS Documentation Packages, and NPL Characteristics Data Collection Forms. During the process, EPA and the QA contractor commented frequently on our responsiveness and

Key Projects (Continued)

the high quality of our draft deliverables. The NPL Site Narratives, HRS Documentation Packages, and NPL Forms for all four sites were finalized by February 2004. EPA proposed the addition of Diaz Chemical Corporation, Cidra Ground Water Contamination, and Peninsula Boulevard Ground Water Plume to the NPL in March 2004. Those three sites went final in July 2004. EPA elected to not propose the Pesticide Warehouse I site at the time due to a request from Headquarters for more sampling data. Weston subsequently completed another sampling event and incorporated the results into the HRS Package, and EPA proposed that site for addition to the NPL in September 2004.

National Site Assessment Symposium 2004 - Poster Session, La Jolla, CA, EPA, Author and Presenter. Prepared and submitted a Poster Abstract, and used Microsoft PowerPoint to complete the draft poster. EPA approved the poster with just two minor revisions. Prior to the conference, Weston also provided some input and assistance to the EPA Region 2 WAM, while he was preparing his own presentation for the conference. Weston's poster, titled "The Usefulness of Field-Screening for Site Assessment Decision-Making", was on display at the National Site Assessment Symposium in La Jolla, California on June 29 and 30. Mr. Gilliland was on hand to discuss the poster with Symposium attendees and answer their questions. The EPA WAM successfully presented his topic, "Site Discovery in Puerto Rico", during the first day of the conference. He and other members of EPA Region 2 expressed their appreciation of our support during the conference.

Screening Risk Assessments for three NPL sites, Upstate New York, EPA, Project Manager. Completed Screening Risk Assessments to show human health risks associated with the use of contaminated ground water at each of three sites: Shenandoah Road Ground Water Contamination, Cayuga County Ground Water Contamination, and Hopewell Precision Area Contamination. At the 2003 National Site Assessment Symposium in Pittsburgh, Pennsylvania, an EPA Region 2 risk assessor supported his presentation "Incorporating Superfund Risk Assessment into PA/SI Investigations" with several references to the Shenandoah and Cayuga Screening Risk Assessments completed by Weston. Weston subsequently completed another Screening Risk Assessment for Hopewell Precision Area Contamination. At EPA's request, Weston incorporated newly proposed, stricter values for the evaluation of risks associated with ingestion of TCE-contaminated ground water at the Hopewell site. Weston submitted the draft report to EPA in April 2004. EPA commented that "Overall, the document was very good and contained everything that it should.", and requested only a few minor revisions. Weston submitted the final Screening Risk Assessment report for the site in June 2004, and also completed the HRS Package for the Hopewell site. EPA added the Shenandoah Road and Cayuga County sites to the NPL in June 2001 and September 2002, respectively, and proposed the Hopewell Precision site for addition to the NPL in September 2004. EPA has incorporated the results of the Screening Risk Assessments into its decisions regarding remedial actions at these NPL sites.

Cidra Ground Water Contamination, Cidra, PR, EPA, Project Manager. Completed both an Expanded Site Inspection (ESI) and a Hazard Ranking System (HRS) Package for the Cidra Ground

Key Projects (Continued)

Water Contamination site. The Cidra site consisted of four public supply wells closed by the Puerto Rico Department of Health (PRDOH) due to contamination by tetrachloroethylene (PCE) and other chlorinated volatile organic compounds (VOCs). The purpose of the ESI was to identify the potential source(s) of contamination. In June 2002, Weston mobilized to Puerto Rico to collect confirmatory groundwater samples from the four closed wells and 20 other active and inactive wells in Cidra. Weston successfully collected all the groundwater samples in the scheduled timeframe despite major changes to the sample collection procedures. In January and February 2003, Weston continued the ESI by investigating 12 industrial sites as potential sources of contamination to the plume. Subsurface soil samples were collected at the 12 industrial sites plus two background sites using Geoprobe® and field-screening with a portable GC/MS. Screening the samples enabled Weston to collect confirmatory Contract Laboratory Program (CLP) samples only where necessary, thereby saving the project significant analytical costs. Weston accelerated the schedule during the January and February sampling, enabling us to meet last-minute changes including collection of sediment and surface water. Weston used the investigation results and knowledge of past chemical usage to identify five potential sources of contamination. Mr. Gilliland prepared the ESI report in September 2003, and it was approved by EPA with only minor revisions. Under Mr. Gilliland's supervision, Weston completed the HRS package in February 2004. EPA added the site to the NPL in July 2004.

Publications and Presentations

Gilliland, Gerry. 2004. "The Usefulness of Field Screening for Site Assessment Decision-Making". Poster Session at EPA's 2004 National Site Assessment Symposium.

WESTON SOLUTIONS, INC.

THIS CERTIFIES THAT

GERRY GILLILAND

HAS COMPLETED THE

8-Hour Hazwoper Refresher Training Course

In accordance with 29 CFR 1910.120 (e)(8) completed on 1/23/2006 in Edison, NJ

Conrad W Lehr, CET

TRAINING MANAGER
Conrad W. Lehr, CET

WESTON SOLUTIONS
Restoring Resource Efficiency

[redacted]

INSTRUCTOR
Alanna Garrison Safety Officer

ROY F. WESTON, INC · 1400 WESTON WAY · WEST CHESTER, PA · 19380

04P-0755

WESTON SOLUTIONS, INC.

THIS CERTIFIES THAT

GERRY GILLILAND

HAS COMPLETED THE

Bloodborne Pathogens Training Course (Refresher)

In accordance with 29 CFR 1910.1030 completed on 1/23/2006 in Edison, NJ

Conrad W Lehr, CET

TRAINING MANAGER
Conrad W. Lehr, CET

WESTON SOLUTIONS
Restoring Resource Efficiency

INSTRUCTOR
Alanna Garrison Safety Officer

ROY F. WESTON, INC · 1400 WESTON WAY · WEST CHESTER, PA · 19380

04P-0755

Qualisys

Qualisys
4501 Circle 75 Parkway, Suite C-3250
Atlanta, GA 30339
Phone: 770-226-9944
Fax: 770-541-0293

Applicant/Employee:

Gilliland, Gerald

ID: 016694

Company: Weston Solutions, Inc.
1400 Weston Way
West Chester PA 19380

Exam Date: 01/03/2006

Clinic: Concentra Edison # 11086

Location: EDC-Edison, NJ

MEDICAL SURVEILLANCE CERTIFICATION

The above applicant/employee's medical examination has been reviewed to determine whether he/she meets the criteria contained in your protocol and job descriptions as supplied to Qualisys, and the regulations noted below.

Please Note that areas in which he/she did not meet your criteria are explained on Page 2 of this report. Before instituting work restrictions based on these findings, you may wish to consider any accommodations that may be applicable. If further evaluations or testing are requested by Qualisys, appropriate clearances will be issued after receipt of the requested information. Any attached medical information should be treated as Confidential Medical Information in accordance with Section 102C of the Americans with Disabilities Act.

Examination Type: 42009-Annual Hazardous/Respirator
FITNESS FOR DUTY:

☒ **No significant medical impairments noted. May be assigned duties consistent with skills and training.**

☐ **Clearances May Be Given or Added When Further Information Is Received (See Page 2).**

THIS APPLICANT/EMPLOYEE IS MEDICALLY CLEARED FOR:

RESPIRATORS (29 CFR 1910.134)	***OSHA (29 CFR) and DOT (49 CFR)***
☒ **Negative Pressure (NPR)**	☐ **DOT Clearance (391.41)**
☒ **Self-Contained (SCBA)**	☒ **Hazardous Waste (1910.120)**
☒ **Supplied or Powered Air (SAPR/PAPR)**	☐ **Asbestos (1910.1001 / 1926.1101)**

Evaluation Date: 1/13/06

E. D. Walker
Everett D. Walker, M.D.

All Immunizations For An Individual

09/28/05

Name **Gilliland, Gerald** SSN **158-46-3590** Dept **OU91141**				ID **016694** DOB **09/19/63**
Date	Type	Description	Status	
09/08/05	TD	Tetanus & Diphtheria Vaccinati	C	

WESTON FIT TEST RECORD

NAME (print) Gerry Gilliland **DATE** 9/12/05

SOC. SECURITY NO. 158-46-3590 **YOUR WORK LOCATION** EDC

NAME of TEST ADMINISTRATOR (print) Alanna Garrison

(Circle all responses)

Qualitative Fit Test Protocol Administered

[✓ **Irritant Smoke**] **Bitrex**

Negative Pressure Mask(s)

Type of Mask: full face
Manufacturer: MSA
Model: ultra twin
Size: M

[✓ **Pass**]/**Fail** **Pass/Fail**

Positive Pressure Mask(s)

Type of Mask: ______
Manufacturer: ______
Model: ______
Size: ______

Pass/Fail **Pass/Fail**

Comments:

Clean Shaven? [✓ **YES**] / **NO** **Spectacle kit required?** **YES** / [✓ **NO**]

I hereby certify that the above-named individual has been qualitatively fit tested, that all WESTON fit test procedures have been completed and that the above information reflects the results of the test.

Test Administrator Signature: am garrison

The fit test documented by this form is intended for use in conjunction with a fully implemented respiratory protection program as required by 29 CFR 1910.134. This fit test in no way certifies that the individual being fit tested will use the respirator as it is designed or according to manufacturer's directions. Proper use of respiratory protection is the responsibility of the individual and the individual's employer. The fit test has been conducted by an individual who has received instruction in fit testing and is authorized to perform the test. Should the individual being fit tested have a significant weight gain or loss, have facial or dental surgery, suffer injury that changes facial structure, or be assigned another brand and model of respirator, the designated respirator may not fit properly, the fit test is invalidated, and the person should be fit tested again before further respirator use. This fit test applies only to the respirator(s) size, model, and manufacturer indicated on the form.

RISKS AND LIABILITY

Any individual engaged in activities requiring the use of a respirator faces the risk of health impairment. Fit testing cannot completely eliminate risk and injuries that may occur despite successful completion of the fit test. Fit testing simply determines that at the time of the test, the particular respirator fit properly. This fit test has been administered in accordance with OSHA 29 CFR 1910.134 regulations. Roy F. Weston, Inc. does not make any warranties, either expressed or implied, concerning the proper use or function of respiratory protection used by the individual subsequent to this fit test. In no event shall Roy F. Weston, Inc. be liable for any loss of special, incidental, consequential, or other damages caused by subsequent use of respiratory protection.

Test Subject Signature: ______

Revised 01/2000

WILLIAM H. MORRISON

Qualifications Summary

- More than 12 years of experience in the environmental remediation industry.
- Member of WESTON's EPA/Site Assessment Team (SAT).
- Responsible for several site investigations and has assisted on field activities on other SAT members' projects.
- Conducted numerous building surveys, inspections, and assessments, and developed management strategies, including abatements.
- Provided asbestos services to a wide range of clients in the private sector, federal and state agencies, and numerous school districts throughout New Jersey, New York, Connecticut, and Pennsylvania.
- Extensive knowledge of federal, state, and local regulations.

Registration

Certified New York City Asbestos Investigator, NYC Department of Environmental Protection (2005)
Certified Pennsylvania Asbestos Building Inspector, Department of Labor and Industry (2005)
Certified Virginia Asbestos Inspector, Department of Professional and Occupational Regulation (2005)
Certified Asbestos Management Planner (2004)
Certified Asbestos Project Designer (2004)
Certified New York/New Jersey/EPA Lead Inspector/Risk Assessor, NAETI (2002)
Certified New Jersey Asbestos Safety Technician, New Jersey Department of Community Affairs (1994)
Certified New York/New Jersey/EPA Asbestos Building Inspector, National Asbestos and Environmental Training Institute (#AH98-13545; 1996)
Certified New York State Asbestos Project Monitor, National Asbestos and Environmental Training Institute (1994)

Fields of Competence

Site investigations (SIs); field activities; asbestos project monitoring, inspection, design, and management; asbestos surveys and inspections; asbestos consulting services to a wide range of clients, with extensive experience in numerous school districts under the Asbestos Hazard Emergency Response Act (AHERA) regulations; knowledge of federal, state, and municipal abatement rules and regulations.

Education

B.S., Marine Science (Minor-Biology)—Rider University (1992)

Credentials

8-Hour Hazardous Waste Refresher Course, OSHA 29 CFR 1910.120(e)(8), WESTON (2005)
FEMA Basic Incident Command System IS-195 (2004)
Bloodborne Pathogens Refresher Training, OSHA 29 CFR 1910.1030, WESTON (2002)
Weston Solutions, Inc. Manual of Procedures for Shipping and Transporting Dangerous Goods Training Course, WESTON (2002)

Credentials (Continued)

10-Hour Construction Safety Training, OSHA 29 CFR 1926, WESTON (2002)
Site Health and Safety Coordinator Course, OSHA 29 CFR 1910.120(e)(4), WESTON (2001)
Confined Space Training for Non-Entry Rescuers, OSHA 29 CFR 1910.146, WESTON (2000)
Certified OSHA HAZWOPER Training, Compliance Solutions (1999)
Certified First Aid and CPR, Red Cross (2001)

Employment History

1999-Present	WESTON
1996-1999	PMK Group
1993-1996	Briggs Associates/Princeton Testing Laboratory

Key Projects

Asbestos/Industrial Hygiene Consulting Services, Various Locations, Gilbane Building Company. Was responsible for implementing field decisions for a major mold remediation project in an apartment building in Richmond, VA. Also provided asbestos project monitoring and abatement design services for the high profile Deutsche Bank deconstruction project in Lower Manhattan, NY.

Columbia Shuttle Recovery, Nacogdoches, TX, U.S. Environmental Protection Agency (EPA) Region 6 Superfund Technical Assessment and Response Team (START)-2. Responsible for recording detailed information regarding any Space Shuttle components located in the field as part of the Columbia Space Shuttle recovery effort February – March 2003. Part of the time was spent with a U.S. Forestry Service search crew. The remaining part involved working closely with a representative of EPA on point recovery detail. This involved recovering Space Shuttle components from private homes, at the request of the homeowner.

Soil Sampling, Seneca Army Depot, Romulus, NY, U.S. Army Corps of Engineers (USACE), Consultant. Performed soil and air sampling for particulates. Packed and shipped samples to an off-site laboratory. Excavated the top 6 inches of soil, and sampled for arsenic, mercury, chromium, and physically removed contamination from the site.

Site Investigations, Various Locations, EPA Region 2, Site Assessment Team (SAT) Member. Responsible for several EPA SIs under Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) in EPA Region 2 (New York, New Jersey, Puerto Rico, U.S. Virgin Islands). Assisted on several other SAT members' projects in field activities involving sampling of groundwater, soil, surface water, and sediment. SAT projects include field sampling for Diamond Aerosol in Glen Gardner, NJ; Duane Marine in Perth Amboy, NJ; Cidra groundwater contamination site; and Caribe Biochemicals in Puerto Rico; and Diaz Chemicals in Holley, NY.

SAT Project Management, Various Locations, EPA Region 2, Project Manager. Currently conducting project management at the following sites: Grinding Balls in Cinnaminson, NJ; Plainsboro Landfill in Plainsboro, NJ; Patterson Road East in Patterson, NJ; Metem in

Key Projects (Continued)

Parsippany, NJ; Flowen Oil in Camden, NJ; Hamilton Hardware in Neptune, NJ; and Stamplate, Inc. in Wallkill, NY. Responsible for site background research and previous sampling history. Scored sites in accordance with EPA's Hazard Ranking System (HRS).

Organics Sampling, New Jersey, Plainsboro Landfill Site. Managed a 2-day sampling event to obtain organic compound samples in thick undergrowth along the Millstone River at the Plainsboro Landfill site in NJ. Applied HRS scoring to characterize the impacts from nearly 13,000 gallons of waste dumped at the site.

Mapping and Sampling, New Jersey, Patterson Road Site. Managed mapping and sampling at the first Patterson Road site, NJ. Identified and marked sampling locations 6 weeks prior to event. Overlaid GPS sampling locations on an aerial map of the site to expedite the sampling event, reducing field time. Provided QA/QC oversight for all assessment tasks. At the Patterson Road East site, reduced costs by using the recently acquired background information from the adjacent Patterson Road site, enabling WESTON to quickly perform the investigation without "re-inventing the wheel."

Groundwater Sampling, Newark, NJ, Confidential Client, Project Monitor. Conducted groundwater sampling at the Newark and Gibbsboro sites. Supervised asbestos abatement.

Asbestos Consulting Services, New York City, TriBoro Bridge and Tunnel Authority (TBTA), Consultant. Provided asbestos consulting services at the TBTA's various facilities throughout New York City including the TriBoro Bridge, the Verrazano Narrows Bridge, and the Throgs Neck Bridge.

Asbestos Consulting Services, Manhattan, NY, Confidential Client, Consultant. Provided asbestos consulting services at client's facilities in lower Manhattan at the World Financial Center and 222 Broadway.

Asbestos Consulting Services, Deutsche Bank Building Site, Manhattan, NY, McLaren-Toplis, Consultant. Provided asbestos consulting services for the oversight of sampling activities at the Deutsche Bank Building. This building is located in lower Manhattan and was severely damaged as a result of the 9/11 terrorist activities.

Asbestos Surveys, National Park Service, Various Locations, Asbestos Building Inspector. Conducted asbestos surveys associated with Phase I site assessments at the Appalachian Trail in Unionville, NY, Morristown National Historic Park, Morristown, NJ; and Governor's Island in New York Harbor.

Asbestos Consulting Services, Various Locations, Port Authority of New York and New Jersey, Asbestos Consultant. Provided asbestos consulting services at various Port Authority facilities throughout the New York/New Jersey metropolitan area including Newark, LaGuardia, and JFK Airports; the Outerbridge Crossing; and a special assignment involving emergency cleanup following the World Trade Center disaster. More recently, has been assigned to JFK Airport where duties included project management for abatement activities conducted by airport tenants.

Key Projects (Continued)

Asbestos Consulting, Riverview Medical Center, Red Bank, NJ, Environmental Scientist. Provided asbestos consulting services to the Medical Center. Conducted asbestos inspections and monitored asbestos abatements in coordination with the Medical Center's numerous and ongoing renovation projects.

Asbestos Consulting, Multiple New Jersey Board of Education School Systems, New Jersey, Environmental Scientist. Provided asbestos consulting services to numerous Boards of Education to ensure compliance with the AHERA provisions, and conducted the 3-year reinspections, 6-month surveillance inspections, assisted with design specifications, and monitored numerous asbestos abatement projects for the following school systems:

Union Township Board of Education
Woodbridge Township Board of Education
Rivervale Board of Education
Rahway Board of Education
Elizabeth Board of Education
Livingston Board of Education
New Brunswick Board of Education
Bernards Township Board of Education
Wall Township Board of Education
Newark Public Schools

Asbestos/Lead Consulting, Montefiore Medical Center, Bronx, NY, Industrial Hygiene Technician. Was responsible for asbestos monitoring projects of various sizes and scope, and led monitoring during demolition activities.

Asbestos Surveys, Exxon Company, USA, Various New Jersey Locations, Environmental Scientist. While employed by the PMK Group, conducted asbestos identification surveys of numerous Exxon locations throughout New Jersey.

Asbestos Consulting, Schering Plough, Union and Kenilworth, NJ, Environmental Scientist. Provided asbestos consulting services and project monitoring for various renovation projects throughout the Union and Kenilworth facilities.

Asbestos Consulting, Brookdale Community College, Lincroft, NJ, Environmental Scientist. Conducted asbestos identification surveys in several Brookdale facilities. Performed surveys in 12 buildings.

Asbestos Surveys, Monmouth University, West Long Branch, NJ, Environmental Scientist. Conducted asbestos identification surveys of all Monmouth University buildings and provided detailed reports of all asbestos-containing materials (ACM) throughout these buildings. Also provided monitoring on several asbestos abatement projects.

Asbestos Consulting, Saint Barnabas Health Care System, Clara Maas Medical Center, Belleville, NJ, Environmental Scientist. Provided asbestos consulting services and project monitoring for various renovation projects throughout the facility.

Asbestos Consulting, Sisters of Charity of St. Elizabeth, Convent Station, NJ, Environmental Scientist. Provided asbestos consulting services and project monitoring for various renovation projects throughout the facility.

Asbestos Consulting, Hunterdon Central Regional High School District, Flemington, NJ, Environmental Scientist. Provided asbestos consulting services and project monitoring for

Key Projects (Continued)

several large-scale and high-profile asbestos abatement projects throughout the high school complex.

Asbestos Consulting, Robert Wood Johnson University Hospital, New Brunswick, NJ, Environmental Scientist. Provided asbestos consulting services and project monitoring for various renovation projects throughout the facility.

Asbestos Consulting, Tunxis Management at Constitution Plaza, Hartford, CT, Environmental Scientist. Conducted on-site project management and monitoring of a multi-phase, high-profile abatement project at the office complex over a 9-month period.

Asbestos Consulting, Dormitory Authority of the State of New York (DASNY), Bronx Community College, Bronx, NY, Industrial Hygiene Technician. Conducted project monitoring, including abatement and duct work, at the Science and Technology Center.

Asbestos Consulting, Union and Hudson County Courthouses, New Jersey, Environmental Scientist. Conducted project monitoring on various abatement projects at these two facilities. This was a Subchapter 8 occupied asbestos abatement including removal of duct insulation and abatement.

Indoor Air Quality Services, Various Locations, Multiple Clients, Industrial Hygiene Technician. Performed a variety of indoor air quality services and investigations for various public and private clients. Duties included CO and CO_2 monitoring, and air sampling for VOCs, mold spores, and mold samples from duct works. Conducted a full investigation to determine indoor air problems.

Asbestos Consulting, First Union National Bank, Various Locations in New Jersey and Connecticut, Environmental Scientist. Performed building surveys and abatement project monitoring. Surveyed for asbestos-containing materials at bank branches, and project monitoring during the weekends.

WESTON SOLUTIONS, INC.

THIS CERTIFIES THAT

WILLIAM MORRISON

HAS COMPLETED THE

8-Hour Hazwoper Refresher Training Course

In accordance with 29 CFR 1910.120 (e)(8) completed on 5/19/2005 in Edison, NJ

Conrad W Lehr, CET

TRAINING MANAGER
Conrad W. Lehr, CET

WESTON SOLUTIONS
Restoring Resource Efficiency

INSTRUCTOR
Alanna Garrison Safety Officer

ROY F. WESTON, INC · 1400 WESTON WAY · WEST CHESTER, PA · 19380

04P-0755

WESTON SOLUTIONS, INC.

THIS CERTIFIES THAT

WILLIAM MORRISON

HAS COMPLETED THE

Bloodborne Pathogens Training Course (Refresher)

In accordance with 29 CFR 1910.1030 completed on 5/19/2005 in Edison, NJ

Conrad W Lehr, CET

TRAINING MANAGER
Conrad W. Lehr, CET

WESTON SOLUTIONS
Restoring Resource Efficiency

INSTRUCTOR
Alanna Garrison Safety Officer

ROY F. WESTON, INC · 1400 WESTON WAY · WEST CHESTER, PA · 19380

04P-0755

Qualisys

Qualisys
4501 Circle 75 Parkway, Suite C-3250
Atlanta, GA 30339
Phone: 770-226-9944
Fax: 770-541-0293

Applicant/Employee:

Morrison, William

ID: 015906

Company: Weston Solutions, Inc.
1400 Weston Way
West Chester PA 19380

Exam Date: 04/14/2005

Clinic: Concentra Edison # 11086

Location: EDC-Edison, NJ

MEDICAL SURVEILLANCE CERTIFICATION

The above applicant/employee's medical examination has been reviewed to determine whether he/she meets the criteria contained in your protocol and job descriptions as supplied to Qualisys, and the regulations noted below.

Please Note that areas in which he/she did not meet your criteria are explained on Page 2 of this report. Before instituting work restrictions based on these findings, you may wish to consider any accommodations that may be applicable. If further evaluations or testing are requested by Qualisys, appropriate clearances will be issued after receipt of the requested information. Any attached medical information should be treated as Confidential Medical Information in accordance with Section 102C of the Americans with Disabilities Act.

Examination Type: 42003-Baseline Asb/HazWaste/Respirator

FITNESS FOR DUTY:

☒ **No significant medical impairments noted. May be assigned duties consistent with skills and training.**

☐ **Clearances May Be Given or Added When Further Information Is Received (See Page 2).**

THIS APPLICANT/EMPLOYEE IS MEDICALLY CLEARED FOR:

RESPIRATORS (29 CFR 1910.134)

☒ **Negative Pressure (NPR)**

☒ **Self-Contained (SCBA)**

☒ **Supplied or Powered Air (SAPR/PAPR)**

OSHA (29 CFR) and DOT (49 CFR)

☐ **DOT Clearance (391.41)**

☒ **Hazardous Waste (1910.120)**

☒ **Asbestos (1910.1001 / 1926.1101)**

Evaluation Date: 4/25/05

E D Walker
Everett D. Walker, M.D.

WESTON FIT TEST RECORD

NAME (print) Bill Morrison **DATE** 11/23/05

SOC. SECURITY NO. ____________ **YOUR WORK LOCATION** EDC

NAME of TEST ADMINISTRATOR (print) ____________

(Circle all responses)

Qualitative Fit Test Protocol Administered

	[✓ Irritant Smoke]	**Bitrex**
Negative Pressure Mask(s)		
Type of Mask: full face **Manufacturer:** MSA **Model:** ultra twin **Size:** M	**[✓ Pass]/Fail**	**Pass/Fail**
Positive Pressure Mask(s)		
Type of Mask: ____ **Manufacturer:** ____ **Model:** ____ **Size:** ____	**Pass/Fail**	**Pass/Fail**

Comments:

Clean Shaven? [✓ YES] / NO **Spectacle kit required?** [✓ YES] / NO

I hereby certify that the above-named individual has been qualitatively fit tested, that all WESTON fit test procedures have been completed and that the above information reflects the results of the test.

Test Administrator Signature: AM Jamison

The fit test documented by this form is intended for use in conjunction with a fully implemented respiratory protection program as required by 29 CFR 1910.134. This fit test in no way certifies that the individual being fit tested will use the respirator as it is designed or according to manufacturer's directions. Proper use of respiratory protection is the responsibility of the individual and the individual's employer. The fit test has been conducted by an individual who has received instruction in fit testing and is authorized to perform the test. Should the individual being fit tested have a significant weight gain or loss, have facial or dental surgery, suffer injury that changes facial structure, or be assigned another brand and model of respirator, the designated respirator may not fit properly, the fit test is invalidated, and the person should be fit tested again before further respirator use. This fit test applies only to the respirator(s) size, model, and manufacturer indicated on the form.

RISKS AND LIABILITY

Any individual engaged in activities requiring the use of a respirator faces the risk of health impairment. Fit testing cannot completely eliminate risk and injuries that may occur despite successful completion of the fit test. Fit testing simply determines that at the time of the test, the particular respirator fit properly. This fit test has been administered in accordance with OSHA 29 CFR 1910.134 regulations. Roy F. Weston, Inc. does not make any warranties, either expressed or implied, concerning the proper use or function of respiratory protection used by the individual subsequent to this fit test. In no event shall Roy F. Weston, Inc. be liable for any loss of special, incidental, consequential, or other damages caused by subsequent use of respiratory protection.

Test Subject Signature: ____________

Revised 01/2000

AUGUSTINE SALAZAR, P.G.

Qualifications Summary

- Eight years of professional experience.
- Field Geologist/Engineer on subsurface investigations involving test borings and test pits for proposed construction sites. Backfill, compaction, proctor curves, moisture content, and grain size analysis.
- Field lead on several remedial investigation projects involving soil and groundwater sampling, geophysical surveys, and well installations.
- Data Manager for the EDC office involving work using "Paperless" sample collection systems.
- GIS Manager on small and large projects using ESRI ArcView 3.3 and 8.3.
- Extensive experience using Autodesk AutoCAD (up to 2005).
- Programming experience using Visual Basic and Visual Basic for Applications in all of the Microsoft Office products.
- Microsoft Access Database Management and programming, including TDMS, EnviroData, and standalone databases.
- GPS Mapping, Navigation, and Surveying using Sub-Meter GPS units.

Registration

Registered Professional Geologist in the State of Tennessee (2001)
Certified New Jersey Asbestos Safety Technician (#01031; 1999)
Troxler Nuclear Densometer Certification, Melick-Tully and Associates, PC (1997)

Fields of Competence

Data Manager for Edison Corporate Office, geological investigations, soil and groundwater sampling techniques, construction oversight, lead person on field investigation, drilling and monitoring well installation oversight, GIS analysis and manager, AutoCAD software, Database Management and Visual Basic Programming, PC and LAN support.

Credentials

M.S., Geological Engineering—University of Alaska - Fairbanks (1996)
B.S., Environmental Geology—University of Illinois - Urbana (1995)
16-Hour Mine Surface Hazard Training Course, MSHA, University of Alaska - Fairbanks (1996)
40-Hour Hazardous Waste Site Training Course, OSHA 29 CFR 1910.120(e)(3), WESTON (1998)
First Aid/CPR (1998)
New Jersey Department of Community Affairs (NJDCA) Asbestos Safety Technician (1999)
Site Health and Safety Coordinator Course, OSHA 29 CFR 1910.120(e)(4), (1999)

Employment History

1998-Present	WESTON
1997-1998	Melick-Tully and Associates, PC
1995-1996	University of Alaska - Fairbanks

Key Projects

Subsurface Investigation/Structural Fill and Compaction, New Brunswick, NJ, K. Hovnanian Enterprises, Geotechnical

Key Projects (Continued)

Field Engineer. Observed the performance of over 50 subsurface investigations involving soil borings and test pits for a proposed construction site. Recorded depths and conditions of all fill material, suitability of virgin material for structural loads, and the presence of any groundwater. Approved on-site or imported fill material for use on building foundations, and supervised backfill and compactions. Confirmed that optimum density was achieved using sand-cone or nuclear-density meters.

Audits, Cushman and Wakefield Compliance, Greenwich, CT, Auditor. Assisted in the performance of environmental compliance audits at a large office building complex that housed several different businesses. Scope of work included evaluation of regulatory compliance related to wetlands protection, wastewater discharge, solid and hazardous management, dam safety, and asbestos-containing material.

Remedial Investigation/Feasibility Study, Ellenburg Depot, NY, U.S. Army Corps of Engineers (USACE), Project Geoscientist. Performed site investigation to determine possible causes of trichlorethylene (TCE) contamination in the local groundwater. Conducted records research and aerial photography examination. A sampling and analysis plan was then established and implemented. The plan involved the sampling of more than 60 residential wells for four quarters. Organized and implemented on-site field activities including oversight of multiple subcontractors performing clearing and grubbing, utility mark-out, site survey and grid layout, and geophysical investigation involving electromagnetic techniques 31 and 61, and ground penetrating radar. Supervised the installation of Gore-Sorber® passive soil-gas screening survey. Installed bedrock monitoring wells, collected 400 feet of NX diameter core samples, and performed packer testing. Observed down-hole geophysical investigation involving caliper, temperature, resistivity, spontaneous potential (SP), and heat-pulse flow meter logs. This was followed by quarterly sampling. Coordinated on-site and off-site media relations activities. Assisted in writing the reports and prepared all AutoCAD drawings for each site activity.

Underground Storage Tank Removal/Closures, New York, NY, New York City School Construction Authority, Geoscientist. Performed oversight on several projects involving the emptying, cleaning, and removing or filling of underground storage tanks (USTs) at various public schools. Priorities were to maintain site safety, verify that removal or closure regulations were followed, and ensure quality of work.

Remedial Investigation/Feasibility Study (RI/FS), Gibbsboro, NJ, Confidential Client, Geoscientist/Data Manager. Performed oversight during the installation of several monitoring wells between 80 and 100 ft deep, and screening, logging, and sampling of soil samples as required by the New Jersey Technical Requirements for Site Remediation. Managed large analytical Microsoft Access database for the project using WESTON proprietary TDMS software. Performed maintenance using the TDMS software as well as advanced query building and Visual Basic for Applications. Linked database to ArcView GIS projects for site mapping and data presentation. Developed a "Paperless" field sample collection system that fully integrates Table PCs, GPS, digital photography, mobile printing, and both Weston-developed and

Key Projects (Continued)

third party software. System is designed to be integrated with the sites GIS and Database systems.

RI/FS, Pittsfield, MA, USACE, Team Member. Member of a field team installing monitoring wells, and conducting soil and wildlife sampling activities. Worked in close contact with members of the U.S. Environmental Protection Agency (EPA).

RI/FS, Edison, NJ, USACE, Database Administrator/GIS Manager. Maintain the project Envirodata database which stores over 10 years of analytical data including soil, water, and indoor air data. Developed a site-wide GIS for the project that fully integrated the analytical database with both Raster and Vector data. Performed database conversion from TDMS to Envirodata that required advance query building using SQL and Visual Basic for Applications.

RI/FS, Staten Island, NY, U.S. Postal Service, Database Manager. Designed and implemented a database interface for handheld PCs. Observations on potential environmental issues were to be collected in the field directly into the handheld devices. Data were later downloaded to a Microsoft Access database.

Pre-Design Investigation/Remedial Action, New Jersey, Confidential Client, Task Lead. Prepared for and implemented the pre-design investigation for soil remediation. Performed a subsurface investigation for the collection of geo-technical data and environmental sampling. Lead team tasked with polychlorinated biphenyl (PCB) delineation of 2,000 ft of off-site wetlands to determine volume estimations for removal. Mapped in AutoCAD and ArcView the horizontal and vertical extent of contamination using sub-meter Global Positioning System (GPS).

Compliance Audit, Bayonne, NJ, IMTT, Database Programmer. Created a Microsoft Access database with a user-friendly front-end interface using Visual Basic for Applications to be used by non-database experienced users. Worked directly with client at the facility to transfer all electronic and hard-copy data into the database. Customized and redesigned the interface at the client's request while implementing the database.

Compliance Audit, New Jersey, Confidential Client, Database Programmer. Created a Microsoft Access database with a user-friendly front-end interface using Visual Basic for Applications. Database is to be used for the input of daily air-monitoring test data by non-database trained users and to produce summary reports on demand.

Remedial Investigation, Clark, NJ, Karnak Corporation, Project Lead. Designed and implemented the remedial investigation based on a site investigation completed by a previous consultant. Work included soil and groundwater sampling, monitoring well installation, subcontractor management, and GPS mapping.

GPS Mapping and Surveying, Various Locations, Project Lead. Performed site survey work using Sub-Meter GPS units. Downloaded collection data from the GPS units and performed data correction. Uploaded predetermined locations in the office to the units in order to locate points in the field. Performed data conversion to and from software packages like ESRI ArcView,

Key Projects (Continued)

Autodesk AutoCAD, Microsoft Access, and Golden Software Surfer. Work with GPS units involved the use of proprietary data loggers as well as PDA/Tablet PC devices.

WESTON SOLUTIONS, INC.

THIS CERTIFIES THAT

AUGUSTINE SALAZAR

HAS COMPLETED THE

8-Hour Hazwoper Refresher Training Course

In accordance with 29 CFR 1910.120 (e)(8) completed on 8/30/2005 in Edison, NJ

Conrad W Lehr, CET

TRAINING MANAGER
Conrad W. Lehr, CET

WESTON SOLUTIONS
Restoring Resource Efficiency

[redacted]

INSTRUCTOR
Alanna Garrison Safety Officer

ROY F. WESTON, INC · 1400 WESTON WAY · WEST CHESTER, PA · 19380

04P-0755

WESTON SOLUTIONS, INC.

THIS CERTIFIES THAT

AUGUSTINE SALAZAR

HAS COMPLETED THE

Bloodborne Pathogens Training Course (Refresher)

In accordance with 29 CFR 1910.1030 completed on 8/30/2005 in Edison, NJ

Conrad W Lehr, CET

TRAINING MANAGER
Conrad W. Lehr, CET

WESTON SOLUTIONS
Restoring Resource Efficiency

[redacted]

INSTRUCTOR
Alanna Garrison Safety Officer

ROY F. WESTON, INC · 1400 WESTON WAY · WEST CHESTER, PA · 19380

04P-0755

Qualisys

Qualisys
4501 Circle 75 Parkway, Suite C-3250
Atlanta, GA 30339
Phone: 770-226-9944
Fax: 770-541-0293

Applicant/Employee:

Salazar, Augustine

ID: 014-85-1

Company: Weston Solutions, Inc.
1400 Weston Way
West Chester PA 19380

Exam Date: 09/07/2005

Clinic: Qualisys # Q

Location: EDC-Edison, NJ

INTERIM SURVEILLANCE CERTIFICATION

Please Note that areas in which he/she did not meet your criteria are explained on Page 2 of this report. Before instituting work restrictions based on these findings, you may wish to consider any accommodations that may be applicable. If further evaluations or testing are requested by Qualisys, appropriate clearances will be issued after receipt of the requested information. Any attached medical information should be treated as Confidential Medical Information in accordance with Section 102C of the Americans with Disabilities Act.

Examination Type: 42020-Clearance Extension Review
FITNESS FOR DUTY:

Based on a review of the interim history, the following clearances are extended:

☒ **May be assigned duties consistent with skills and training.**

☐ **Clearances may be given or added when further information is received (See page 2).**

THIS APPLICANT/EMPLOYEE IS CLEARED FOR:

RESPIRATORS (29 CFR 1910.134)	***OSHA (29 CFR) and DOT (49 CFR)***
☒ **Negative Pressure (NPR)**	☐ **DOT Clearance (391.41)**
☒ **Self-Contained (SCBA)**	☒ **Hazardous Waste (1910.120)**
☒ **Supplied or Powered Air (SAPR/PAPR)**	☐ **Asbestos (1910.1001 / 1926.1101)**

Previous Exam Clearances Expire On 08-23-06.

Evaluation Date: 9/9/05

E D Walker
Everett D. Walker, M.D.

All Immunizations For An Individual

09/28/05

Name	**Salazar, Augustine**		ID	**014851**
SSN	**143-80-2289**		DOB	**01/09/73**
Dept	**OU1141**			

Date	Type	Description	Status	
09/08/05	TD	Tetanus & Diphtheria Vaccinati	C	

WESTON FIT TEST RECORD

NAME (print) Augustine Salazar DATE 7/15/05

SOC. SECURITY NO. 143802289 YOUR WORK LOCATION EPC

NAME of TEST ADMINISTRATOR (print) Alanna Garrison

(Circle all responses)

Qualitative Fit Test Protocol Administered

[✓ Irritant Smoke] Bitrex

Negative Pressure Mask(s)

Type of Mask: full face
Manufacturer: MSA
Model: ultra-twin
Size: L

[✓ Pass]/Fail Pass/Fail

Positive Pressure Mask(s)

Type of Mask:
Manufacturer:
Model:
Size:

Pass/Fail Pass/Fail

Comments:

Clean Shaven? [✓ YES] / NO Spectacle kit required? [✓ YES] / NO

I hereby certify that the above-named individual has been qualitatively fit tested, that all WESTON fit test procedures have been completed and that the above information reflects the results of the test.

Test Administrator Signature: ann garrison

The fit test documented by this form is intended for use in conjunction with a fully implemented respiratory protection program as required by 29 CFR 1910.134. This fit test in no way certifies that the individual being fit tested will use the respirator as it is designed or according to manufacturer's directions. Proper use of respiratory protection is the responsibility of the individual and the individual's employer. The fit test has been conducted by an individual who has received instruction in fit testing and is authorized to perform the test. Should the individual being fit tested have a significant weight gain or loss, have facial or dental surgery, suffer injury that changes facial structure, or be assigned another brand and model of respirator, the designated respirator may not fit properly, the fit test is invalidated, and the person should be fit tested again before further respirator use. This fit test applies only to the respirator(s) size, model, and manufacturer indicated on the form.

RISKS AND LIABILITY

Any individual engaged in activities requiring the use of a respirator faces the risk of health impairment. Fit testing cannot completely eliminate risk and injuries that may occur despite successful completion of the fit test. Fit testing simply determines that at the time of the test, the particular respirator fit properly. This fit test has been administered in accordance with OSHA 29 CFR 1910.134 regulations. Roy F. Weston, Inc. does not make any warranties, either expressed or implied, concerning the proper use or function of respiratory protection used by the individual subsequent to this fit test. In no event shall Roy F. Weston, Inc. be liable for any loss of special, incidental, consequential, or other damages caused by subsequent use of respiratory protection.

Test Subject Signature:

Revised 01/2000

WESTON SOLUTIONS, INC.

THIS CERTIFIES THAT

AUGUSTINE SALAZAR

HAS COMPLETED THE

10-Hour Construction Safety and Health Training Course

In accordance with OSHA's Construction Outreach Training Program completed on 8/22/2002 in Edison, NJ

Conrad W Lehr, CET

TRAINING MANAGER
Conrad W. Lehr, CET

WESTON SOLUTIONS
Restoring Resource Efficiency

Conrad W Lehr, CET

INSTRUCTOR
Conrad W. Lehr CET

ROY F. WESTON, INC · 1400 WESTON WAY · WEST CHESTER, PA · 19380

THOMAS CATFISH BROWNELL

Qualifications Summary

- Five years of Professional Geological/Environmental Experience.
- Field/Site Geoscientist conduct field/site investigations and remediation design, including implementing of site/field HASP oversight of field staff and sub-contractors; conducting daily Health and Safety meetings, air monitoring and other required sampling, assessing site conditions, and maintaining site all required documentation.
- Field activities including: collection of multi-media environmental/hazardous waste samples and sample mgmt; field screening; site assessments; technical oversight; and field documentation
- Technical writing & research including: experience in designing developing and implementing, remedial technologies, sampling plans, work plans, reviewing analytical data, producing analytical summaries, reports, recommendations, data reduction tables, and site maps/GIS
- Student member of Geological Society of America; Association of Engineering and Environmental Geologists

Fields of Competence

Field/Site Investigation and Remediation Design, including: Implementing site HASP; oversight of field staff and sub-contractors; conducting daily health and safety meetings, air monitoring and other required sampling, assessing site conditions, and maintaining site all required documentation. Site assessment and field activities including: multi-media sampling i.e. soil, sediment, air, gas, groundwater, hazardous waste, hazardous materials and; phase I and phase II environmental/industrial site assessments; remediation; field screening, waste characterization, transportation and disposal; site evaluations, technical oversight. Drilling and installations of wells/soil borings perform operations and maintenance on groundwater treatment systems. Reviewing analytical data, producing analytical summaries, data reduction tables, and producing site maps/GIS.

Credentials

B.S. Geology, University of Port Harcourt, Nigeria

Certificate: Environmental Audits & Site Assessment, Rutgers, NJ

Masters of Science Candidate; Environmental Geology
(30 credits currently completed) – Rutgers University

40-hour OSHA Training, July 2001

Site Safety Supervisor, July 2001

Certificate: Waste Management Training Program, Langhorne, PA, August 2002

Certificate: DOT/HM-126F Program, Langhorne, PA, December 2002

Bloodborne Pathogens Training, 2004

Certificate Hazardous Wastes Disposal (DOT), Nov. 2002

First Aid Training, September, 2004

Employment History

02/04-Present Weston Solutions, Inc Edison, NJ

08/03-01/04 Onsite Env. Staffing/ Earth Tech, - King of PrussiaPA

03/03-07/03 Full Time Student

06/02-02/03 Foster Wheeler Environmental Corp., .Langhorne PA

02/01-05/02 Forensic Environmental Services, Exton, PA

12/98-12/00 New African Research Development Agency, Liberia

Key Projects Cond't

Freshkills Landfill, Staten Island, NY Weston Solutions, Inc./Department of Sanitation of New York ,Site Hydrogeoscientist

The Freshkills Landfill, located in Staten Island, New York, is the largest landfill in the United States of America. Wesotn Solutions, Inc. operated and maintained the water treatment plant and is responsible for the design and final capping of the landfill. I served as the onsite hydrogeologist on this project. I was primarily responsible for the measurement, operations and maintenance of all hydraulic monitoring wells onsite, including leak T's, peizometers . My duties also included the measurement and maintenance of the slurry (gabion) walls around the landfill using extension and incline meters. Duties further included the collection of totalizers readings and the measurement, sampling, and maintenance of all supplementary leachate collection chambers and drains, and ensuring that all effluent discharge was within permit range as stated by the contract and work plan. Hence, was responsible of the treatment and subsequent discharge of about 20,000,000 (twenty) million gallons of water per month. Also providing and maintaining a database of all figures from totalizers and laboratory results on specific conductance, chlorides and ammonia from all water bodies on site. Duties further included the preparation on monthly report, including figures, tables and context of all leachate generated during the month, the total effluent discharge to the local river, the status of the slurry walls. Etc. Developed system to record effluent data from SCADA model, and prepared monthly reports

GROUNDWATER SAMPLING PROGRAM

Kauffman and Minteer Site, Burlington County, New Jersey, (Assistant Geoscientist II)

Project include the sampling (low flow) of groundwater at the project site.

Former Raritan Arsenal Site, Edison, Middlesex County, New Jersey (Assistant Geoscientist II)

Prepared Scope of Work (SOW) for the drilling of eighty (80) soil boring locations, the collection of groundwater samples and the installation of fifteen (15) monitoring wells, so as to delineate the concentration of groundwater contamination plume around the Former Raritan Arsenal. During this event, with the use/aid of a Global Positioning System (GPS), located and identified all boring/well locations. Conducted soil boring via Geoprobe®, conducted soil logging and sampling and conducted groundwater investigation and sampling via 'check-valve. Drilled and installed completely monitoring wells via Hollow Stem Auger®.

DEFENSE SUPPLY CENTER

Former Defense Supply Center, Philadelphia, PA (Associate Geoscientist)

The Former Defense Supply Center in South Philadelphia, PA is one of the Department of Defense largest projects in Pennsylvania. This site is contaminated with DNAPL and LNAPL.

Key Projects Cond't

To map and delineate the extent of contamination and institute remedial measures, I was involved in the preparation of the site for these activities, beginning with the Phase I. Putting in monitoring and sentinel wells, collecting soil and groundwater samples, to establish the extent of the contamination plume. My duties, included amongst other things, supervising drillers, implementing site HASP, logging wells, wells measurements, sampling of groundwater and soil, preparing monthly reports. I had direct interaction with the client DoD, who maintained periodic inspections and visits to the site.

NAVAL WEAPONS STATION

Naval Weapons Station, Earle- Colts Neck New Jersey (Associate Geoscientist)

The Naval Weapon Station located in Earle, had a groundwater contamination of LNAPL, and groundwater remediation systems (Pump & Treat and SVE) Groundwater pump and Treatment, and a Soil Vapor Extraction System. My duties included the drilling, installation of monitoring wells and the excavation, trenching and piping of the wells to connect to the treatment systems. I conducted periodic operations and maintenance on the systems, including, the removal of carbon drums, changing of clay units, measurement of oil/water interface, collection of air samples via summa canisters, and monthly groundwater sampling events (low-flow).

SAINT-GOBAIN PERFORMANCE PLASTICS

Saint-Gobain Performance Plastics formerly Northern Performance Plastics, Wayne, New Jersey (Field Geoscientist)

The plastic production company had a contaminated groundwater Methyl tertiary buty lether (MTBE). In keeping with NJDEP regulations a remediation plan was approved for the installing of monitoring wells, air sparging system and soil vapor extraction to remediate the nature and extent of the groundwater contamination at this site. I was involved in the installation of the groundwater monitoring wells, the air spargin systems and the soil vapor extraction. I conducted the drilling of these boring via Geoprobe® and Hollow Stem Auger®, these wells were connected to the onsite groundwater treatment system and fitted with pneumatic pumps. I was responsible for the maintenance and operation of the treatment system; removing and changing out of expired carbon drums

EXXON-MOBIL vs. PEOPLE OF SAN FRANCISCO BAY AREA (Research Geoscientist)

The San Francisco Bay area had a severe groundwater contamination of hydrocarbon products, and as such the Exxon- Mobile gas stations, which were the largest of all filling station in the area were seen as being responsible of the contamination via leaking under ground storage tanks. I was involved in reviewing twenty-five (25) filling stations in the area data of UST leakages,

Key Projects Cond't

and review groundwater measurements and analytical results. Using Excel to prepare hydrographs and note any point of spike in the results, also reviewed remediation and site closure correspondence between the regulatory agencies and the filling stations, and prepared site chronologies- to support litigation. Similar duties and functions with, Exxon-Mobile vs. AMACO, Sturbridge, MA. Exxon-Mobile vs. Shell, Sturbridge, MA

ESSO-TUTU/EXXON – MOBIL

St. Thomas US Virgin Island (Field Geoscientist)

A one point two (1.2) miles radius area in the Esso-Tutu section of St. Thomas was contaminated with an Under Ground Storage Tank (UST) leakage for about thirty years, groundwater contamination remediation effort consisted of the construction of a bio-soil treatment and water treatment system. I was involved in the installation of monitoring wells at the project location, the excavation of 2000 cubic yards of contaminated soil. I was also involved in the supervision of the bio-soil treatment construction, with the covering of the entrenchment with geo-textile material (lineer), the seaming of the liner, the installation of irrigation pipes and sprinklers and the construction of a sump station for water.

NEW AFRICAN DEVELOPMENT RESEARCH DEVELOPMENT AGENCY

Agenda 21: Mining and Water Contamination: Oxfam-Liberia/UNDP/NARDA (Research Officer)

With the implementation of Agenda 21, the United Nations Development Program, with its implementing partners (Oxfam & NARDA) in Liberia, conducted an investigation into protection ground/surface water in Liberia from mining pollution, which is the number one cause of water contamination in the country. I was involved in the collection of water (ground/surface) samples, the installations of monitoring wells around mining concessions. Reviewed analytical results and noted high areas of concentration and location of direct point source of contamination.

RESEARCH PAPERS & PRESENTATIONS

- Effect of Urbanization on the Groundwater Quality of South Philadelphia-Hydrogeology- University of West Chester, PA/Rutgers University, Newark, NJ
- Biogeochemical Circles of Carbon, Nitrogen and Nutrients in the Earth Systems: Environmental Geochemistry- University of West Chester, PA
- Geophysical Techniques in Groundwater Contamination Investigation (Electrical Resistivity; Electromagnetic and Ground Penetrating Radar)- Electrical Environmental Geophysics – Rutgers University, NJ

Key Projects Cond't

- Groundwater Contaminants: Transportation and Remediation- Environmental Engineering- Rutgers University, NJ
- Water Development and Planning in the Delaware Valley- Regional Planning, West Chester University, PA
- International Environmental Policy- Rutgers University, NJ

CERTIFICATE OF TRAINING

This certificate awarded to

Thomas Brownell

For satisfactory participation in

OSHA 8 Hour Hazwoper Refresher
Online Course

Awarded on February 15, 2006

Eduwhere

eduwhere

WESTON SOLUTIONS, INC.

THIS CERTIFIES THAT

THOMAS BROWNELL

HAS COMPLETED THE

Bloodborne Pathogens Training Course (Refresher)

In accordance with 29 CFR 1910.1030 completed on 1/19/2005 in Edison, NJ

Conrad W Lehr, CET

TRAINING MANAGER
Conrad W. Lehr, CET

WESTON SOLUTIONS
Restoring Resource Efficiency

George M Crawford CIH

INSTRUCTOR
George M. Crawford CIH

ROY F. WESTON, INC · 1400 WESTON WAY · WEST CHESTER, PA · 19380

04P-0755

All Immunizations For An Individual

09/29/05

Name **Brownell, Thomas**
SSN **102-90-3242**
Dept **OU91141**

ID **017870**
DOB **01/04/74**

Date	Type	Description	Status	
09/16/05	TD	Tetanus & Diphtheria Vaccinati	C	

Qualisys
4501 Circle 75 Parkway, Suite C-3250
Atlanta, GA 30339
Phone: 770-226-9944
Fax: 770-541-0293

Applicant/Employee:

Brownell, Thomas

ID: 017870

Company: Weston Solutions, Inc.
1400 Weston Way
West Chester PA 19380

Exam Date: 02/16/2006

Clinic: Concentra Edison # 11086

Location: EDC-Edison, NJ

MEDICAL SURVEILLANCE CERTIFICATION

The above applicant/employee's medical examination has been reviewed to determine whether he/she meets the criteria contained in your protocol and job descriptions as supplied to Qualisys, and the regulations noted below.

Please Note that areas in which he/she did not meet your criteria are explained on Page 2 of this report. Before instituting work restrictions based on these findings, you may wish to consider any accommodations that may be applicable. If further evaluations or testing are requested by Qualisys, appropriate clearances will be issued after receipt of the requested information. Any attached medical information should be treated as Confidential Medical Information in accordance with Section 102C of the Americans with Disabilities Act.

Examination Type: 42009-Annual Hazardous/Respirator
FITNESS FOR DUTY:

☒ **No significant medical impairments noted. May be assigned duties consistent with skills and training.**

☐ **Clearances May Be Given or Added When Further Information Is Received (See Page 2).**

THIS APPLICANT/EMPLOYEE IS MEDICALLY CLEARED FOR:

RESPIRATORS (29 CFR 1910.134)

☒ **Negative Pressure (NPR)**

☒ **Self-Contained (SCBA)**

☒ **Supplied or Powered Air (SAPR/PAPR)**

OSHA (29 CFR) and DOT (49 CFR)

☐ **DOT Clearance (391.41)**

☒ **Hazardous Waste (1910.120)**

☐ **Asbestos (1910.1001 / 1926.1101)**

Evaluation Date: 2/28/06

Everett D. Walker, M.D.

12/01/2004

LAST NAME BROWNELL
FIRST NAME THOMAS

FIT TEST REPORT

Fit test information

ID NUMBER 017870
LAST NAME BROWNELL
FIRST NAME THOMAS
COMPANY WESTON
LOCATION EDC
NOTE

CUSTOM1
CUSTOM2
CUSTOM3
CUSTOM4

TEST DATE 12/01/2004
TEST TIME 09:47
DUE DATE 12/01/2005

PORTACOUNT S/N 16475
N95 COMPANION N

RESPIRATOR
MANUFACTURER MSA
MODEL ULTRATWIN
MASK STYLE FULL FACE
MASK SIZE MEDIUM
APPROVAL GMC
EFF. < 99% N

PROTOCOL OSHA 29CFR1910.134
PASS LEVEL 500

EXERCISE	**DURATION (SEC)**	**FIT FACTOR**	**PASS**
NORMAL BREATHING	60	12300	Y
DEEP BREATHING	60	7460	Y
HEAD SIDE TO SIDE	60	3860	Y
HEAD UP AND DOWN	60	6250	Y
TALKING	60	3590	Y
GRIMACE	15	Excl.	X
BEND AND TOUCH TOES	60	1210	Y
NORMAL BREATHING	60	18100	Y

OVERALL FF 3900 Y

FIT TEST OPERATOR am garrison DATE 12/1/04
A. GARRISON

NAME DATE 12/01/04
THOMAS BROWNELL

WESTON SOLUTIONS, INC.

THIS CERTIFIES THAT

THOMAS BROWNELL

HAS COMPLETED THE

30-Hour Construction Safety and Health Training Course

In accordance with OSHA Outreach Training Program (Includes Competent Person Instruction as indicated in 29 CFR 1926 Subparts C, E, M, P, & X) completed on 3/17/2005 in West Chester, PA

Conrad W Lehr, CET
TRAINING MANAGER
Conrad W. Lehr, CET

WESTON SOLUTIONS
Restoring Resource Efficiency

INSTRUCTOR
Theodore Blackburn CSP, CET

ROY F. WESTON, INC · 1400 WESTON WAY · WEST CHESTER, PA · 19380

04P-0755

Certificate of Completion

this is to certify that

Thomas C. Brownell

has successfully completed the

Professional Safety Training Services

Safety Training Program on the

8 Hour Supervisor/Management Course

(In Accordance With OSHA 29 CFR 1910.120)

on this 20th day of July, 2001

Calvin C. Williams Jr.

Instructor

S.S.#: **102-90-3242** PSTS Certificate #: **3544A2**

GILBERTO A. MELLO, P.G.

Qualifications Summary

- More than 10 years experience in academic research work in earth sciences and three years of professional experience in environmental consulting in New Jersey, New York and Pennsylvania.
- Performed marine geology and geophysics fieldwork using sub-bottom seismic profilers and echo sounders in both shallow and deep marine environment.
- Conducted field geology and subsurface investigations involving test borings and test pits.
- Field lead on several remedial investigation projects involving soil and groundwater sampling, geophysical survey and well installations.
- Performed human health risk assessment analysis in former industrial sites using BP-RISC (Risk Assessment Software for Cleanups) software.
- Performed fate and transport analysis of groundwater plume contaminants using *Quick_Domenico.xls* (PADEP) and chlorinated compounds using *Biochlor.xls* software.

Registration

Registered Professional Geologist in the States of Delaware (2001) and Pennsylvania (2002)

Fields of Competence

Geological investigations, soil and groundwater sampling techniques, lead person on field investigations, geophysical survey, test pitting, soil boring and monitoring well installation oversight, GIS, human health risk assessment and fate and transport software.

Credentials

M.S., Marine Geology—Federal University of Rio de Janeiro - Brazil (1988).
B.S., Oceanography—State University of Rio de Janeiro - Brazil (1982).
40-Hour Hazardous Waste Site Training Course, OSHA 29 CFR 1910.120(e)(3), TREBOR, Inc., (1992).
8-Hour Hazardous Waste Refresher Course, OSHA 29 CFR 1910.120(e)(8), WESTON (2003).
Certificate in GIS, GEOMATICS, Continuing Professional Education Program, Cook College, Rutgers University, NJ (2000).
Certificate in Methodology for Delineating Wetlands, Continuing Professional Education Program, Cook College, Rutgers University, NJ (2000).

Employment History

2003- Present:	WESTON.
2000-2002:	Pennoni Associates, Inc., New Jersey.
1989-2000:	Lamont-Doherty Earth Observatory of Columbia University, Palisades, New York.

Key Projects

Newark Basin Coring Project, Senior Research Assistant, Paleomagnetism Group. Participated in the drilling and data management of 22,000 feet rock core from the Triassic-Jurassic

Key Projects (Continued)

rift basin. Worked both in the field and in the laboratory with scientists and students from Lamont-Doherty Earth Observatory of Columbia University performing investigations on rock magnetism and magnetostratigraphy using cryogenic magnetometer, micro-magnetometer and rock susceptibility meter. Supervised and maintained laboratory equipment and coordinated rock sample preparation for various scientific analyses. Coordinated scientific research work with principal investigators and graduate students, collaborated in the writing of scientific articles.

Oceanographic and Geologic Investigations, Brazil Basin, Amazon Submarine Fan and Sulu Sea (Southeast Asia), Researcher and Team Member. Investigated submarine sediment deposits sedimentary processes using a variety of submarine geophysical instruments including 12 kHz and 3.5 kHz echo sounders, single-channel seismic profilers and towed magnetometer. Collected, described and analyzed sediment cores for deep-sea sedimentary processes, paleo-oceanographic and paleomagnetic investigations.

Environmental Site Assessments and Remedial Investigations, Philadelphia, PA, Department of Commerce, Land Recycling Program, Associate Geologist. Performed oversight during the installation of soil borings, monitoring wells and the excavation of test pits in former industrial sites. Activities included supervision of geophysical assessment using electromagnetic (EM) and ground-penetrating radar (GPR) techniques and the screening, logging and sampling of soils and groundwater, as required by the Pennsylvania Land Recycling and Environmental Remediation Standards Act (Act 2, 1995). Used groundwater analytical results for interpretation of natural attenuation of plume contaminants. Performed fate and transport analysis of contaminants using *Quick_Domenico* and *Biochlor* software, and human health risk assessment using *BP-RISC* v.4.0 software for indoor air quality affected by volatile organic compound-impacted groundwater. Prepared RI and SIA (Special Industrial Area) reports for submission and review by the PADEP.

Underground Storage Tank Removals, NJ, Associate Geologist. Performed oversight on projects involving the emptying, cleaning, and removing of underground storage tanks (USTs) at gas stations and private residences in New Jersey. Activities involved maintaining site safety, monitoring of confined space air, assistance to confined space entry and workmen safety, and verifying condition of USTs after removal.

Remedial Investigations, Jersey City Public Schools, Jersey City, NJ, Associate Geologist. Performed oversight during the installation of soil borings and monitoring wells in several Jersey City Public Schools. Activities included supervision of geophysical assessment using electromagnetic (EM) and ground-penetrating radar (GPR) techniques; the screening, logging and sampling of soils and groundwater as required by the New Jersey Technical Requirements for Site Remediation; and the use of pump-and-treat remedial method to remove light non-aqueous phase liquids from contaminated aquifers. Soil and groundwater laboratory results were tabulated and interpreted during preparation of RI reports for submission to the NJDEP.

Cidra Groundwater Plume Site, Cidra, Puerto Rico, Field Geologist. Collaborated with the WESTON Site Assessment Team (SAT) in the Regional Groundwater Plume Contamination project, which included the sampling of soil and groundwater in 12 industrial sites located in the

Key Projects (Continued)

town of Cidra, PR. Activities included supervision of Geoprobe drilling, logging and sampling of soils, sediments and groundwater, and use of geologic map for regional geology interpretations.

Groundwater Sampling and Remedial Investigation, New Jersey, Confidential Client, Associate Geoscientist. Prepared and implemented groundwater sampling plan for site plume delineation and remedial investigation. Lead drilling crew tasked with the delineation of groundwater impacted by chlorinated compounds using a Membrane Interface Probe (MIP). Used MIP and groundwater analytical data to map the horizontal and vertical extent of plume migration and plan the locations of groundwater sampling points. Modeled groundwater plume migration using software (*Biochlor.xls*) and used model results to select further sampling locations for plume delineation. Located sampling points in the field using sub-meter Global Positioning System (GPS).

Soil and Groundwater Sampling New Jersey, Confidential Client, Team Leader. Conducted soil sampling using hand auger and low-flow groundwater sampling using both submersible and peristaltic pumps. Coordinated sampling routine with field crew and laboratory project manager, prepared and delivered samples to laboratory according with standard sampling operation procedures.

Publications

1. Mello, G.A., Flood, R.D., Orsi, T.H. and Lowrie, A., 1992, Southern Brazil Basin: Sedimentary Processes and Features and Implications for Continental Rise Evolution, In: Geological Evolution of Atlantic Continental Rises, C.W. Poag and P. C de Graciansky (eds.); Van Nostrand-Reinhold, 378 p.
2. Schneider, D.A., Mello, G.A., 1996, A High-Resolution Marine Sedimentary Record of Geomagnetic Intensity During the Brunhes Chron; Earth and Planetary Sci. Letters, 144, 297-314.
3. Schneider, D.A., Mello, G.A. and Gee, J., 1994, Pleistocene Geomagnetic Intensity Variation From Sulu Sea Sediments; poster, EOS, Transactions, Am. Geoph. Union, 1994 fall meeting, vol. 75, no. 44, p. 193.
4. Schneider, D.A., Kent, D.V. and Mello, G.A., 1992, A Detailed Chronology of the Australasian Impact Event, the Brunhes-Matuyama Geomagnetic Polarity Reversal, and Global Climate Change, Earth Planet. Sci. Letters, 111, 395-405.
5. Damuth, J.E., Flood, R.D., Manley, P.L., Mello, G.A., Klaus, A. and Gamboa, L.A.P., 1989, Sedimentation Processes on the Continental Rise of Eastern South America: Trinidad (10°N) to Falkland Plateau (59°S); abstract, XXVII Intl. Geology Congress, Washington D.C., USA, vol.1, July 9-19, 1989, p. 1-365.

WESTON SOLUTIONS, INC.

THIS CERTIFIES THAT

GILBERTO MELLO

HAS COMPLETED THE

8-Hour Hazwoper Refresher Training Course

In accordance with 29 CFR 1910.120 (e)(8) completed on 1/23/2006 in Edison, NJ

Conrad W Lehr, CET

TRAINING MANAGER
Conrad W. Lehr, CET

WESTON SOLUTIONS
Restoring Resource Efficiency

INSTRUCTOR
Alanna Garrison Safety Officer

ROY F. WESTON, INC · 1400 WESTON WAY · WEST CHESTER, PA · 19380

04P-0755

WESTON SOLUTIONS, INC.

THIS CERTIFIES THAT

GILBERTO MELLO

HAS COMPLETED THE

Bloodborne Pathogens Training Course (Refresher)

In accordance with 29 CFR 1910.1030 completed on 1/23/2006 in Edison, NJ

Conrad W Lehr, CET

TRAINING MANAGER
Conrad W. Lehr, CET

WESTON SOLUTIONS
Restoring Resource Efficiency

INSTRUCTOR
Alanna Garrison Safety Officer

ROY F. WESTON, INC · 1400 WESTON WAY · WEST CHESTER, PA · 19380

04P-0755

Qualisys

Qualisys
4501 Circle 75 Parkway, Suite C-3250
Atlanta, GA 30339
Phone: 770-226-9944
Fax: 770-541-0293

Applicant/Employee:
Mello, Gilberto
ID: 017-48-8
Company: Weston Solutions, Inc.
1400 Weston Way
West Chester PA 19380

Exam Date: 12/28/2005
Clinic: Qualisys # Q
Location: EDC-Edison, NJ

INTERIM SURVEILLANCE CERTIFICATION

Please Note that areas in which he/she did not meet your criteria are explained on Page 2 of this report. Before instituting work restrictions based on these findings, you may wish to consider any accommodations that may be applicable. If further evaluations or testing are requested by Qualisys, appropriate clearances will be issued after receipt of the requested information. Any attached medical information should be treated as Confidential Medical Information in accordance with Section 102C of the Americans with Disabilities Act.

Examination Type: 42020-Clearance Extension Review
FITNESS FOR DUTY:

Based on a review of the interim history, the following clearances are extended:

☒ **May be assigned duties consistent with skills and training.**

☐ **Clearances may be given or added when further information is received (See page 2).**

THIS APPLICANT/EMPLOYEE IS CLEARED FOR:

RESPIRATORS (29 CFR 1910.134)

☒ **Negative Pressure (NPR)**

☒ **Self-Contained (SCBA)**

☒ **Supplied or Powered Air (SAPR/PAPR)**

OSHA (29 CFR) and DOT (49 CFR)

☐ **DOT Clearance (391.41)**

☒ **Hazardous Waste (1910.120)**

☐ **Asbestos (1910.1001 / 1926.1101)**

Previous Exam Clearances Expire On 01/18/2007.

Evaluation Date: 12/29/05

E D Walker
Everett D. Walker, M.D.

WESTON FIT TEST RECORD

NAME (print) GILBERTO MELLO **DATE** 12-29-05

SOC. SECURITY NO. 036-58-8745 **YOUR WORK LOCATION** EDC

NAME of TEST ADMINISTRATOR (print) ALANA GARRISON

(Circle all responses)

Qualitative Fit Test Protocol Administered

[✓ **Irritant Smoke**] **Bitrex**

Negative Pressure Mask(s)

Type of Mask: full face
Manufacturer: MSA
Model: ultra twin
Size: small

[✓ **Pass**]/**Fail** **Pass/Fail**

Positive Pressure Mask(s)

Type of Mask: ____
Manufacturer: ____
Model: ____
Size: ____

Pass/Fail **Pass/Fail**

Comments:

Clean Shaven? [✓ **YES**] / **NO** **Spectacle kit required?** **YES** / [✓ **NO**]

I hereby certify that the above-named individual has been qualitatively fit tested, that all WESTON fit test procedures have been completed and that the above information reflects the results of the test.

Test Administrator Signature: AM garrison

The fit test documented by this form is intended for use in conjunction with a fully implemented respiratory protection program as required by 29 CFR 1910.134. This fit test in no way certifies that the individual being fit tested will use the respirator as it is designed or according to manufacturer's directions. Proper use of respiratory protection is the responsibility of the individual and the individual's employer. The fit test has been conducted by an individual who has received instruction in fit testing and is authorized to perform the test. Should the individual being fit tested have a significant weight gain or loss, have facial or dental surgery, suffer injury that changes facial structure, or be assigned another brand and model of respirator, the designated respirator may not fit properly, the fit test is invalidated, and the person should be fit tested again before further respirator use. This fit test applies only to the respirator(s) size, model, and manufacturer indicated on the form.

RISKS AND LIABILITY

Any individual engaged in activities requiring the use of a respirator faces the risk of health impairment. Fit testing cannot completely eliminate risk and injuries that may occur despite successful completion of the fit test. Fit testing simply determines that at the time of the test, the particular respirator fit properly. This fit test has been administered in accordance with OSHA 29 CFR 1910.134 regulations. Roy F. Weston, Inc. does not make any warranties, either expressed or implied, concerning the proper use or function of respiratory protection used by the individual subsequent to this fit test. In no event shall Roy F. Weston, Inc. be liable for any loss of special, incidental, consequential, or other damages caused by subsequent use of respiratory protection.

Test Subject Signature: ____

Revised 01/2000

WESTON SOLUTIONS, INC.

THIS CERTIFIES THAT

GILBERTO MELLO

HAS COMPLETED THE

8-Hour Site Manager and Supervisor Training Course (SHSC)

In accordance with 29 CFR 1910.120(e)(4) completed on 5/21/2004 in Edison, NJ

Conrad W Lehr, CET

TRAINING MANAGER
Conrad W. Lehr, CET

WESTON SOLUTIONS
Restoring Resource Efficiency

George M Crawford CIH

INSTRUCTOR
George M. Crawford CIH

ROY F. WESTON, INC · 1400 WESTON WAY · WEST CHESTER, PA · 19380

04P-0755

WEN-JEI FANG, P.E., CHMM

Qualifications Summary

- Ten years of experience in hydrogeologic studies, engineering design and groundwater modeling; development of conceptual and numerical models; fate and transport modeling of contaminants in porous media, and computer programming for environmental data management.
- Ten years experience in hazardous site cleanup and remediation; site investigation; conceptual design of remedial systems; evaluation of remedial alternatives; feasibility studies and cost analysis.
- Eight years experience in environmental, health and safety assessment and audit; Phase I and II due diligence; operation performance evaluation; waste vendor requisition and audit.

Registration

Registered Professional Engineer in the State of Ohio
Certified Hazardous Material Manager (CHMM)
Certified, The Sandia National Laboratory Risk Assessment Methodology for Water Surety (RAM-W), WESTON (2002)

Fields of Competence

Environmental, heath and safety (EHS) compliance assessment and audit; hydrogeological investigation and studies; hazardous waste site cleanup and remediation; engineering design and evaluation of remedial alternatives; computer modeling of groundwater flow and solute transport; development of wellhead protection programs; hazardous waste management; site characterization with field testing and geophysical survey; field operation and health and safety management; Title V permitting and landfill gas sampling; landfill closure and post-closure management; landfill final cover inspection program; evaluation of landfill design; optimal design of groundwater monitoring systems.

Credentials

M.S., Environmental Engineering—University of Cincinnati (1992)
B.S., Agricultural Engineering—National Taiwan University (1986)
National Water Well Association, Technical Division

Employment History

1992-Present	WESTON
1989-1992	Groundwater Research Center, University of Cincinnati (GRCUC)
1988-1989	National Hydraulic Experimental Laboratory (Taiwan)

Key Projects

Landfill Closure and Post-Closure Monitoring and Maintenance Operation, New York City Department of Sanitation, New York, Professional Engineer, 2001 – 2002,

Key Projects (Continued)

Weston. Prepared the post-closure monitoring and maintenance operation manual, including final cover inspection, environmental monitoring program, leachate control, and landfill gas emission control. Provided consulting service on post-closure issues. Prepared final closures plan in compliance with NYSDEC requirements.

Soil Remediation, Army Corps of Engineers, New England/New York/Omaha Districts, New Jersey, Project Engineer, 2001-2002, Weston. Supported in on-site remediation activities, including providing technical review and comments on NJ regulations and rules. Identified remedial alternatives for site-wide and area-specific issues. Provided post-excavation sampling and monitoring of removal activities.

Waste Cleanup and Soil Bioremediation, Confidential Petrochemical Client (Chinese Petroleum Corporation), Taoyuan County, Taiwan, Project Manager, 2000-2001, Weston. Provided field investigation for site characterization and identified remedial alternatives for treatment of the contaminated soil. Performed field cleanup action by mobilizing to the site, separating the contaminated soil, and conducted on-site bioremediation to treat the contaminated soil to regulatory requirements within 90 days. Conducted daily field operation for site remediation and sampling for remedial progress monitoring. Responsible for final disposal of the treated soil and provided site closure plan to local EPA.

Remedial Investigation, Remedial Design and Corrective Actions, Confidential Petrochemical Client (Chinese Petroleum Corporation), Taiwan, Project Manager, 1999 – 2001, Weston. Conducted a remedial investigation to identify the plume, the source of the contamination, and provide remedial suggestions for corrective actions. Perform a site investigation, including soil gas surveying, soil and groundwater sampling, to identify extent and content of contamination at a petrochemical manufacturing facility. Performed leak detection using infrared technology to screen suspected underground pipelines to identify leaking locations. Environmental and health risk assessments were performed to determine cleanup levels for soil and groundwater contamination. Remedial alternatives were evaluated for short-term and long-term corrective actions. Developed an integrated Groundwater Information System (GIS) with groundwater modeling capability as part of the company's environmental system.

Floating Product Recovery Operation and Remediation System Operation, Confidential Petrochemical Client (Chinese Petroleum Corporation), Taiwan, Project Manager, 1998-2000, Weston. Provided basic and detailed design of the remedial systems, including soil vapor extraction (SVE) and an air sparging (AS) system for soil and groundwater remediation. Assisted the client in the system installation and provided system operation for oil recovery as well as system maintenance. A field pilot study was performed to evaluate the effectiveness of the SVE/AG system and to determine the optimal operation efficiency. In addition to the daily oil recovery operation, Assisted the client to develop a database to evaluate the recovery progress. The information was then used to revise the recovery system and improve the recovery efficiency.

Superfund Site Field Investigation, Cleanup and Remedial Design, Various Locations, USEPA, Project Leader/Manager, 1992 – 1997, Weston. Served in the Technical Assistance

Key Projects (Continued)

Team for USEPA Regions III and IV for project management on various Superfund sites. Responsible for site assessment, comprehensive sampling, investigation for groundwater and soil contamination, identification of extent and content of soil and groundwater contamination, monitoring well installation and groundwater monitoring, review and evaluation of available remedial technologies, engineering risk and cost analysis and management of cleanup operation, preparation of EPA official documents and reports.

Environmental, Health and Safety (EHS) Assessment and Audit, Confidential Client of Composite Materials (Sullar International), Multiple Locations, People's Republic of China, Task Manager, 1997-1998, Weston. Performed site assessment and EHS audits at several manufacturing facilities to identify recognized environmental conditions associated with the historical use of the property, the physical condition of the buildings and adjacent grounds, and present operational practices. Audits were performed to evaluate facility compliance status on EHS issues and provided findings with recommended corrective actions and measures. The assessment also included the identification of waste disposal providers used by the facility to evaluate potential liabilities associated with operations.

Environmental Assessment, Hebei Province, People's Republic of China, Confidential Manufacturing Client (Sullar International), Task Manager, 1996, Weston. Performed a site assessment of Langfang Poly Glass Fiber Co., Ltd. to identify recognized environmental conditions associated with the historical use of the property, the physical conditions associated with the historical use of property, the physical condition of the buildings and adjacent grounds, and present operational practices. The assessment also included identification of waste disposal practice at the facility to evaluate potential liabilities associated with operations.

Waste Management and Environmental Audit, Confidential Electronic Manufacturing Client (AMP), HsinChu County, Taiwan, Task Manager, 1998, Weston . Performed a facility assessment and audit of a manufacturing facility to identify recognized environmental conditions associated with the manufacturing operations, the physical conditions associated with the historical use of property, the physical condition of the buildings and adjacent grounds, and present operational practices. The assessment also included identification of waste disposal practice at the facility to evaluate potential liabilities associated with operations and provided recommendations of strategic plan for waste management.

Songjiang Wastewater Treatment Plant, City of Shanghai, People's Republic of China, Project Manager, 1997-2002, Weston. Provided consulting services for the project management and construction supervision of the Songjiang wastewater treatment plant. Project involved periodic site visits, review of subcontractor reports, preparation of monthly progress reports, monitoring of project costs, project progress and status tracking, quality control and a training program.

Groundwater Monitoring System Installation at Nuclear Power Plant, Taiwan, Taiwan Power Company, Project Manager, 1998-2001, Weston. Designed and installed an integrated monitoring system for monitoring release of radionuclides in the groundwater at Taiwan Power

Key Projects (Continued)

Company's Second Nuclear Power Plant in Taiwan. Developed a seawater intrusion model for the reactor building and a radionuclide transport model for the new radwaste storage building.

Remedial Investigation/Feasibility Study (RI/FS), New York, Confidential Client (University of Cincinnati), Project Research Assistant, 1990-1991, UC Groundwater Research Center. Hydrogeologic analysis for modeling of subsurface flow system and potential contaminant transport; numerical evaluation of remedial performance of existing trench system.

Wellhead Protection Program (WHPP), Ohio, The Miami Conservancy District, Project Research Assistant, 1990-1991, UC Groundwater Research Center. Groundwater and geologic data collection, interpretation, and evaluation to generate site conceptual model; analysis of interrelationship between surface and subsurface flow system with three-dimensional numerical model; optimal design of groundwater monitoring system; analysis and documentation of alternative flow paths of potential contaminants from potential pollution sites.

Remedial System Design, Texas, Confidential Client, Project Research Assistant, 1990, UC Groundwater Research Center. Evaluation of horizontal wells used as collection system in subsurface remedial actions; numerical analysis of feasible approaches to remediation of subsurface contamination; evaluation of performance of horizontal wells in artesian aquifer with two- and three-dimensional models.

Control System Design, Taiwan, Department of Natural Resources (DNR), Assistant Engineer, 1988-1989, Taiwan National Hydraulic Experimental Laboratory. Study and evaluation of the existing flood control programs in Taiwan; development of numerical models and computer programs for real-time rainfall runoff control in small watersheds. Development of basic hydrologic system model of northern Taiwan, including model calibration, sensitivity, and factor analysis; development of optimal integrating system for reservoir operation and flood control.

Recovery System Design, New Hampshire, Confidential Client, Project Research Assistant, 1990-1992, UC Groundwater Research Center. Development of computer-aided system to evaluate existing and potential subsurface contamination and to interface with a Geological Information System (GIS) to conduct site characterization. Hydrogeologic data collection and interpretation.

Removal Action Monitoring, Kentucky, Environmental Protection Agency (EPA), Associate Project Scientist, 1993-1994, Weston. On-site monitoring of cleanup activities for site safety and contractor performance. Responsibilities included soil sampling for cleanup confirmation and technical assistance on the removal action. Summarized and evaluated the analytical data to address cleanup efforts and maintained frequent contact with EPA.

Oil Spill Contamination, Kentucky, EPA, Associate Project Scientist, 1995, Weston. Site characterization and geophysical survey to identify locations of suspected subsurface oil wells; operation of field magnetic intensity indicator (magnetometer) and field conductivity/resistivity indicator (EM-31); data collection, analysis, and interpretation.

Publications and Presentations

Fang, W.J. 1991. "Groundwater Modeling for Wellhead Protection Program of Hamilton to New Baltimore Area, Ohio." Thirty-fifth Midwest Groundwater Conference.

Fang, W.J. 1989. "Study on the Estimating Methods of Design Runoff for Small Watersheds." Hydraulic Research Report (Taiwan) No. 97.

Fang, W.J. 1988. "Study on Planning of Operation Automation for the Operation of Shihmen Reservoir." Hydraulic Research Report (Taiwan) No. 87.

WESTON SOLUTIONS, INC.

THIS CERTIFIES THAT

WEN JEI FANG

HAS COMPLETED THE

8-Hour Hazwoper Refresher Training Course

In accordance with 29 CFR 1910.120 (e)(8) completed on 8/30/2005 in Edison, NJ

Conrad W Lehr, CET

TRAINING MANAGER
Conrad W. Lehr, CET

WESTON SOLUTIONS
Restoring Resource Efficiency

INSTRUCTOR
Alanna Garrison Safety Officer

ROY F. WESTON, INC · 1400 WESTON WAY · WEST CHESTER, PA · 19380

04P-0755

WESTON SOLUTIONS, INC.

THIS CERTIFIES THAT

WEN JEI FANG

HAS COMPLETED THE

Bloodborne Pathogens Training Course (Refresher)

In accordance with 29 CFR 1910.1030 completed on 8/30/2005 in Edison, NJ

Conrad W Lehr, CET

TRAINING MANAGER
Conrad W. Lehr, CET

WESTON SOLUTIONS
Restoring Resource Efficiency

INSTRUCTOR
Alanna Garrison Safety Officer

ROY F. WESTON, INC · 1400 WESTON WAY · WEST CHESTER, PA · 19380

04P-0755

Qualisys

Qualisys
4501 Circle 75 Parkway, Suite C-3250
Atlanta, GA 30339
Phone: 770-226-9944
Fax: 770-541-0293

Applicant/Employee:

Fang, WenJei

ID: 011398

Company: Weston Solutions, Inc.
1400 Weston Way
West Chester PA 19380

Exam Date: 12/14/2005

Clinic: Concentra Edison # 11086

Location: EDC-Edison, NJ

MEDICAL SURVEILLANCE CERTIFICATION

The above applicant/employee's medical examination has been reviewed to determine whether he/she meets the criteria contained in your protocol and job descriptions as supplied to Qualisys, and the regulations noted below.

Please Note that areas in which he/she did not meet your criteria are explained on Page 2 of this report. Before instituting work restrictions based on these findings, you may wish to consider any accommodations that may be applicable. If further evaluations or testing are requested by Qualisys, appropriate clearances will be issued after receipt of the requested information. Any attached medical information should be treated as Confidential Medical Information in accordance with Section 102C of the Americans with Disabilities Act.

Examination Type: 42009-Annual Hazardous/Respirator
FITNESS FOR DUTY:

☒ **No significant medical impairments noted. May be assigned duties consistent with skills and training.**

☐ **Clearances May Be Given or Added When Further Information Is Received (See Page 2).**

THIS APPLICANT/EMPLOYEE IS MEDICALLY CLEARED FOR:

RESPIRATORS (29 CFR 1910.134)	***OSHA (29 CFR) and DOT (49 CFR)***
☒ **Negative Pressure (NPR)**	☐ **DOT Clearance (391.41)**
☒ **Self-Contained (SCBA)**	☒ **Hazardous Waste (1910.120)**
☒ **Supplied or Powered Air (SAPR/PAPR)**	☐ **Asbestos (1910.1001 / 1926.1101)**

Evaluation Date: 12/30/05

E D Walker
Everett D. Walker, M.D.

WESTON FIT TEST RECORD

NAME (print) Wen Fang **DATE** 12/01/05

SOC. SECURITY NO. ______ **YOUR WORK LOCATION** EDC

NAME of TEST ADMINISTRATOR (print) A. Garrison

(Circle all responses)

Qualitative Fit Test Protocol Administered

[✓ **Irritant Smoke**] **Bitrex**

Negative Pressure Mask(s)

Type of Mask: full face
Manufacturer: MSA
Model: Ultra twin
Size: medium

Irritant Smoke: **[✓ Pass]/Fail** Bitrex: **Pass/Fail**

Positive Pressure Mask(s)

Type of Mask: ______
Manufacturer: ______
Model: ______
Size: ______

Irritant Smoke: **Pass/Fail** Bitrex: **Pass/Fail**

Comments:

Clean Shaven? [✓ YES] / NO **Spectacle kit required?** [✓ YES] / NO

I hereby certify that the above-named individual has been qualitatively fit tested, that all WESTON fit test procedures have been completed and that the above information reflects the results of the test.

Test Administrator Signature: Ann Garrison

The fit test documented by this form is intended for use in conjunction with a fully implemented respiratory protection program as required by 29 CFR 1910.134. This fit test in no way certifies that the individual being fit tested will use the respirator as it is designed or according to manufacturer's directions. Proper use of respiratory protection is the responsibility of the individual and the individual's employer. The fit test has been conducted by an individual who has received instruction in fit testing and is authorized to perform the test. Should the individual being fit tested have a significant weight gain or loss, have facial or dental surgery, suffer injury that changes facial structure, or be assigned another brand and model of respirator, the designated respirator may not fit properly, the fit test is invalidated, and the person should be fit tested again before further respirator use. This fit test applies only to the respirator(s) size, model, and manufacturer indicated on the form.

RISKS AND LIABILITY

Any individual engaged in activities requiring the use of a respirator faces the risk of health impairment. Fit testing cannot completely eliminate risk and injuries that may occur despite successful completion of the fit test. Fit testing simply determines that at the time of the test, the particular respirator fit properly. This fit test has been administered in accordance with OSHA 29 CFR 1910.134 regulations. Roy F. Weston, Inc. does not make any warranties, either expressed or implied, concerning the proper use or function of respiratory protection used by the individual subsequent to this fit test. In no event shall Roy F. Weston, Inc. be liable for any loss of special, incidental, consequential, or other damages caused by subsequent use of respiratory protection.

Test Subject Signature: ______

Revised 01/2000

WESTON SOLUTIONS, INC.

THIS CERTIFIES THAT

WEN JAI FANG

HAS COMPLETED THE

10-Hour Construction Safety and Health Training Course

In accordance with OSHA's Construction Outreach Training Program completed on 8/22/2002 in Edison, NJ

Conrad W Lehr, CET

TRAINING MANAGER
Conrad W. Lehr, CET

WESTON SOLUTIONS
Restoring Resource Efficiency

Conrad W Lehr, CET

INSTRUCTOR
Conrad W. Lehr CET

ROY F. WESTON, INC · 1400 WESTON WAY · WEST CHESTER, PA · 19380

04P-0755

WESTON SOLUTIONS, INC.

THIS CERTIFIES THAT

WEN JEI FANG

HAS COMPLETED THE

30-Hour Construction Safety and Health Training Course

In accordance with OSHA Outreach Training Program (Includes Competent Person Instruction as indicated in 29 CFR 1926 Subparts C, E, M, P, & X) completed on 3/17/2005 in West Chester, PA

Conrad W Lehr, CET
TRAINING MANAGER
Conrad W. Lehr, CET

WESTON
SOLUTIONS
Restoring Resource Efficiency

T.R. Blackburn CSP, CET
INSTRUCTOR
Theodore Blackburn CSP, CET

ROY F. WESTON, INC · 1400 WESTON WAY · WEST CHESTER, PA · 19380

04P-0755

JEFFREY LYNES

Qualifications Summary

- 2.5 years of experience with environmental consulting engineering firms
- Soil and sediment sampling experience
- Well gauging experience
- GPS collecting and correction experience
- Experience using ESRI ArcMap and ArcView
- Programming experience using Visual Basic and Visual Basic for Applications.
- Experience using Microsoft Access and other Microsoft Office components.
- Experience using the database program Enviro Data
- WinLog and WinFence experience

Credentials

B.S, Double Major in Environmental Science and Policy with a Concentration in Environmental Mapping and Data Management and a Second Major of Geography with a concentration in Geographical Information System and Computer Cartography. – University of Maryland – College Park (2004)

- Deans List Fall 2003
- Distinguished Deans List Spring 2004

First Aid and CPR Training, Medic First Aid, WESTON (2004)
40-Hour Hazardous Waste Site Training Course, OSHA 29 CFR 1910.120(e)(3), Emilcott Training Institute (2005)
8-Hour Hazardous Waste Refresher Course, OSHA 29 CFR 1910.120(e)(8), WESTON (2006)
8-Hour Managers and Supervisors Course (SHSC), OSHA 29 CFR 1910.120(e)(4), WESTON (2006)
OSHA 10 Hour Construction Safety Training, OSHA 29 CFR 1926, AdvanceOnline (2006)
Basic MGIS Certified Training Course-TerraSync, Keystone Precision Instruments (2005)

Employment History

2004-Present WESTON Solutions
2001-2003 Intern during summer and winter breaks while in college at Hatch Mott MacDonald (Formerly Killam Associates)
1999-2000 Interned at the Law Office of Decker & Magaw

Past Projects

New York City Department of Environmental Protection (NYCDEP) Water Tunnel Project, Millburn, NJ NYCDEP, Intern. Conversion of existing rock core and boring logs into electronic database files for NYCDEP Water Tunnel Project.

District of Columbia Water and Sewer Authority (DCWSA) Water System, DCWSA, Intern (in Millburn, NJ). Created an attributed WaterCAD drawing for part of the

Key Projects (Continued)

DCWSA water system from paper copies of the water system.

Bloomfield Water System, Township of Bloomfield, Intern (in Millburn, NJ). Created WaterCAD drawing for the Township of Bloomfield, New Jersey water system based on a paper copy of the township's water system.

Bay Avenue Project, Edison, NJ, Port Authority of New York and New Jersey, Assistant Geoscientist I. Created maps and managed database for the Port Authority of New York and New Jersey for the Corbin Street and Bay Avenue project. The maps and databases contained information regarding soil samples and well points and other parameters for each type of sample.

Raritan Arsenal Project, Edison, NJ, United States Army Corp of Engineers, Assistant Geoscientist I. Managed database containing information on all sample that were collected. This involved inputting new data received from labs and making corrections to any errors that were found in the database. Also created maps showing sample locations and proposed sample locations.

SAT EPA Region 2 Contract, U.S. Environmental Protection Agency, Assistant Geoscientist I. Created maps for a variety of different locations under the SAT EPA Region 2 Projects. Different maps were created for site location, 4-mile radius of site, and 15-mile pathway from the site location. The 4-mile radius maps contained Hazard Ranking System (HRS)-eligible wetlands, public supply wells, and wellhead protection areas where applicable. The 15-mile pathway maps included the 15-mile pathways, HRS-eligible wetlands, and frontage along the pathway. Along with these maps, calculations were done to find the total HRS-eligible wetlands within the 4-mile radius, and calculating the length of frontage along the 15-mile pathways. Tasks also included completing soil, sediment, and tap water samples, and collection of GPS points for multiple SAT sites.

Hurricane Katrina/Rita Hurricane Response, U.S. Environmental Protection Agency, Assistant Geoscientist I. Worked 8 weeks over three stints in Lake Charles, LA; New Orleans, LA; and Baton Rouge, LA. Tasks included data management, GIS, and drum recovery. Data management tasks included running queries and checking integrity of database. GIS tasks included map creation for the U.S. Coast Guard, U.S. Environmental Protection Agency, Louisiana Department of Environmental Quality, and for Weston field crews. Drum Recovery task involved accompanying field crews and checking contents of drums and marking them for pick-up.

Confidential Client, Gibbsboro, NJ, Assistant Geoscientist I. Created maps showing sample locations along with exceedances at each location. Maps were created for about 10 areas across the site. Other maps included creating and verifying lot and blocks locations for sampling areas. Field duties included collecting pore water, surface water, and soil samples.

Key Projects (Continued)

Hatco Project, Fords, New Jersey. Hatco Corporation, Assistant Geoscientist I. Completed well gauging event for about 20 on-site wells. Tasks included getting depth to water, depth to product, and the condition of the well for all wells on site. Completed bail-down test for six wells known to contain product. Bail-down test was used to characterize the type of product found in the well.

IMTT, Bayonne, NJ, IMTT, Assistant Geoscientist I. Collected around 70 surface soil samples in attempt to delineate extent of a spill that occurred on site. After receiving lab results, collected 30 more samples to further delineate the extent of the spill.

WESTON SOLUTIONS, INC.

THIS CERTIFIES THAT

JEFFREY LYNES

HAS COMPLETED THE

8-Hour Hazwoper Refresher Training Course

In accordance with 29 CFR 1910.120 (e)(8) completed on 1/23/2006 in Edison, NJ

Conrad W Lehr, CET

TRAINING MANAGER
Conrad W. Lehr, CET

WESTON SOLUTIONS
Restoring Resource Efficiency

INSTRUCTOR
Alanna Garrison Safety Officer

ROY F. WESTON, INC · 1400 WESTON WAY · WEST CHESTER, PA · 19380

04P-0755

WESTON SOLUTIONS, INC.

THIS CERTIFIES THAT

JEFFREY LYNES

HAS COMPLETED THE

Bloodborne Pathogens Training Course (Refresher)

In accordance with 29 CFR 1910.1030 completed on 1/23/2006 in Edison, NJ

Conrad W Lehr, CET

TRAINING MANAGER
Conrad W. Lehr, CET

WESTON SOLUTIONS
Restoring Resource Efficiency

INSTRUCTOR
Alanna Garrison Safety Officer

ROY F. WESTON, INC · 1400 WESTON WAY · WEST CHESTER, PA · 19380

04P-0755

Qualisys
4501 Circle 75 Parkway, Suite C-3250
Atlanta, GA 30339
Phone: 770-226-9944
Fax: 770-541-0293

Applicant/Employee:
Lynes, Jeffrey
ID: 018-22-0
Company: Weston Solutions, Inc.
1400 Weston Way
West Chester PA 19380

Exam Date: 07/25/2005
Clinic: Qualisys # Q
Location: EDC-Edison, NJ

INTERIM SURVEILLANCE CERTIFICATION

Please Note that areas in which he/she did not meet your criteria are explained on Page 2 of this report. Before instituting work restrictions based on these findings, you may wish to consider any accommodations that may be applicable. If further evaluations or testing are requested by Qualisys, appropriate clearances will be issued after receipt of the requested information. Any attached medical information should be treated as Confidential Medical Information in accordance with Section 102C of the Americans with Disabilities Act.

Examination Type: 42020-Clearance Extension Review
FITNESS FOR DUTY:

Based on a review of the interim history, the following clearances are extended:

☒ **May be assigned duties consistent with skills and training.**

☐ **Clearances may be given or added when further information is received (See page 2).**

THIS APPLICANT/EMPLOYEE IS CLEARED FOR:

RESPIRATORS (29 CFR 1910.134)	***OSHA (29 CFR) and DOT (49 CFR)***
☒ **Negative Pressure (NPR)**	☐ **DOT Clearance (391.41)**
☒ **Self-Contained (SCBA)**	☒ **Hazardous Waste (1910.120)**
☒ **Supplied or Powered Air (SAPR/PAPR)**	☐ **Asbestos (1910.1001 / 1926.1101)**

Previous Exam Clearances Expire On 8/10/2006.

Evaluation Date: 9/6/05

Everett D. Walker, M.D.

All Immunizations For An Individual

09/28/05

Name **Lynes, Jeffrey**
SSN **155-74-8952**
Dept **OU91141**

ID **018220**
DOB **03/30/82**

Date	Type	Description	Status	
09/09/05	TD	Tetanus & Diphtheria Vaccinati	C	

01/13/2005

LAST NAME LYNES
FIRST NAME JEFFREY

FIT TEST REPORT

Fit test information

ID NUMBER 8952
LAST NAME LYNES
FIRST NAME JEFFREY
COMPANY WESTON SOLUTIONS
LOCATION EDISON, NJ
NOTE

CUSTOM1
CUSTOM2
CUSTOM3
CUSTOM4

TEST DATE 01/13/2005
TEST TIME 12:25
DUE DATE 01/13/2006

PORTACOUNT S/N 15032
N95 COMPANION N

RESPIRATOR
MANUFACTURER MSA
MODEL ULTRATWIN
MASK STYLE FULLFACE
MASK SIZE LARGE
APPROVAL
EFF. < 99% N

PROTOCOL OSHA 29CFR1910.134
PASS LEVEL 500

EXERCISE	DURATION (SEC)	FIT FACTOR	PASS
NORMAL BREATHING	60	17100	Y
DEEP BREATHING	60	16200	Y
HEAD SIDE TO SIDE	60	21200	Y
HEAD UP AND DOWN	60	28300	Y
TALKING	60	4610	Y
GRIMACE	15	Excl.	X
BEND AND TOUCH TOES	60	29600	Y
NORMAL BREATHING	60	35500	Y
OVERALL FF		14500	Y

FIT TEST OPERATOR Mike Alves DATE 1/13/05
MIKE ALVES

NAME Jeff Lynes DATE 1/21/05
JEFFREY LYNES

AdvanceOnline Online Institute

Certificate of Completion

Jeffrey Lynes

has met the online course completion requirements for

OSHA 10-Hour Construction Safety

This student has completed the formal instruction for the 10-Hour Construction Outreach Program. Topics covered in this program were Introduction to OSHA, Electrical Safety, Excavation Safety, Fall Protection, Forklift Safety, Ladder Safety, Materials Handling, Permit-Required Confined Spaces, Personal Protective Equipment, and Scaffold Safety.

Instructor: Rick Gleason, MSPH, CIH, CSP

Certificate ID:	157210	**Date:**	22 April 2006
Continuing Education Units:	1	**Time Online:**	10:13

AdvanceOnline™

AdvanceOnline
5858 Westheimer Rd. Ste. 405
Houston, TX 77057
Toll Free: 1.866.4BRAINS
http://www.advanceonline.com

This education program meets the Criteria for Certification established by the Authorized Provider Commission of the International Association for Continuing Education and Training, 1200 19th St., NW, Suite 300, Washington, DC 20036-2401.

IACET

STEVE POULTNEY

Qualifications Summary

- Ten years of professional experience.
- AutoCAD trained to version 2004.
- NDT Level II trained.
- Proficient in automotive/ mechanical repair and upgrade.
- Digital imaging and manipulation (novice level).

Fields of Competence

AutoCAD software; general personal computer (PC) operations; X-ray/radiographic and other NDT fields; mechanical/ automotive skills; digital photography and manipulation.

Credentials

A.A.S., Mechanical Engineering Technology—Union County College (1993)
Management Leadership Skills for First Time Managers – Rockhurst University CEU (2001)
40-Hour Hazardous Waste Site Training Course, OSHA 29 CFR 1910.120(e)(3), Emilcott Associates (2003)
FAA Repairman License issued by E.F. Britten & Co., Inc. (#2559408; 1997, Inactive)

Employment History

2003-Present	WESTON
1995-2003	E.F. Britten & Co., Inc.
1994-1995	Branch Laboratories
1988-1994	E.F. Britten & Co., Inc.

Key Projects

Computer-Aided Design (CAD) Drawings, Edison, NJ, Multiple Clients, Draftsman. Prepared CAD drawings for confidential New Jersey industrial clients, the Port Authority of NY and NJ, U.S. Army Corps of Engineers (USACE), and others. Also performed editing and printing duties.

Global Positioning System (GPS) Way Points, Newark, NJ, Confidential Client, Technical Assistant. Responsible for tracking locations of wells to be drilled for sampling. Operated GPS software.

Raritan Arsenal Soil Gas Sampling and Indoor Air Sampling, Edison, NJ, U.S. Army Corps of Engineers, Field Technician. Performed subslab soil gas sampling using vapor probes and Summa canisters, and indoor air sampling via Summa canisters with 24-hour regulators.

Key Projects (Continued)

International Matex Tank Terminals (IMTT) Remediation and Groundwater Sampling, Bayonne, NJ, Field Technician. Performed field work including oversight of drilling of new wells and testing of an existing pump on site.

Polaris Street and Corbin Street Projects, Port Newark / Port Elizabeth, NJ, Port Authority of New York and New Jersey, Field Technician. Locating/mapping of waste piles and debris. Final mapping of all sample locations for soil borings and piezometers.

WESTON SOLUTIONS, INC.

THIS CERTIFIES THAT

STEVEN POULTNEY

HAS COMPLETED THE

8-Hour Hazwoper Refresher Training Course

In accordance with 29 CFR 1910.120 (e)(8) completed on 5/19/2005 in Edison, NJ

Conrad W Lehr, CET

TRAINING MANAGER
Conrad W. Lehr, CET

WESTON SOLUTIONS
Restoring Resource Efficiency

INSTRUCTOR
Alanna Garrison Safety Officer

ROY F. WESTON, INC · 1400 WESTON WAY · WEST CHESTER, PA · 19380

04P-0755

WESTON SOLUTIONS, INC.

THIS CERTIFIES THAT

STEVEN POULTNEY

HAS COMPLETED THE

Bloodborne Pathogens Training Course (Refresher)

In accordance with 29 CFR 1910.1030 completed on 5/19/2005 in Edison, NJ

Conrad W Lehr, CET

TRAINING MANAGER
Conrad W. Lehr, CET

WESTON SOLUTIONS
Restoring Resource Efficiency

INSTRUCTOR
Alanna Garrison Safety Officer

ROY F. WESTON, INC · 1400 WESTON WAY · WEST CHESTER, PA · 19380

04P-0755

Qualisys
4501 Circle 75 Parkway, Suite C-3250
Atlanta, GA 30339
Phone: 770-226-9944
Fax: 770-541-0293

Applicant/Employee:

Poultney, Steven

ID: 017573

Company: Weston Solutions, Inc.
1400 Weston Way
West Chester PA 19380

Exam Date: 02/22/2006

Clinic: Concentra Edison # 11086

Location: EDC-Edison, NJ

MEDICAL SURVEILLANCE CERTIFICATION

The above applicant/employee's medical examination has been reviewed to determine whether he/she meets the criteria contained in your protocol and job descriptions as supplied to Qualisys, and the regulations noted below.

Please Note that areas in which he/she did not meet your criteria are explained on Page 2 of this report. Before instituting work restrictions based on these findings, you may wish to consider any accommodations that may be applicable. If further evaluations or testing are requested by Qualisys, appropriate clearances will be issued after receipt of the requested information. Any attached medical information should be treated as Confidential Medical Information in accordance with Section 102C of the Americans with Disabilities Act.

Examination Type: 42002-Baseline Hazardous/Respirator
FITNESS FOR DUTY:

☒ **No significant medical impairments noted. May be assigned duties consistent with skills and training.**

☐ **Clearances May Be Given or Added When Further Information Is Received (See Page 2).**

THIS APPLICANT/EMPLOYEE IS MEDICALLY CLEARED FOR:

RESPIRATORS (29 CFR 1910.134)

☒ **Negative Pressure (NPR)**

☒ **Self-Contained (SCBA)**

☒ **Supplied or Powered Air (SAPR/PAPR)**

OSHA (29 CFR) and DOT (49 CFR)

☐ **DOT Clearance (391.41)**

☒ **Hazardous Waste (1910.120)**

☐ **Asbestos (1910.1001 / 1926.1101)**

Evaluation Date: 3/6/06

E D Walker
Everett D. Walker, M.D.

WESTON FIT TEST RECORD

NAME (print) Steve Poultney DATE 9/15/05

SOC. SECURITY NO. 147-52-9707 YOUR WORK LOCATION Edison

NAME of TEST ADMINISTRATOR (print) Alanna Garrison

(Circle all responses)

Qualitative Fit Test Protocol Administered

[✓ Irritant Smoke] Bitrex

Negative Pressure Mask(s)

Type of Mask: full face
Manufacturer: MSA
Model: ultra twin
Size: S

Irritant Smoke: [✓ Pass]/Fail
Bitrex: Pass/Fail

Positive Pressure Mask(s)

Type of Mask:
Manufacturer:
Model:
Size:

Irritant Smoke: Pass/Fail
Bitrex: Pass/Fail

Comments:

Clean Shaven? [✓ YES] / NO Spectacle kit required? YES / [✓ NO]

I hereby certify that the above-named individual has been qualitatively fit tested, that all WESTON fit test procedures have been completed and that the above information reflects the results of the test.

Test Administrator Signature: AM Garrison

The fit test documented by this form is intended for use in conjunction with a fully implemented respiratory protection program as required by 29 CFR 1910.134. This fit test in no way certifies that the individual being fit tested will use the respirator as it is designed or according to manufacturer's directions. Proper use of respiratory protection is the responsibility of the individual and the individual's employer. The fit test has been conducted by an individual who has received instruction in fit testing and is authorized to perform the test. Should the individual being fit tested have a significant weight gain or loss, have facial or dental surgery, suffer injury that changes facial structure, or be assigned another brand and model of respirator, the designated respirator may not fit properly, the fit test is invalidated, and the person should be fit tested again before further respirator use. This fit test applies only to the respirator(s) size, model, and manufacturer indicated on the form.

RISKS AND LIABILITY

Any individual engaged in activities requiring the use of a respirator faces the risk of health impairment. Fit testing cannot completely eliminate risk and injuries that may occur despite successful completion of the fit test. Fit testing simply determines that at the time of the test, the particular respirator fit properly. This fit test has been administered in accordance with OSHA 29 CFR 1910.134 regulations. Roy F. Weston, Inc. does not make any warranties, either expressed or implied, concerning the proper use or function of respiratory protection used by the individual subsequent to this fi test. In no event shall Roy F. Weston, Inc. be liable for any loss of special, incidental, consequential, or other damages caused by subsequent use of respiratory protection.

Test Subject Signature:

Revised 01/2000

ALANNA GARRISON

Qualifications Summary

- More than 4 years of technical and regulatory experience in both the private and public sectors.
- Experienced with NJ regulatory and permitting processes.
- NJDEP Subsurface Evaluator Certification License # 0025161
- Familiar with ISRA, NJPDES and various state regulatory programs.
- Natural resource damages experience
- UST investigation /closure experience
- Development of site investigations/sampling programs
- Safety Officer qualifications
- OSHA 10- and 30-hour Construction Safety Certified
- Oversight of EHS and Medical Monitoring Programs
- Overburden and bedrock well installation, soil boring installation, extended-duration pump testing, ground water sampling and soil sampling experience.
- Supervised large-scale Health and Safety monitoring activities and excavation work on multi-contractor sites.

Fields of Competence

NJDEP compliance, particularly under the ISRA program (including PA/SI, Remedial Investigations and Remedial Actions); design and implementation of soil and groundwater sampling programs; implementation of remedial technologies; UST sampling activities and removal; Health and Safety Officer applications; Health and Safety Plan design and writing; construction site Health and Safety oversight; field Health and Safety oversight; Phase I and Phase II investigations; subcontractor proposals, bidding and selection; client – subcontractor communications, negotiations and oversight; field supervision of soil/groundwater sampling teams and construction activities; PA, SI, RIWP, RIR, RAWP, RAR, CEA, Deed Notice and Progress Report writing and submittal; submittals of electronic deliverables for CEAs, Deed Notices, and EDDs.

Credentials

- B.S., Physical Geology and Studio Art – Allegheny College, PA (January 2000)
- Geological Society of America Professional Member
- Association of Women Geoscientists Professional Member
- Association of Engineering Geologists Professional Member
- 40-Hour Hazardous Waste Site Training Course, OSHA 29 CFR 1910.120, Emilcott Associates (2000)
- 8-Hour Hazardous Waste Refresher Course, OSHA 29 CFR 1910.120, NAETI (2000)
- 8-Hour Health and Safety Supervisor Training Course, OSHA 29 CFR 1910.120, Emilcott Associates (2001)
- 8-Hour Site Health and Safety Coordinator Training, Weston (2001)
- 8-Hour Hazardous Waste Refresher Course, OSHA 29 CFR 1910.120, Weston (2002, 2003, 2004)
- Hazardous Waste Management and Shipping for Environmental Professionals Course, eduwhere (2002)
- GIS and Electronic Data Deliverables Training Course, Rutgers (2000)
- Regulatory Training in Underground Storage Tanks, NJDEP (2002)
- Site Remediation Basics, Rutgers (2003)
- Natural Resource Damages, Rutgers (2004)

- Industrial Hygiene Summer Training Course, New Jersey Section of American Industrial Hygiene Association (2003)
- 10-Hour Construction Safety and Health Training Course, OSHA 29 CFR 1926, Weston (2002)
- 30-Hour Occupational Safety and Health Standards for the Construction Industry Course, Keene College OSHA Training Institute and Education Center (2002)

Employment History

2001-Present WESTON
2000-2001 Dan Raviv Associates, Inc.

Key Projects

Remedial Investigation (ISRA), New Jersey, Confidential Client, Technical Oversight. For a former paint manufacturing facility, conducted multiple soil and groundwater investigations to delineate and characterize on-site contamination. Included installation of multiple bedrock and overburden wells, characterization of subsurface materials, and bedrock coring. Acted as field lead, laboratory and subcontractor contact, and site Health and Safety supervisor.

Remedial Investigation (ISRA), New Jersey, Confidential Client, Technical Oversight. For a large paint manufacturing plant, implemented both soil and groundwater studies to characterize suspected PCB contamination on-site. Confirmed and delineated PCB presence in soils through implementation of a Geoprobe study. Conducted an ongoing groundwater study to confirm that low PCB levels in ground water were due to suspended sediments.

Remedial Investigation (ISRA), New Jersey, Confidential Client, Technical Oversight. For a metal bed component manufacturing facility, designed and conducted a groundwater investigation to determine possible effects on groundwater after a prior UST removal and backfill operation failed to remove all contaminated soils. Determined that all contamination was due to on-site sources and not the responsibility of a neighboring property with confirmed contamination. Managed the implementation of the ground water investigation, including client communications, laboratory analysis, monitoring well installation, lithologic logging and subcontractor oversight.

Health and Safety Oversight (NJDEP), New Jersey, Confidential Client, On-site Supervisor. For a multi-billion dollar combined residential and commercial development project in Hudson County, served as on-site Health and Safety supervisor during all excavation and trenching activities, building piling and conduit installations. Responsible for implementation of real-time air-monitoring for organic vapors to ensure worker safety. Included

Key Projects (Continued)

working in inclement conditions (temperatures below freezing and high sustained winds on a daily basis) on an active construction site.

Remedial Action Oversight (ISRA), New Jersey, Confidential Client, On-site Supervisor/Client Representative. For a large-scale asbestos removal project; included both Health and Safety supervision and multiple contractor supervision and communications in both English and Spanish. Oversight and inspection of outdoor excavation at an active trucking facility. Supervised removal of 10,000+ tons of non-friable asbestos soils, waste-class sampling, backfill, compaction and paving activities. High temperatures (100+ degrees) and humidity levels were encountered for a large portion of project implementation. Handled various clashes with protesting local union officials in an effective and non-confrontational manner.

Phase I Investigation (Tennessee DEC), Tennessee, Confidential Client, Technical Oversight. For a mid-sized automotive parts manufacturer in Dyer County; included on-site investigation and contact/communications with various local and Tennessee state officials, including the TDEC. Prepared and submitted a complete Phase I report to the client.

Phase I Investigation, New Jersey, Confidential Client, Technical Oversight. For a mid-sized retail automotive dealership to facilitate a property transaction; on-site investigation, including sampling excavated soils and a detailed site reconnaissance. Conference-call discussions with client (potential property purchaser) and current property owner representatives. Prepared a complete Phase I report for client.

Preliminary Assessment and Site Investigation (ISRA), New Jersey, Confidential Client, Technical Oversight. For a former paint manufacturing and development facility in Middlesex County; included research, investigation and preparation of a PA Report; a soil boring program; investigation of a contaminant release, and investigation/removal/replacement of on-site storm sewer system; and submittal of a SI Report. Included multi-contractor communications and oversight; multiple buried and overhead utilities in excavation area; and client-contractor relations. Served as on-site Health and Safety Coordinator and Project Lead. Actions were appreciated and praised by client. Received NFA for client operations without NJDEP comments, saved client over $30,000 in estimated costs.

Preliminary Assessment (ISRA), New Jersey, Confidential Client, Technical Oversight. For a former commercial printmaking facility; included research, investigation of a Preliminary Assessment Report; received NFA for client operations.

Key Projects (Continued)

Remedial Action Report (ISRA), New Jersey, Confidential Client, Report Preparation. For a manufacturer of high-end lubricants and oils; included data analysis and interpretation of a large, complex remedial action; preparation of a Remedial Investigation Report; received NFA for site soils with few easily-resolved NJDEP comments.

WESTON SOLUTIONS, INC.

THIS CERTIFIES THAT

ALANNA GARRISON

HAS COMPLETED THE

8-Hour Hazwoper Refresher Training Course

In accordance with 29 CFR 1910.120 (e)(8) completed on 2/10/2006 in West Chester, PA

Conrad W Lehr, CET

TRAINING MANAGER
Conrad W. Lehr, CET

WESTON SOLUTIONS
Restoring Resource Efficiency

Conrad W Lehr, CET

INSTRUCTOR
Conrad W. Lehr CET

ROY F. WESTON, INC · 1400 WESTON WAY · WEST CHESTER, PA · 19380

04P-0755

WESTON SOLUTIONS, INC.

THIS CERTIFIES THAT

ALANNA GARRISON

HAS COMPLETED THE

Bloodborne Pathogens Training Course (Refresher)

In accordance with 29 CFR 1910.1030 completed on 2/10/2006 in West Chester, PA

Conrad W Lehr, CET
TRAINING MANAGER
Conrad W. Lehr, CET

WESTON SOLUTIONS
Restoring Resource Efficiency

Conrad W Lehr, CET
INSTRUCTOR
Conrad W. Lehr CET

ROY F. WESTON, INC · 1400 WESTON WAY · WEST CHESTER, PA · 19380

04P-0755

Qualisys
4501 Circle 75 Parkway, Suite C-3250
Atlanta, GA 30339
Phone: 770-226-9944
Fax: 770-541-0293

Applicant/Employee:
Garrison-Kast, Alanna
ID: 017-11-5
Company: Weston Solutions, Inc.
1400 Weston Way
West Chester PA 19380

Exam Date: 10/27/2005
Clinic: Qualisys # Q
Location: EDC-Edison, NJ

INTERIM SURVEILLANCE CERTIFICATION

Please Note that areas in which he/she did not meet your criteria are explained on Page 2 of this report. Before instituting work restrictions based on these findings, you may wish to consider any accommodations that may be applicable. If further evaluations or testing are requested by Qualisys, appropriate clearances will be issued after receipt of the requested information. Any attached medical information should be treated as Confidential Medical Information in accordance with Section 102C of the Americans with Disabilities Act.

Examination Type: 42020-Clearance Extension Review
FITNESS FOR DUTY:

Based on a review of the interim history, the following clearances are extended:

☒ **May be assigned duties consistent with skills and training.**

☐ **Clearances may be given or added when further information is received (See page 2).**

THIS APPLICANT/EMPLOYEE IS CLEARED FOR:

RESPIRATORS (29 CFR 1910.134)	***OSHA (29 CFR) and DOT (49 CFR)***
☒ **Negative Pressure (NPR)**	☐ **DOT Clearance (391.41)**
☒ **Self-Contained (SCBA)**	☒ **Hazardous Waste (1910.120)**
☒ **Supplied or Powered Air (SAPR/PAPR)**	☐ **Asbestos (1910.1001 / 1926.1101)**

Previous Exam Clearances Expire On 11/05/2006.

Evaluation Date: 10/31/05

Everett D. Walker, M.D.

WESTON FIT TEST RECORD

NAME (print) Alanna Garrison **DATE** 01/25/06

SOC. SECURITY NO. ____________ **YOUR WORK LOCATION** EDC

NAME of TEST ADMINISTRATOR (print) Jill Asch

(Circle all responses)

Qualitative Fit Test Protocol Administered

[✓ **Irritant Smoke**] **Bitrex**

Negative Pressure Mask(s)

Type of Mask: full face
Manufacturer: MSA
Model: ultra twin
Size: Small

[✓ **Pass**]**/Fail** **Pass/Fail**

Positive Pressure Mask(s)

Type of Mask: ____________
Manufacturer: ____________
Model: ____________
Size: ____________

Pass/Fail **Pass/Fail**

Comments:

Clean Shaven? YES / NO **Spectacle kit required?** YES/[✓ NO]

I hereby certify that the above-named individual has been qualitatively fit tested, that all WESTON fit test procedures have been completed and that the above information reflects the results of the test.

Test Administrator Signature: Jill Asch, MPH, CIH

The fit test documented by this form is intended for use in conjunction with a fully implemented respiratory protection program as required by 29 CFR 1910.134. This fit test in no way certifies that the individual being fit tested will use the respirator as it is designed or according to manufacturer's directions. Proper use of respiratory protection is the responsibility of the individual and the individual's employer. The fit test has been conducted by an individual who has received instruction in fit testing and is authorized to perform the test. Should the individual being fit tested have a significant weight gain or loss, have facial or dental surgery, suffer injury that changes facial structure, or be assigned another brand and model of respirator, the designated respirator may not fit properly, the fit test is invalidated, and the person should be fit tested again before further respirator use. This fit test applies only to the respirator(s) size, model, and manufacturer indicated on the form.

RISKS AND LIABILITY

Any individual engaged in activities requiring the use of a respirator faces the risk of health impairment. Fit testing cannot completely eliminate risk and injuries that may occur despite successful completion of the fit test. Fit testing simply determines that at the time of the test, the particular respirator fit properly. This fit test has been administered in accordance with OSHA 29 CFR 1910.134 regulations. Roy F. Weston, Inc. does not make any warranties, either expressed or implied, concerning the proper use or function of respiratory protection used by the individual subsequent to this fit test. In no event shall Roy F. Weston, Inc. be liable for any loss of special, incidental, consequential, or other damages caused by subsequent use of respiratory protection.

Test Subject Signature: AM Garrison

Revised 01/2000

WESTON SOLUTIONS, INC.

THIS CERTIFIES THAT

ALANNA GARRISON

HAS COMPLETED THE

10-Hour Construction Safety and Health Training Course

In accordance with OSHA's Construction Outreach Training Program completed on 8/22/2002 in Edison, NJ

Conrad W Lehr, CET
TRAINING MANAGER
Conrad W. Lehr, CET

WESTON
SOLUTIONS
Restoring Resource Efficiency

Conrad W Lehr, CET
INSTRUCTOR
Conrad W. Lehr CET

ROY F. WESTON, INC · 1400 WESTON WAY · WEST CHESTER, PA · 19380

04P-0755

WESTON SOLUTIONS, INC.

THIS CERTIFIES THAT

ALANNA GARRISON

HAS COMPLETED THE

8-Hour Site Manager and Supervisor Training (SHSC)

completed on 5/1/2002 at Edison, NJ

Conrad W Lehr, CET
TRAINING MANAGER
Conrad W. Lehr, CET

WESTON SOLUTIONS
Restoring Resource Efficiency

George M Crawford CIH
INSTRUCTOR
George M. Crawford CIH

ROY F. WESTON, INC · 1400 WESTON WAY · WEST CHESTER, PA · 19380

04P-0755

JOSEPH R. KENDALL

Qualifications Summary

- More than 22 years of experience managing all U.S. Army Technical Escort Unit EOD personnel; expert in proper recovery, security, safety, and disposal techniques for all nuclear, biological, and chemical materials according to all military, local, state, and federal rules/regulations.
- Eastern Division 4th Quarter 1999 Safety Award for the emergency recovery work of over 3,100 UXO items at Westover Air Reserve Base.
- Awarded U.S. Meritorious Service Medal in 1998 for "unparalleled knowledge and expertise in the field of nuclear, chemical, biological weapons…" and the "…safe recovery, packaging, sampling, identification, and transportation of hazardous munitions and material."
- Senior Explosives Forensics Investigation Instructor for the FBI and Secret Service.
- Primary point of contact for all U.S. and foreign historical nuclear, biological, and chemical ordnance munitions.
- Worldwide chemical, biological, and radiological emergency response supervisor.
- Foreign munitions advisor for the State Department.
- Land mine warfare clearance supervisor.
- Improvised/special weapons disablement supervisor.
- Designed and implemented only Ordnance Recognition publication system authorized by USATEU, EOD personnel.

Registration

Certified Level I/II Munitions X-Ray Identification, U.S. Navy (1997), Update by U.S. Army Technical Escort Unit (2002)
Mine Field Clearance Certified, OJT (1988-1999)

Fields of Competence

Explosive ordnance disposal (EOD); remediation of unexploded conventional, chemical, biological, and nuclear ordnance; forensics and x-ray investigation; EPA Munitions Rule development; infrastructure analysis of historical munitions; EOD training program; chemical and biological analytical development; and EOD support for executive protection.

Credentials

A.A., Criminal Justice—Columbia College (1993)
B.S., Criminal Justice—Columbia College (In Progress)
Advanced EOD Management and Technology, U.S. Navy (1995)
EOD School, U.S. Navy (1984)
U.S. Army Advanced Non-Commissioned Officer EOD Course (ANCOC) (1997)
NATO/Joint Service EOD (IEDD) School (1996)
U.S. Army Ordnance, Technical Escort, J-5 Course (2002)
Master EOD Badge, U.S. Navy (1991)
Hazardous Materials Incident Response Operations, U.S. EPA (1994)
Toxic Live Agent Training, U.S. Army (1994)
Map Reading and Land Navigation, U.S. Army (1985)
HAZWOPER 40-Hour Training, U.S. Army (1987)
8-Hour Hazardous Waste Refresher Course, OSHA 29 CFR 1910.120(e)(8), WESTON (2002)
OSHA 8-Hour Confined Space Supervisor Training, U.S. Army (1991)
Site Health and Safety Coordinator Course, OSHA 29 CFR 1910.120(e)(4), WESTON (1999)
First Aid/CPR, WESTON (2002)
U.S. Marine Corps Basic Officer Candidate School (1986)
Environmental Sampling Workshop Course, U.S. Army (1994)
Biological Sampling Techniques, U.S. Army (1996)

Employment History

1998-Present	WESTON
1987-1998	U.S. Army
1977-1987	U.S. Marine Corps

Key Projects

Columbia Shuttle Recovery, Texas, U.S. Environmental Protection Agency (EPA) Region 6 START, Senior UXO Supervisor. Participated in recovery of explosive components of hazardous items dispersed over extremely widespread area.

Time-Critical and Non-Time-Critical UXO Clearance/Removal Actions, Aberdeen Proving Ground (APG), MD, Senior UXO Site Supervisor. Directed 20 projects involving identification, excavation, and removal of suspected hazardous materials. Recovered 20,000 conventional, 15 biological, and 25 chemical hazardous weapons, including a chemical rocket. Completed actions with zero-downtime.

Time-Critical UXO Avoidance/Geophysical Operation Action, Washington, DC, U.S. Army Corps of Engineers (USACE), Senior UXO Site Supervisor. Directed surveys at 11 Spring Valley FUDS sites for MAG and EM anomalies. Identified WWI and WWII-vintage items.

UXO Clearance/Removal Action, Westover Air Reserve Base, Chicopee, MA, USACE, Senior UXO Site Supervisor. Supervised 43 personnel for action involving suspected chemical and biological materials, as well as radioactive munitions and materials.

UXO Clearance/Removal Action, Keystone Ordnance Recovery Site, PA, UXO Site Supervisor. Directed 9 personnel for the Investigation of Raw-TNT Burial Sites for suspected UXO/OE.

D-Field Time-Critical Unexploded Ordnance (UXO) Removal Action, Aberdeen Proving Ground (APG), MD, Directorate of Safety, Health, and Environment (DSHE), UXO Manager. Currently identifying and removing munitions from disposal pits adjacent to the shoreline. Removed UXO items directly from the exposed banks of the Bush River and Chesapeake Bay at D-Field perimeter. Supervised and conducted underwater UXO removal in waist-deep waters. Managed and conducted subsurface ordnance location and removal actions to 6 inches along the beach. Completed shoreline ordnance removal within 24 hours, 24 hours ahead of schedule. Removed a total of 398 conventional UXO-related items and 8 chemical warfare material (CWM) items to date, recovering 2,600 pounds (lb) of UXO-related scrap metal. Project has increasingly grown in scope to include the upper reaches of D-Field. Supported DSHE at Restoration Advisory Board (RAB) meetings to address local concerns involving a suspected CWM injury sustained by another contractor's employee. Developed site safety and work plan for UXO excavation and evaluation.

J-Field Time-Critical Removal Action (TCRA), APG, MD, DSHE, UXO Manager. Conducted site walk with WESTON Project Manager and developed bid number for client within 24 hours. Proposed to DSHE that all site work be conducted in Modified Level D personal protective equipment (PPE), with respirators, reducing project costs. Prepared site personnel for immediate Level A PPE upgrade if conditions warranted. Dealt directly with APG safety representatives to ensure work was appropriately scoped.

Key Projects (continued)

Removed a total of 301 conventional UXO-related items, 1 biological, and 3 CWM items, recovering 119,140 lb of UXO-related scrap metal. Supervised all excavation activities once removal of munitions by hand had been completed. Modified an existing work plan from work previously conducted at J-Field, enabling rapid project startup to satisfy DSHE's time-critical requirements.

Managed site safety and environmental control for project duration. Deployed HAZMATCAD NO and individual chemical agent detectors (ICADs) on-site to detect potential chemical releases. Positioned an evacuation truck on-site. Conducted radioactivity monitoring prior to removal activities to locate potential radiological "hot spots." Completed multiphase UXO excavation and removal project in 7 weeks, 10 weeks ahead of schedule.

Supervised 6 UXO workers, 7 equipment operators, 7 removal personnel, and 14 ATC Associates, Inc. personnel. Completed 11,900 manhours in a hazardous UXO/CWM environment without an Occupational Safety and Health Administration (OSHA)-recordable or lost-time incident. Project was time-critical after an accidental fire exposed munitions within the tree line.

Building 2066 UXO Removal, APG, MD, DSHE, UXO Manager. Identified contents of crates on-site as thousands of mercury fulminate fuses. Developed UXO removal alternative after APG Technical Escort Unit (TEU) refused to move the fuses, fearing they were too unstable for transport. Alternative response addressed DSHE's concerns that TEU on-site detonation would result in unacceptable mercury contamination levels. Developed work plan within 4 days of site walk. Packaged fuses for transport to a safe work area. Developed an innovative disposal method after initial research indicated that disposal costs would be $2 million at a Canadian facility.

Packaged fuses at work site to eliminate accidental mercury release. Dismantled fuses and packed components in sawdust and antifreeze medium in 5-gallon buckets to reduce the likelihood of accidental detonation by 90%. Recorded packaging images on digital CDs for U.S. Department of Transportation (DOT) and U.S. disposal facility review. Received approval from both for transport and disposal of fuse components, acquiring the appropriate DOT classification to ship packaged fuses.

Proposed to DSHE that all site work be conducted in Modified Level D PPE, with respirators, reducing project costs. Supervised UXO specialist and Site Health and Safety Officer on-site. Limited staff to reduce accidental detonation consequences. Developed a separate UXO safety plan for UXO removal and disposal phase.

Westwood Cluster 2 Burn Pits, Time-Critical UXO/CWM Removal Action, APG, MD, DSHE, UXO, Safety, and Environmental Controls Manager. Supervised the excavation of three disposal pits. Completed UXO removal in 11 days, nearly 2 months ahead of schedule. Designed and supervised the installation of silt fences and cofferdams to prevent contaminants from seeping into the adjacent wetlands. Developed controls to protect active Amtrak lines 170 ft from site from the blast wave or fragmentation from a potential accidental explosion. Completed 990 manhours without an OSHA recordable or lost-time incident.

Key Projects (continued)

Immediate Response, National Missile Defense Site, Fort Greely, AK, USACE, Omaha District, Rapid Response, CWM Manager. Provided remote expertise to identify, isolate, and remove drums suspected to contain CWM. Communicated directly with site personnel, establishing procedures required to ensure site safety. Coordinated the transfer of samples to APG testing facilities to confirm drum contents. Made arrangements with Edgewood Chemical Biological Center (ECBC) on type, quantity, and shipping requirements. Facilitated sample turnaround within 24 hours (12 hours), reducing work delays on the $350 million federal project.

Dictated safety setup procedures, and Site Safety and Health Plan (SSHP) and Work Plan (WP) changes to WESTON personnel on a time-critical response request by the Commander within 4 hours. Dictated initial policy and procedures to the State of Alaska, U.S. Environmental Protection Agency (EPA), U.S. Army Corps of Engineers (USACE), and post personnel, while awaiting soil sampling analysis. Viewed photographs of items, work area, and soil composition to verbally instruct safety procedures and soil sampling; analysis results obtained within 12 hours. Soil sample analysis confirmed initial suspect materials, allowing initial SSHP and WP to be enforced with a work stoppage of less than 48 hours.

Ordnance Evaluation and Removal, Landfill Capping Project, Westover Air Reserve Base (ARB), MA, U.S. Army, UXO Manager. Evaluated landfill site after the unexpected discovery of a 250-lb bomb during grading and capping activities. Established procedures required to remove UXO items and continue capping work at the site within 4 days (24 hours following special request and arrival at Westover ARB). Met with EPA and USACE Huntsville representatives to explain and receive approval for UXO investigation actions required to permit work to continue. Established UXO work plan and safety procedures for site. Integrated UXO plan into construction plan to facilitate project completion on schedule despite 3-week work delay after ordnance was discovered. Immediately upgraded personnel to Level B upon the discovery of a stainless-steel drum containing acid. Identified drum contents and placed the drum into an overpack drum for subsequent disposal.

Emergency Response Remediation of Nuclear, Biological, and Chemical (NBC) Warfare Materials, Various Locations, APG, MD, U.S. Army Base Environmental Support Team (BEST). Performed multiple restoration assignments, including site investigations (SIs) and characterization, feasibility studies (FSs), Proposed Plan (PP) and Record of Decision (ROD) documentation, geophysical surveys, waste management, multimedia sampling and analysis, underground storage tank (UST) evaluations, UXO including identification test pit and removal operations, and ecological preservation studies at an Edgewood, MD, National Priorities List (NPL) site. Examples of UXO recovery work performed include the following:

- Recovered 1,351,973 lb of nonhazardous UXO-related scrap metal and debris items.
- Recovered 19,701 total hazardous UXO-related items: 19,664 conventional, 22 chemical, and 15 biological items.
- Taught courses as the senior instructor for the Technical Escort J-5 school, Live Agent Training at Ft. McClellan, and the Federal Bureau of Investigation (FBI)'s EOD section in forensics investigation.

Key Projects (continued)

- Senior instructor and supervisor for all EOD training at McKienley Range at Redstone Arsenal, AL.

Emergency Response Remediation of Nuclear, Biological, and Chemical Warfare Materials, Various Locations, U.S. Army, U.S. Department of Defense (DOD) Military Representative. Performed Level A through D operations in UXO, quality assurance/quality control (QA/QC), and disposal support to the Rapid Response missions. Provided emergency UXO remediation response including identification, test pits, removal and separation of hazardous UXO- and nonhazardous UXO-related materials and debris items, and disposal by detonation in accordance with all federal and state regulations at the following sites:

- Lowry Bombing and Gunnery Range, CO: Recovered 125,000 lb of nonhazardous UXO-related scrap metal and debris items, and disposal by detonation of 256 hazardous UXO-related items and 3 HD-Mustard Chemical Agent Identification Kit (CAIS) bottles.
- Mare Island, CA: Recovered 4,811,225 lb of nonhazardous UXO-related scrap metal and debris items, and disposal by detonation of 218,563 hazardous UXO-related items.
- Westover ARB, MA: Recovered 645,000 lb of nonhazardous UXO-related scrap metal and debris items, and disposal by detonation of 3,545 hazardous UXO-related items.
- Fort Devens, MA: Recovered 285,000 lb of nonhazardous UXO-related scrap metal and debris items, and disposal by detonation of 1,931 hazardous UXO-related items. Level A protection was used for the removal operation of unknown filled 55-gallon drums.

Emergency Response Remediation of Nuclear, Biological, and Chemical Warfare Materials, Various Locations, U.S. Army, DOD Army Military Representative. Focused on developing a historical munitions database system for the identification of pre-Civil War to the Vietnam era ordnance items. This project included policy development, allocation, review, and overall approval. Served as the primary EOD advisor to the Commander of the U.S. Army TEU on all matters pertaining to nuclear, biological, and chemical warfare materials recovered worldwide. As Senior EOD advisor, chaired the U.S. Army Armament, Munitions, and Chemical Command (AMCCOM) Munitions Assessment Review Board (MARB) on all reviews of NBC warfare materials.

Subject Matter Expert, Various Locations, U.S. Army TEU, Senior EOD Operations, Non-Commissioned Officer-in-Charge (NCOIC). Supervised all EOD nuclear, biological, and chemical incident operations worldwide. Responsible for identifying all standard and experimental ordnance items recovered. Primary point-of-contact (POC) for United States and foreign ordnance found or recovered worldwide. Enforced SSHPs, reviewed risk hazard analyses, and monitored contractor's safety program. Ensured all unit EOD procedures complied with federal, state, and local environmental laws.

- Managed, facilitated, and informed the Munitions Assessment Review Board (MARB), acting on behalf of the Commander for the U.S. Army TEU.
- Responsible for positive identification, safe handling, and disposal of all 6,311 nuclear,

Key Projects (continued)

biological, and chemical military munitions items destroyed.

- Designed, modified, and implemented an Ordnance Recognition publication set that allowed the U.S. Army TEU and EOD personnel to reduce the time spent identifying military ordnance from days to minutes. This publication system is the only one authorized for use by U.S. Army TEU EOD personnel.
- Designed, developed, and performed specialized emergency render-safe procedures (RSPs) for unknown military munitions and improvised explosive devices in emergency time-critical operations.
- Key advisor for redesign of the Sweep Frequency Acoustic Integration (SFAI) chemical/biological detection equipment.
- Key advisor for the implementation of updating the Idaho National Engineering and Environmental Laboratory (INEEL) Portable Isotopic Neutron Spectroscopy (PINS) equipment to identify V-Series nerve agents faster with a positive result.
- Key advisor for the design and operational phase of the Munitions Assessment and Processing System (MAPS) facility for the disassembly and decontamination of chemical, biological, and radiological explosively configured munitions in a controlled environment.
- Monitored testing and authorization phase of the Explosive Disassembly System (EDS), to be incorporated in the MAPS facility under an explosively controlled environment.
- Key advisor for the redesign of the 5-lb Emergency Explosive Portable Explosive Containment System (EEPECS) designed and used by the Federal Aviation Administration (FAA), now enabling chemical, biological, and radiological items to be contained without a release to the atmosphere.

Averaged more than 1,000 responses per year to explosive items requiring hands-on work for safe removal, with 67% of personnel in a temporary duty status. Worked with the Fort Irwin Special Group OP4 and instructed its engineers on explosives safety. Safely disposed of more than 80 metric tons of hazardous explosives, munitions, propellants, and training devices with no accidents or incidents in a 4-year period.

Senior Advanced/Basic Noncommissioned Officers Course (ANCOC/BNCOC) (Advanced Senior Leadership/Specialty Course), Redstone Arsenal, AL, U.S. Army, Instructor for all EOD Soldiers. Acted as the Post's primary ordnance identification historian. Taught additional courses as the Senior Instructor for the Technical Escort J-5 School, Live Agent Training at Ft. McClellan, and the FBI's EOD section in forensics investigation. Senior instructor and supervisor for all EOD training at McKinley Range at Redstone Arsenal, AL.

Explosives Safety, Fort Irwin, CA, U.S. Army, Safety Instructor. Averaged more than 1,000 responses per year to explosive items requiring hands-on work for safe removal, with 67% of personnel in a temporary duty status. Worked with the Fort Irwin Special Group OP4 and instructed its engineers on explosives safety. Safely disposed of more than 80 metric tons of

Key Projects (continued)

hazardous explosives, munitions, propellants, and training devices with no accidents or incidents in a 4-year period.

Munitions Instructions, Various Locations, U.S. Marine Corps, UXO Instructor. Gathered information on military munition items. Instructed both enlisted personnel and officers on military ordnance.

EUGENE F. "SONNY" RICHARDSON

Qualifications Summary

- Over 28 years of EOD/UXO experience including 24 years of active duty military impact/demolition range operations as an EOD Technician performing UXO search, detection, clearance identification, and disposal operations.
- Five years of civilian UXO industry experience.
- Master Explosive Ordnance Disposal Technician.
- UXO Operations Supervisor and Project Manager.
- Handling, removal, and disposal of all aspects of UXO and range residue.
- Working knowledge of the USACE, federal, and state laws and regulations.

Registration

UXO Certification, USACE Huntsville Center (No. 0653)
Certified Blaster in the State of Pennsylvania (2003)
Certified Master EOD Technician, U.S. Navy (1983)
Accredited AHERA Asbestos Inspector, EPA (2001)

Fields of Competence

Supervision of Hazardous, Toxic, Radioactive (HTRW)/ Unexploded Ordnance (UXO) projects; UXO Project Manager; high hazard remediation; Site Safety and Health Officer; UXO site excavation, removal, and disposal; range clearance and disposal operations; explosive ordnance disposal; chemicals; radioactive materials including nuclear weapons; explosives transportation and storage; and safety and environmental compliance.

Credentials

B.S., General Studies—Chaminade University of Honolulu (1988)
Graduate, Explosive Ordnance Disposal School, U.S. Navy, Indian Head, MD (1976)
40-Hour Hazardous Waste Operators Health and Safety Course, 29 CFR 1910.120(e)(3), K.I.S 2 (1994)
8-Hour Hazardous Waste Refresher Course, OSHA 29 CFR 1910.129(e)(8), UXB International (2003)
8-Hour Managers and Supervisor's Course, OSHA 29 CFR 1910.120(e)(8), UXB International (2003)
Confined Space Entry Rescue Training, OSHA 29 CFR 1910.146, UXB International (2001)
CPR/First Aid Training, WESTON (2001)
Qualified Mixed Gas Diver, U.S. Navy (1981)
Qualified Naval Free Fall and Static Line Parachutist, U.S. Navy (1983)
Advanced Access and Disablement – EOD, U.S. Navy (1984)
Dynamics of International Terrorism, U.S. Air Force (1991)
Qualified Free Fall and Static Line Parachute Jumpmaster, U.S. Navy (1984)
Qualified Mixed Gas Diver, U.S. Navy (1984)

Credentials (Continued)

Military Awards and Decorations:

Navy Achievement Medal (1980): Project monitor for Area Point Search System development, implementation, and service acceptance.

Navy Commendation Medal (1982): Diving operations response to a diving accident resulting in the saving of a life.

Employment History

2003-Present	WESTON
1999-2003	UXB International, Inc.
1998-1999	U.S. Navy, EOD Mobile Unit Two
1994-1998	U.S. Navy, Defense EOD School
1990-1994	U.S. Navy, EOD Mobile Unit Two Det. Mayport
1975-1990	Various Naval EOD Units

Key Projects

Range Residual Removal Program (R3), Various Locations (Fort Drum, NY/Moody AFB, GA/ Saylor Creek Bombing Range, Mountain Home, ID/Dare County Bombing Range, NC/ Falcon Bombing Range, Cash, OK; Poinsett Bombing Range, Shell AFB, SC/ Townson Bombing Range, Townson, GA/ Claiborne Bombing Range, Shreveport,LA), U. S. Air Force, Operations Director. As Operations Director, managed the location, ID, removal, and demilitarization of bombing range residue. Used innovative technology which consisted of hydraulic crushing machine designed specifically to demilitarize practice ordnance. Oversaw activities for 6 staff members.

Time Critical Removal Action, Buck Roe Beach, VA, USACE, Baltimore District, HTRW Contract, Project Manager. Oversee execution of deliverables, including UXO removal of deposited ordnance and disposal items on Buck Roe Beach, VA. Used geophysical mapping, not previously used at this site, prior to excavation of ordnance items consisting so far of 40mm and 76mm anti-aircraft projectiles.

Time Critical Removal Action, Quonset Point, RI, USACE, Omaha, Rapid Response Contract, UXO Project Manager. Created work plans, and worked onsite to institute removal of discovered cache of sea mines. Used excavator and hand access mine to determine if safe before removal. Disposal to be determined.

Remediation/Demilitarization Projects, Various Locations, Multiple Clients, Project Manager. Responsible for the development of numerous projects, managing all aspects of assigned projects from cradle to grave. Most recently involved in the R3 work on various military bombing ranges (U.S. Air Force, National Guard, and U.S. Air Force Reserve) throughout the United States. Projects include:

Key Projects (Continued)

- Management of UXO remediation contract for U.S. Army Corps of Engineers on a Time and Materials basis at the former Camp Maxey, Texas. Maintained a 16% profit line and received positive comments from all concerned.
- Management of UXO fixed price remediation contract at the former Fort Learnard, Alaska for the U.S. Army Corps of Engineers. Achieved a profit margin of 51.38% verses the 10% bid rate.
- Management of a UXO fixed price remediation contract at the Quantico Marine Corps Base for Whiting Turner Contracting Co. During this demanding and logistically difficult project, managed to achieve a profit margin of 27% verses the 10% bid rate.

Demilitarization Projects, Various Locations, Multiple Clients, Project Manager. Management of five demilitarization projects for various clients under a fixed price contract basis.

UXO Remediation, Loring Air Force Base, ME; Canoga Park, CA; Former Camp Maxie, TX; Houston, TX; Dutch Harbor, AK; U.S. Army Corps of Engineers (USACE) Huntsville, CONUS/OCONUS Contract, Life Cycle Project Manager. As a Life Cycle Project Manager, made resources available (personnel, facilities, and equipment); communicated and directed instructions from the client for scoping, negotiating, or modifying contract costs and schedules; managed all aspects of the project; coordinated all contract work; and oversaw task identification and resolutions. Was responsible for achieving the contractual cost and schedule targets. Coordinated the preparation of detailed work order specifications and schedules; identified the technical and site personnel to accomplish the work scope; assisted the UXO Quality Control Specialist and UXO Safety Officer in the implementation of project quality, and safety and health procedures; and directed personnel. Ensured that the proper project documentation is on-site, including personnel certifications, the approved work plan, and corporate memoranda and policies. Interfaced directly with the client's project manager, advised the client on progress, and promptly implemented client-authorized changes.

UXO and Ordnance Explosives Remediation, Former Nansemond Ammunition Depot, Virginia, USACE Huntsville, CONUS/OCONUS Contract, Senior UXO Supervisor. During this temporary assignment, planned, coordinated, and supervised all UXO and subcontractor activities; supervised multiple project teams that were performing UXO and UXO-related activities (clearance, land surveying, geophysics, reconnaissance and classification of UXO, pyrotechnic items, and military explosives and materials); located surface and subsurface UXO; destroyed UXO and OE by burning or detonation; and/or transported and stored UXO and explosive materials. Participated in the preparation of standard operating procedures for UXO operations; ensured compliance with Department of Defense, federal, state, and local statutes and codes; certified ammunitions, explosives, and dangerous articles and/or range scrap are ready for turn-in or disposal; identified potential problem areas and instituted corrective measures; assisted the Quality Control Specialist and UXO Safety Officer with quality and health and safety procedures; documented site conditions; prepared project reports; and identified efforts to accomplish the scope of work.

Key Projects (Continued)

Training/Readiness Programs, NAB Little Creek, Virginia, U.S. Navy, EOD Mobile Unit Two, Readiness, Training, and Diving Officer. Responsible for developing and implementing EOD Mobile Unit Two's training and readiness programs. This included the monitoring of real world contingencies, and tailoring training and readiness exercises to meet and exceed the requirements necessary to successfully succeed all possible military events.

Operation of United Kingdom's Explosive Ordnance Disposal School, Lodge Hill Camp, Chattenden, England, U.S. Navy, Defense EOD School, Second in Charge (2 I/C), Naval Training Officer, Diving Officer, and Instructor. As the Executive Officer (2 I/C), responsible for the day-to-day operation of the United Kingdom's Explosive Ordnance Disposal School including: personnel (military and civilian), discipline, budget, foreign training, and curriculum development. As Naval Training Officer, researched and devised and implemented new curriculum to meet the needs of the Royal Navy.

EOD Services, EOD Mobile Unit Two Det. Mayport, Mayport Naval Station, Florida, U.S. Navy, Officer in Charge and Naval Station Diving Officer. Responsible for Explosive Ordnance Disposal services for Mayport Naval Station and Naval ordnance items that are within the State of Florida. Assisted and augmented various federal agencies as required. Performed semi-annual range clearance at Pinecastle Bombing Range in Astor, Florida. Also responsible for all diving evolutions on Mayport Naval Station. Received numerous accolades and letters of appreciation for operational response, support, and assistance.

Ordnance Location/ID/Rendering Safe, Multiple Naval EOD Units, Various United States and International Locations, EOD Technician up to Readiness and Training Officer/Diving Officer. Performance of duties included, but were not limited to, the location, identification, and rendering safe of foreign and domestic surface, air dropped and underwater ordnance, remote or clandestine insertion by means of parachute or diving, and the rendering safe of improvised explosive devices. Employed on numerous high-risk evolutions ranging from Presidential Protection to EOD support for the 1984 Summer Olympic Games to Range Clearances in Somalia.

Qualisys
4501 Circle 75 Parkway, Suite C-3250
Atlanta, GA 30339
Phone: 770-226-9944
Fax: 770-541-0293

Applicant/Employee:
Richardson, Eugene
ID: 017646
Company: Weston Solutions, Inc.
1400 Weston Way
West Chester PA 19380

Exam Date: 08/16/2005
Clinic: Qualisys # Q
Location: STX - San Antonio, TX

MEDICAL SURVEILLANCE CERTIFICATION

The above applicant/employee's medical examination has been reviewed to determine whether he/she meets the criteria contained in your protocol and job descriptions as supplied to Qualisys, and the regulations noted below.

Please Note that areas in which he/she did not meet your criteria are explained on Page 2 of this report. Before instituting work restrictions based on these findings, you may wish to consider any accommodations that may be applicable. If further evaluations or testing are requested by Qualisys, appropriate clearances will be issued after receipt of the requested information. Any attached medical information should be treated as Confidential Medical Information in accordance with Section 102C of the Americans with Disabilities Act.

Examination Type: 42009-Annual Hazardous/Respirator
FITNESS FOR DUTY:

☒ **No significant medical impairments noted. May be assigned duties consistent with skills and training.**

☐ **Clearances May Be Given or Added When Further Information Is Received (See Page 2).**

THIS APPLICANT/EMPLOYEE IS MEDICALLY CLEARED FOR:

RESPIRATORS (29 CFR 1910.134)

☒ **Negative Pressure (NPR)**
☒ **Self-Contained (SCBA)**
☒ **Supplied or Powered Air (SAPR/PAPR)**

OSHA (29 CFR) and DOT (49 CFR)

☐ **DOT Clearance (391.41)**
☒ **Hazardous Waste (1910.120)**
☐ **Asbestos (1910.1001 / 1926.1101)**

Evaluation Date: 8/17/05

E D Walker
Everett D. Walker, M.D.

PROFESSIONAL PROFILE

CHARLES H. HEATON, JR., P.E.

Qualifications Summary

- More than 25 years of professional experience, including management, leadership, construction and engineering, communications, and contract administration.
- More than 14 years of experience managing and executing MMR projects.
- Extensive experience in the management of construction, hazardous and toxic waste (HTW), and unexploded ordnance (UXO) programs and projects.
- Experienced construction project engineer for construction projects at remote locations in Alaska.
- Lead negotiator for both government and industry on contract awards, claims, and modifications. Served as Contracting Officer's Representative (COR) and Contracting Officer (CO).
- Extensive government training in leadership, engineering, and contracting.
- OSHA 1910.120b Trained.

Registration

Registered Professional Engineer in the Commonwealth of Virginia (#022049; 1991)
Construction Quality Management for Contractors Certification, USACE (1989)

Fields of Competence

Development, management, and execution of construction, hazardous/toxic waste, and military munition response (MMR) (UXO/MEC) projects; development and execution of MEC Fixed Price Remediation with insurance projects; development and administration of military munitions response policy and training; construction contract administration, including contractor compliance; supervision of military construction projects, including design, material acquisition, training, budget, and safety.

Education

M.S., Civil Engineering—University of Alaska, Anchorage (1993)
B.S., Civil Engineering—Carnegie Mellon University (1984)

Credentials

Commander's Award for Civilian Service, USACE (1997)
Employee of the Year, Huntsville Center, USACE (1996)
Society of American Military Engineers
American Society of Civil Engineers
Proficient in the Use of Microsoft Project, Word, Excel, Power Point, Visio, Outlook, and Grantlun's HardDollar™ Estimating and Project Management Software Suite
40-Hour Hazardous Waste Site Training Course, OSHA 29 CFR 1910.120(e)(3), University of Alaska (1991)
8-Hour Hazardous Waste Refresher Course, OSHA 29 CFR 1910.120(e)(8), WESTON (2004)
Construction Contract Administration, USACE (1989)
Advanced Construction Contract Administration, USACE (1990)
Implementation of HTRW Laws and Regulations, USACE (1994)

Credentials (Continued)

Human Resources Management II, IV, USACE (1994, 1993)
Negotiating Construction Modifications, USACE (1990)
Conducting Site Assessments, EPA (1991Ordnance and Explosives Project Workshop, USACE (1993)
Recovered Chemical Warfare Materiel Workshop, USACE (1994)
District Officer's Introduction to Contracting, USACE (1990)
Risk Communication, EPA (1991)
All Terrain Vehicle Safety, ATV Safety Institute (1992)
U.S. Army Ordnance Safety Training, USACE (1993)
Federal Appropriations Law, USDA (1995)
Demining in the Aftermath of War, United Nations (1998)
Flood Emergency Response Training, USACE (1990)
Architect-Engineer Contracting, USACE (1991)
Government Contract Law, U.S. Air Force Institute of Technology (1991)

Employment History

2002-Present	WESTON
1997-2002	UXB International, Inc.
1992-1997	U.S. Army Corps of Engineers (Civilian)
1979-1992	U.S. Army (Active Duty)

Key Projects

Munitions and Explosives of Concern Fixed Price Remediation with Insurance Contract, Huntsville, AL, U.S. Army Corps of Engineers (USACE) Huntsville Center, Program Manager. Program Manager for a major multiple award remediation contract for MEC remediation at sites throughout the U.S. Responsibility includes proposal development, and oversight of the successful attainment of project objectives. MARC base contract value – up to $250M.

UXO Site Investigation and Clearance, Barry Goldwater Range, Luke AFB, AZ, U.S. Air Force, Air Education Training Command (AETC), Director, UXO Services. Developed a strategy and oversaw execution of two projects to investigate and clear UXO and munitions debris from an abandoned target complex and 68 miles of roadway (respectively) in a parcel of land being transferred to the Bureau of Land Management. Work involved the digital geophysical mapping of the site; data analysis; and investigation, removal, and destruction of UXO and munitions debris. Work was authorized by two AETC firm fixed price (FFP) task orders (totaling approximately $2.0M).

Nevada Test Site (NTS) Unexploded Ordnance (UXO) Clearance, Nevada, U.S. Department of Energy (Stoller-Navorro), Director, UXO Services. Developed a strategy and oversaw execution of a project to clear UXO and munitions debris from several corrective action sites. Work involved clearing and destroying recovered UXO, and providing digital geophysical maps of the final product. Work was authorized by a $863K cost reimbursable task order.

Key Projects (Continued)

Revision of MMRP Program Guidance Document, Huntsville, AL, USACE Huntsville Center, Program Manager. The project involves the revision of the USACE's Engineering Pamphlet 1110-1-18, which prescribes the methods and procedures USACE will use in the MMRP. The EP is being revised to conform to the CERCLA process and move the principal response from the Removal Process to the Remedial Process, and incorporate Munitions Constituent sampling, characterization, and remediation into the MMR Program. The work is authorized by a time and materials (T&M) task order for $200K under the USAESCH MMRP Prime Contract with Zapata Engineering.

Davis Range UXO Clearance and Support, Fort Richardson, AK, USACE Omaha District, Director, UXO Services. Developed and implemented a response strategy to clear UXO from an ongoing Range Construction Project that was halted by the discovery of UXO. Work involved both clearing UXO and providing construction support for the Range Construction Contractor, and was authorized by a $490.6K cost-plus-fixed-fee (CPFF) Rapid/Immediate Response contract task order.

Fort Devens UXO Support, Fort Devens, MA, USACE New England District, Director, UXO Services. Work involved the development of a Conceptual Site Model (CSM) for historical ranges on the former Fort Devens. The CSM was used in the development of site investigation (SI) sampling strategies. Work was authorized by a FFP task order.

Buckroe Beach UXO Time Critical Removal Action (TCRA), Buckroe, VA, USACE Baltimore District, Director, UXO Services. Developed and implemented a response strategy for a TCRA UXO clearance project to remove UXO from the public beach and in the water where the public might be exposed. Work involved public relations, regulator coordination, digital geophysical mapping of the site (land and water), data analysis, and removal of UXO. The work was authorized by a $430K FFP CENAB HTRW contract task order.

Former Tobyhanna Artillery Ranges UXO Time Critical Removal Action, Tobyhanna, PA, USACE Baltimore District, Director, UXO Services. Developed and implemented a response strategy for a TCRA UXO clearance project to remove UXO from 12 miles of roads and trials in the state game lands where the public is exposed. Work involved public relations, real estate survey, location, removal, and disposal of UXO. The work was authorized by a $784.4K FFP CENAB HTRW contract task order.

Former Tobyhanna Artillery Ranges UXO Remedial Investigation/Feasibility Study, Tobyhanna, PA, USACE Baltimore District, Project Manager. Managed the execution of a UXO RI/FS for the project site, covering approximately 20,000 acres of former artillery ranges. The project site is currently used for recreation, camping, hiking, and hunting; and is covered with numerous former artillery ranges. Work includes: public relations, preparing a conceptual site model, development of work and safety plans, executing a site investigation to quantify the types and extent of UXO and associated Munitions Constituent contamination, and development and approval of the EE/CA and Action Memorandum. The work was authorized by a series of CPFF Pennsylvania Department of Environmental Protection contract task orders with a total value of $3.5M.

Key Projects (Continued)

Seneca Army Depot UXO Removal, Seneca Army Depot, Seneca NY, USACE Omaha District, Director, UXO Services. Oversaw execution of a project to clear UXO and munitions debris from a former open burning grounds, and to investigate and remove UXO from a former open detonation grounds at the former Seneca Army Depot. Work involved public relations, digital geophysical mapping of the site, data analysis, and removal of UXO. Work was authorized by a series of task orders under the Rapid Response contract.

Chino Hills UXO Removal, Chino Hills, CA, URS Corporation (Aerojet General Corporation – Owner), Program Manager. Program Manager for a project that involved the removal of UXO and munitions debris from a former open detonation grounds. Soils were excavated and mechanically sifted to remove the items of concern. The site contained in excess of 500,000 cubic yards of soil requiring processing; to date, over 30,000 UXO items have been recovered. Work was authorized by a T&M contract with the URS Corporation.

Chino Hills Geophysical Quality Assurance, Chino Hills, CA, Aerojet General Corporation, Project Manager. Developed and implemented a geophysical quality assurance program for the client to verify the integrity of the UXO removal and quality control of the incumbent (Blackhawk) contractor's work. Prepared a QA plan and achieved approval with the CA DTSC, and executed a series of blind test grids to prove the incumbent's quality procedures. Provide continuing QA oversight as an independent third party for Aerojet. Work was authorized by a T&M contract with Aerojet Corporation for $62K.

Quonset Point Ordnance TCRA, Quonset Point, RI, USACE Omaha District, Director, UXO Services. Developed and implemented a response strategy to clear ordnance from an ongoing HTRW Remediation Project that was halted by the discovery of USN Ordnance items. Work involved finding, removing, and certifying the hazard of the ordnance items, and then providing disposal of the items in an expeditious manner to allow the remediation contractor to resume work. Work was authorized by a $272.1K CPFF Rapid/Immediate Response contract task order.

Environmental and Explosives Program, Various Locations, Multiple Clients, Project Manager. Specific duties included:

- Management of the USACE, Huntsville Center UXO Remediation – Continental U.S. (CONUS), Alaska, and Hawaii. Contract valued at $50M. Successfully completed 23 delivery orders (DOs) over a 3-year period, with an awarded value of $33,910,165.
- Corporate management of the U.S. Navy, Kaho'olawe Island Reserve, Hawaii. Restoration contract was valued at $280M. Successfully executed 53 task orders with an awarded value of $211,327,153.
- Tripled operational sector's sales for unexploded ordnance work in a 2-year period.
- Managed the execution of over 50 projects per year, with no explosive accidents or injuries, while meeting the clients' budgets, schedules, and quality requirements.

OE Center of Expertise (CX), Huntsville, AL, USACE, Manager. Activities were as follows:

Key Projects (Continued)

- Oversight of all USACE activities, execution of OE projects, development and administration of USACE OE policy, and OE training for USACE and other agencies.
- Supervised personnel in their work and duties, reviewed work products, and allocated resources to enable mission completion.
- Developed and managed the OE CX budget of approximately $10M per year.
- Supervised the proper execution of the entire USACE annual program for OE investigation and remediation, with a program budget of approximately $100M/year.
- Served as a principal member of the U.S. Department of Defense (DOD) Munitions Working Group. Worked with the U.S. Environmental Protection Agency (EPA) to draft and promulgate the Military Munitions Rule (an amendment to the Resource Conservation and Recovery Act [RCRA]) and DOD's Range Rule (a new environmental statute).
- Served on the core team of presenters for the nationwide public information forums concerning the Range Rule.

Development/Execution of an OE/UXO Environmental Design and Restoration Program, Huntsville, AL, USACE Huntsville Center, Program Manager. Supervised development and execution of an OE/UXO environmental design and restoration program with an annual budget in excess of $40M. Supervised multiple professional project managers; responsible for work assignments, training, counseling, and performance evaluations. Principal Advisor to the Director of the Center's Ordnance Team on matters concerning the OE program, execution, policy, and personnel matters. Marketed Huntsville Center services to USACE, Department of the Army installations, and other federal agencies. Gained the U.S. Marine Corps as a major new client for OE services (with an initial project budget of $2M).

Management of Multiple Environmental Restoration Projects, Various Locations, USACE Huntsville Center and Alaska District, Project Manager. Coordinated the project's scope, budget, schedule, and procurement of design and construction services. Conducted design reviews, and negotiated methods and levels of remediation with stakeholders.

Multiple Construction Contracts, Various Locations, USACE Alaska District, Project Engineer. Responsible for construction contract administration, modifications, and contractor compliance of multiple construction contracts. Project Engineer of record for building rehabilitation, building (dormitory, industrial, and recreational facilities) new construction, and communication facility refurbishment. As a Contracting Officer's Representative, reviewed and approved contract submittals and shop drawings.

Oversight of Material and Acquisition Programs, Fort Benning, GA, U.S. Army Infantry School, Project Engineer. Provided Infantry School input and oversight for over 100 material and acquisition programs for engineer equipment. Principal Engineer Advisor to the Army's Chief of Infantry, and liaison to industry.

Construction Projects Design, Fort Benning, GA, U.S. Army, Commander, Engineer Construction Company. Responsible for the training and morale of 164 construction,

Key Projects (Continued)

maintenance, and support soldiers and their families. Designed, programmed, and supervised construction projects. Supervised the maintenance and 100% accountability for approximately $40 million of construction equipment, trucks, and tools.

Various Military Leadership Activities, Various Unit Assignment Locations, U.S. Army, Platoon Leader/Executive Officer. Responsible for a variety of tasks including construction, maintenance, budgeting, planning, and safety.

√RD

ualisys

Qualisys
4501 Circle 75 Parkway, Suite C-3250
Atlanta, GA 30339
Phone: 770-226-9944
Fax: 770-541-0293

Applicant/Employee:

Heaton, Charles

ID: 017427

Company: Weston Solutions, Inc.
1400 Weston Way
West Chester PA 19380

Exam Date: 12/20/2005

Clinic: Occupational Health Center # 13729

Location: HHI

MEDICAL SURVEILLANCE CERTIFICATION

The above applicant/employee's medical examination has been reviewed to determine whether he/she meets the criteria contained in your protocol and job descriptions as supplied to Qualisys, and the regulations noted below.

> *Please Note that areas in which he/she did not meet your criteria are explained on Page 2 of this report. Before instituting work restrictions based on these findings, you may wish to consider any accommodations that may be applicable. If further evaluations or testing are requested by Qualisys, appropriate clearances will be issued after receipt of the requested information. Any attached medical information should be treated as Confidential Medical Information in accordance with Section 102C of the Americans with Disabilities Act.*

Examination Type: 42009-Annual Hazardous/Respirator

FITNESS FOR DUTY:

☒ **No significant medical impairments noted. May be assigned duties consistent with skills and training.**

☐ **Clearances May Be Given or Added When Further Information Is Received (See Page 2).**

THIS APPLICANT/EMPLOYEE IS MEDICALLY CLEARED FOR:

RESPIRATORS (29 CFR 1910.134)	***OSHA (29 CFR) and DOT (49 CFR)***
☒ **Negative Pressure (NPR)**	☐ **DOT Clearance (391.41)**
☒ **Self-Contained (SCBA)**	☒ **Hazardous Waste (1910.120)**
☒ **Supplied or Powered Air (SAPR/PAPR)**	☐ **Asbestos (1910.1001 / 1926.1101)**

Evaluation Date: 12/23/05

E D Walker MD
Everett D. Walker, M.D.

All Immunizations For An Individual

12/23/05

Name **Heaton, Charles**
SSN **497-52-7321**
Dept **OU1565**

ID **017427**
DOB **06/23/57**

Date	Type	Description	Status	
12/20/05	TD	Tetanus & Diphtheria Vaccinati	C	

FLD 43 BIOLOGICAL HAZARDS

Return to top

GENERAL

Response personnel may encounter biological hazards that include endemic hazards as follows: animals, insects, molds and fungus, and plants. In addition, hazardous waste site personnel may be exposed to etiological agents (infectious diseases).

Endemic Biological Hazards

An important part of health and safety planning and protection includes identifying and understanding local flora and fauna. Animals, insects, molds and fungus, and poisonous plants vary from site to site, their likelihood of causing harm also varies. Risk assessment and protection protocol determinations include knowing the how, where and what of hazardous types of plants, animals, insects, or molds and fungus.

Animals

Animals represent hazards because of their poisons or venoms, size and aggressiveness, diseases transmitted, or the insects they may carry.

Poisonous snakes are common across the U.S. The major variables are the likelihood of encounter and the snake likely to be encountered. Encounters with snakes may be caused by moving containers, reaching into holes, or just walking through high grass, swampy area, or rocks.

Key factors to working safely include being alert, using care when reaching into or moving containers, and being familiar with the habits and habitats of snakes in the vicinity of an incident or site.

A snake bite warrants medical attention after administration of proper first aid procedures. Landfills and abandoned buildings often attract stray or abandoned dogs. These animals often become pack oriented, very aggressive, and represent serious risk of harm to unprotected workers.

Workers entering abandoned buildings should be alert for such animals and avoid approaching them since this may provoke aggressive behavior. Avoidance and protection protocols include watching for animal dens, using good housekeeping, and using repellents.

Animal borne diseases include rabies (generally found in dogs, skunks, raccoons, bats, and foxes). Rabies varies from area to area as do the animals most likely to be rabid.

Questions and Answers about Rabies

Q. *What is Rabies and how is it transmitted?*

A. Rabies is a viral infection most often transmitted by bites of animals infected with the virus.

Q. *What animals are most likely to be infected?*

A. Skunks, raccoons, foxes, and bats are wild animals most frequently found to be infected with rabies; however, any warm blooded animal can be infected. Squirrels, groundhogs, horses, cattle, and rabbits have been tested positive for rabies. Dogs and cats are frequently rabies-infected if not immunized.

Q. How can you tell if an animal is rabies-infected?

A. Rabies infection is not always apparent. Signs to look for in wild animals are over aggressiveness or passivity. Spotting animals which are normally nocturnal (active at night) during the day and being able to approach them would be an example of unusual behavior. Finding a bat alive and on the ground is abnormal. The best precaution, however, is to observe wild animals from a safe distance, even if they are injured. Avoid dogs and cats that you do not know.

Q. What should you do if bitten by an animal you suspect is infected with rabies?

A. As quickly as possible, wash the bite area with soap and water, then disinfect with 70% alcohol and seek medical attention for follow-up.

Try to capture the animal. Avoid being bitten again or contacting the mouth or any saliva of the animal. Keep the animal under surveillance and call the police for assistance to capture it.

Have the animal tested. A dead animal believed to be infected should be preserved and tested for rabies. Health departments are often sources where information can be found regarding testing.

Q. Is there a cure for rabies?

A. Rabies is preventable, even after being bitten, if treatment is begun soon enough. Getting prompt medical attention and confirming the rabies infection of an animal are very important.

Rabies is not curable once symptoms or signs of rabies appear.

There are vaccines available that should be considered if a work assignment involves trapping animals likely to carry rabies. Medical consultants must be involved in decisions to immunize workers against rabies.

Hantavirus

WESTON employees or contractors/subcontractors conducting field work in areas where there is evidence of a rodent population should be aware of an increased level of concern regarding the transmission of "Hantavirus"-associated diseases. Hantavirus is associated with rodents, especially the deer mouse (*Peromyscus maniculanis*) as a primary reservoir host. Hantavirus has resulted in approximately a dozen deaths in the southwestern U.S. in recent months. The Center for Disease Control and Prevention (CDC) was concerned that the virus may have been distributed over a larger geographic area than originally suspected.

The Hantavirus can be transmitted by infected rodents through their saliva, urine, and feces. Human infection may occur when infected wastes are inhaled as a result of aerosols produced directly from the animals. They also may come from dried materials introduced into broken skin or onto mucous membranes. Infections in humans occur most in adults and are associated with activities that provide contact with infected rodents in rural/semirural areas.

Hantavirus symptoms begin with one or more flu-like symptoms (i.e., fever, muscle aches, headache, and/or cough) and progresses rapidly to severe lung disease. Early diagnosis and treatment are vital.
Personnel involved in work areas where rodents and the presence of the Hantavirus are known or suspected will need to take personal protective measures and to develop an expanded site safety plan. Field personnel involved in trapping or contacting rodents or their waste products will need to wear respirators with HEPA filters, eye protection, Tyvek coveralls, chemical resistant gloves, and disposable

boot covers. Strict decontamination requirements are needed. Double-bag, label, and require specific handling, packaging, shipping, storage, and analytical procedures to minimize the risks of exposure of collected mice. More detailed procedures can be obtained from Corporate Health and Safety.

For employees and facilities in rural/semirural areas: the following risk-reduction strategies are appropriate:

- Eliminate rodents and reduce availability of food sources and nesting sites used by rodents.
- Store trash/garbage in rodent-proof metal or thick plastic containers with tight lids.
- Cut all grass/underbrush in proximity to buildings.
- Prevent rodents from entering buildings (e.g., use steel wool, screen, etc., to eliminate openings).

Insects

Diseases that are spread by insects include the following: Rocky Mountain Spotted Fever or Lyme Disease (tick); Bubonic Plaque (fleas); Malaria, and Equine Encephalitis (mosquito).

Lyme Disease is the second most rapidly spreading disease in the U.S.

Lyme Disease

1. Facts

   - Definition:
     - Bacterial infection transmitted by the bite of a deer tick.
     - Prevalence (nationwide and other countries).
   - Three stages/sizes of deer ticks:
     - Larvae
     - Nymph
     - Adult
   - Tick season is May through October.
   - Not all ticks transmit Lyme Disease.
   - Ticks must be attached for several hours before Lyme Disease can be transmitted.
   - Being bitten by a tick does not mean you will get Lyme Disease.

2. Prevention and Protection:

   - Wear light-colored, tight-knit clothing.
   - Wear long pants and long-sleeved shirts.
   - Tuck pant legs into shoes or boots.
   - Wear a hat.
   - Use insect repellant containing DEET (follow manufacturer's instructions for use).

- Check yourself daily for ticks after being in grassy, wooded areas.
- Request information from the Health and Safety Medical Section regarding Lyme Disease.

3. If Bitten:

- Remove the tick immediately with fine-tipped tweezers. Grasp the tick as close to the skin as possible. Pull gently but firmly without twisting or crushing the tick.

- Wash your hands and dab the bite with an antiseptic.

- Save the tick in a jar in some alcohol. Label the jar with the date of the bite, the area where you picked up the tick, and the spot on your body where you were bitten.

- Monitor the bite for any signs of infection or rash.

4. Symptoms:

Early Signs (may vary from person to person)

- Expanding skin rash.

- Flu-like symptoms during summer or early fall that include the following:

  - Chills, fever, headache, swollen lymph nodes.
  - Stiff neck, aching joints, and muscles.
  - Fatigue.

- Later signs

  - Nervous system problems.
  - Heart problems.
  - Arthritis, especially in knees.

5. Upon Onset of Symptoms:

- Notify your Safety Officer (SO) and your supervisor.
- Submit incident report form.

A sensitivity reaction is one of the more dangerous and acute effects of insect bites or stings. It is the most common cause of fatalities from bites, particularly from bees, wasps, and spiders. Anaphylactic shock due to stings can lead to severe reactions in the circulatory, respiratory, and central nervous system. This can also result in death.

Site personnel must be questioned regarding their allergic reaction to insect bites. Anyone knowingly allergic should be required to carry and know how to use a response kit. First aid providers must be instructed on how to use the kit also. The kit must be inspected to ensure it is updated.

Administer first aid and observe persons reporting stings for signs of allergic reaction, such as unusual swelling, nausea, dizziness, and shock. At the first sign of these symptoms, take the individual to a medical facility for attention.

Fire ants are small red ants found primarily in southern and western states. There is some indication that if bitten a person may show allergic reaction in addition to severe pain.

It is important to note that animals may serve as hosts for insects which may spread diseases. Ticks carrying Lyme disease and Rocky Mountain spotted fever are found on grass, but may be carried on animals. Bubonic plague, which has emerged in parts of Colorado, New Mexico, and Arizona, is associated with fleas found on prairie dogs.

Other insect hazards include mosquitos and scorpions. There have been articles published recently indicating increases in encephalitis in Florida. Encephalitis is reportedly spread by mosquitos. The local health department should be contacted prior to working in areas where WESTON does not have good information about potential biological hazards.

Molds and Fungi

In addition to the previously discussed animal inhabitants of old buildings, which are often part of hazardous materials sites, birds often invade the buildings leaving behind debris and droppings which may contain molds and fungi in dry forms. Inhalation of this easily airborne dust can result in serious lung disease such as histoplasmosis.

There is a fungus that grows in soil indigenous to the San Joaquin Valley, parts of southern California, Arizona, and New Mexico. This organism can produce a disease called "Fever", "Valley Fever", or, technically, Coccidiomycosis when inhaled. Growing up in infected areas apparently provides a degree of resistance, which newcomers to the areas do not have.

Awareness of a hazard and the prudent use of respiratory protection are key factors to protection.

Plants

Toxic effects from plants are generally caused by ingestion of nuts, fruits, or leaves. Response personnel should also be concerned with plants like poison ivy, poison oak, and poison sumac, that produce adverse effects from direct contact. The usual effect is dermatitis or inflammation of the skin. The protective clothing and decontamination procedures used for chemicals also reduce the exposure risk from the plant toxins. Risk can be reduced by cleaning the skin thoroughly with soap and water after contact.

Biological Agents

Microbial hazards can occur when the materials handled by workers contain biological contamination. Biological contamination can be a problem if a chemical spill is mixed with sewage. Most bacteria that affects humans prefer a neutral environment (pH 7). Thus, an extremely acid or alkaline environment should destroy or inhibit bacterial growth. However, during neutralization, the environment could become more conducive to bacteria growth. In these situations, normal decontamination procedures will usually alleviate problems associated with worker contamination, although additional decontamination measures may be required for certain biological exposures.

Another source of infection for response workers is poor sanitation. Waterborne and foodborne diseases can be a problem if adequate precautions are not taken. Examples of waterborne diseases are cholera, typhoid fever, viral hepatitis, salmonellosis, bacillary dysentery, and amoebic dysentery. In an emergency response related to a disaster, water supplies may be affected. The source of water for a long-term remedial action is also important. In some locations, it may be necessary to transport water and food to the site. The food and water must be handled properly and come from an uncontaminated source.

The response team must also avoid creating any sanitation problems by making sure that properly designed lavatory facilities are available at the work site. Note that OSHA requires proper sanitation measures and potable water at temporary job sites.

Tetanus is another form of biological hazard encountered on hazardous materials sites. Workers must be careful to avoid puncture hazards, wear appropriate protective clothing, and have current tetanus inoculations.

Medical wastes may be encountered on hazardous materials sites. Agents may be present in this waste that are still capable of causing infection. Generally, procedures for protection against chemical hazards are sufficient to protect workers. Full enclosure chemical protective clothing may be appropriate since these organisms may have the ability to penetrate the skin. One additional precaution is to use bleach or some other equivalent agent capable of destroying the biological organisms in the decontamination procedure.

Bloodborne Pathogens

In July of 1992, OSHA issued a final Standard for Protection of Workers Potentially Exposed to Bloodborne Pathogens (29 CFR 1910.1030). This standard primarily involves medical and research personnel and their exposure to blood or blood-containing fluids infected with Bloodborne Pathogens. Bloodborne pathogens are pathogenic microorganisms that may be present in human blood and may cause disease in humans. These pathogens include, but are not limited to, Hepatitis B Virus (HBV) and Human Immunodeficiency Virus (HIV).

These HIV and HBV organisms could potentially be present in viable states on hazardous waste sites, with Hepatitis Virus being the more likely to survive in temperatures outside the body temperature ranges.

The other potential for exposure would be to workers who could be infected. The OSHA Standard specifically includes first aid providers among workers covered by this standard.

The basic concept of this Standard is that medical care first aid workers must take the **"universal precaution"** of assuming that any blood-containing fluid, person bleeding, or equipment contaminated with blood are infected with both viruses.
Protection involves use of personal protection such as gloves, gowns, eye shields, surgical masks, one-way valve rescue breather devices. It also involves training, disinfectants, and decontamination.

Workers expected to administer first aid must have a basic understanding of Bloodborne Pathogens in order to protect themselves effectively from any hazards.

Completion of safety plans requires identification of and assessment of risk of exposure to biological hazards. This program deals primarily with two forms of infection (Hepatitis B Virus (HBV) and Human Immunodeficiency Virus (HIV)), which are of concern to workers who may come in contact with bodily fluids associated with blood.

At a minimum, WESTON's Bloodborne Pathogen Exposure Control Plan will be on site and implemented for each project for first aid providers. If medical waste is anticipated on a site, WESTON's Employee Exposure Control Plan for Hazardous Waste Workers will be implemented.

Hepatitis B Virus

Definition — The term "hepatitis" simply means an inflammation of the liver. This condition can be caused by a wide variety of agents including medications, alcohol, toxic or poisonous substances, and infectious agents such a viruses. Hepatitis B, formerly known as "serum" hepatitis, is the only form of viral hepatitis that poses a significant occupational threat in the health care environment.

Symptoms — HBV is a disease that causes liver damage, the severity of which can range from mild or even inapparent to severe or fatal. Of the infected individuals, 6-10% will become HBV carriers. Carriers are at risk of developing chronic liver disease, including active hepatitis, cirrhosis and primary liver cancer. Carriers are also infectious to others (USHHS and NIOSH, 1989).

Sources of Infection — The Hepatitis B virus has been isolated from various body fluids including blood, semen, vaginal secretions, breast milk, saliva, and serous fluid. Within the health care setting, however, Hepatitis B is thought to be transmitted primarily by percutaneous or permucosal blood through needle sticks or the splashing of blood or blood-tinged body fluids into the eyes or mouth.

Risk — There is a direct relationship between the likelihood of occupational Hepatitis B infection and the frequency of blood contact. Health care professionals (surgeons, operating room-staff, pathologists, and emergency room personnel) exhibit a high incidence of exposure to Hepatitis B infection. The frequency of blood contact determines the level of risk.

Protective Measures

Protective measures against Hepatitis B infection include good hand washing practices, caution, and proper technique in the handling of the following potentially contaminated items: needles, sharps, supplies, and instruments. Excellent protective treatment for, or prevention of, this disease is afforded by both Hepatitis B immune globulin (HBIG) and by Hepatitis B vaccine. Either or both of these should be given as soon as possible after any documented exposure to blood (Johnson and Johnson, 1992).

Acquired Immunodeficiency Virus

Definition — Acquired Immunodeficiency Syndrome or AIDS is a severe viral disease recently introduced into the U.S. AIDS severely affects the immune system and is characterized by a multitude of opportunistic infections.

The AIDS virus is typical of most viruses. It cannot survive for any appreciable amount of time outside its human host. Its presence in the general environment is extremely unlikely and is limited to body secretions, primarily blood and semen. HIV is very susceptible to a large number of common household disinfectants since it is an unstable virus.

Symptoms — The outcome or manifestation of illness varies with individuals who are infected with the HIV virus.

Some infected persons have no disease symptoms and may not show outward signs of the disease for many years.

Some infected persons suffer less severe symptoms than do those with diagnosed cases of AIDS. These lesser symptoms may include loss of appetite, weight loss, fever, night sweats, skin rashes, diarrhea, tiredness, lack of resistance to infection, and swollen lymph nodes.

AIDS is the result of the progressive destruction of a persons immune system, which is the body's defense against disease. This destruction allows diseases to threaten the person's health and life that the body can normally fight. A particularly dangerous type of pneumonia and certain other infections often invade a body weakened by HIV. HIV can also attack the nervous system and cause damage to the brain. This may take years to develop. The symptoms may include memory loss, indifference, loss of coordination, partial paralysis, or mental disorder (USHHS and NIOSH, 1989).

Sources of Infection — The various modes by which HIV can be transmitted are well defined. Male homosexual and bisexual practices along with intravenous (IV) drug abuse are two major means of transmission.

Although not as efficient a mode of infection, heterosexual transmission does occur, and is increasing in incidence in several countries around the world. Comparatively, fewer individuals have contracted AIDS as the result of receiving contaminated blood or blood products. In addition, the advent of laboratory tests to detect infection with HIV has almost eliminated any possibility of this mode of transmission.

AIDS is not hereditary, however, it can be congenital. In fact, vertical transmission, which involves passage of the virus from an infected woman to her unborn child, is the third major means of transmission and accounts for the majority of cases of pediatric AIDS.

Risk — There is a common misconception that health care workers are at high risk for acquiring HIV infection through occupational exposure. Studies confirm the fact that this supposed risk is less than one percent. Of the thousands of health care workers in the U.S. and other parts of the world who have been exposed to HIV through patient contact, very few have developed subsequent infection. AIDS is a concern of immense proportion to the health care community. However, from an occupational health point of view there is little reason for undue concern regarding this virus.

Protective Measures

Simple use of good personal hygiene, common sense, and the barrier techniques which are discussed in this operating practice will help to prevent health care workers from contracting HIV infection or any other serious illness in the workplace (Johnson and Johnson, 1992).

ATTACHMENT M

BIOLOGICAL HAZARDS

ATTACHMENT N

SITE SPECIFIC HEALTH AND SAFETY PLAN

U.S. ARMY CORPS OF ENGINEERS

FORMER RARITAN ARSENAL PROJECT
SITE SAFETY AND HEALTH PLAN

New England Contract No. DACA41-92-D-8002/0015-0017
Baltimore Contract No. DACA31-00-D-0023/050, 056, and 069
Baltimore Contract No. W912DR-05-D-0022-0001

July 2006

Prepared for:

U.S. ARMY CORPS OF ENGINEERS

Prepared by:

WESTON SOLUTIONS, INC.
205 Campus Drive
Edison, New Jersey 08837

TABLE OF CONTENTS

TABLES

1.0 SITE DESCRIPTION

This Site Safety and Health Plan (SSHP) was prepared by Weston Solutions, Inc. (Weston®) for the former Raritan Arsenal located in Edison, New Jersey. This work is being performed under the following Contract Numbers for the U.S. Army Corps of Engineers (USACE), and U.S. Army Corps of Engineers, New England District (CENAE):

- New England Contract No. DACA41-92-D-8002/0015-0017
- Baltimore Contract No. DACA31-00-D-0023/050, 056, and 069
- Baltimore Contract No. W912DR-05-D-0022-0001

Additional criteria (e.g., programs, policies and site-specific information) required under 29 CFR 1910.120 (HAZWOPER) will be found within the Accident Prevention Plan (APP), in addition to Weston's Field Safety Officer Manual (required to be on site).

2.0 CONTAMINANT CHARACTERIZATION

The contaminants of concern at this site include: trichloroethylene (TCE), tetrachloroethylene (PCE), chloroform, polychlorinated biphenyls (PCBs), pesticides, polyaromatic hydrocarbons (PAHs), arsenic, lead, and other metals. These contaminants have been identified as required in all activity hazard analyses, included in the APP. Should additional contamination be identified, an amendment to the APP will be made and additional activity hazard analyses shall be performed.

Contaminant levels identified at the former Raritan Arsenal during previous investigations are presented in Table 2-1.

Table 2-1
Maximum Contaminant Levels

Parameter Name	Max Concentration	
2,4-DINITROTOLUENE (VOC)	7	mg/kg
2,6-DINITROTOLUENE (VOC)	2.8	mg/kg
4,4-DDE	4.3	mg/kg
4,4-DDT	23	mg/kg
ALDRIN	0.65	mg/kg
ANTHRACENE	180	mg/kg
AROCLOR-1248	9.6	mg/kg
AROCLOR-1260	8.9	mg/kg
ARSENIC	1310	mg/kg
BARIUM	1480	mg/kg
BENZENE	1.9	mg/kg
BENZO(A)ANTHRACENE	440	mg/kg
BENZO(A)PYRENE	370	mg/kg
BENZO(B)FLUORANTHENE	300	mg/kg
BENZO(K)FLUORANTHENE	360	mg/kg
BERYLLIUM	6.55	mg/kg
CHLOROFORM	3.5	mg/kg
CHRYSENE	420	mg/kg
COPPER, TOTAL	1340	mg/kg
DIBENZ(A,H)ANTHRACENE	87	mg/kg
DIELDRIN	0.27	mg/kg
FLUORANTHENE	760	mg/kg
INDENO(1,2,3-C,D)PYRENE	180	mg/kg
LEAD, TOTAL	9180	mg/kg
MERCURY, TOTAL	91.2	mg/kg
METHYLENE CHLORIDE	170	mg/kg
NICKEL, TOTAL	290	mg/kg
PENTACHLOROPHENOL	48	mg/kg
PYRENE	650	mg/kg
SELENIUM, TOTAL	65.6	mg/kg
TETRACHLOROETHYLENE	900	mg/kg
THALLIUM	6.39	mg/kg
TRICHLOROETHYLENE	7000	mg/kg
VANADIUM	208	mg/kg
VINYL CHLORIDE	9.6	mg/kg
XYLENES (TOTAL)	190	mg/kg
ZINC, TOTAL	2620	mg/kg

mg/kg = milligrams per kilogram

3.0 HAZARD AND RISK ANALYSIS

Activity hazard analyses (AHAs) for each task and associated risk analyses are found within the APP.

4.0 STAFF ORGANIZATION, QUALIFICATIONS, RESPONSIBILITIES

Staff organization, qualifications and responsibilities are listed within the APP (Section 4.0).

5.0 TRAINING

Training requirements for this site and tasks are listed within the APP (Section 6.0).

6.0 PERSONNEL PROTECTIVE EQUIPMENT (PPE)

General criteria for selection of Personnel Protective Equipment (PPE) is found within the APP, as well as Weston's Field Safety Officer Manual (maintained on site). The following section outlines specific PPE based upon task, contaminant, hazards, and risk of exposure.

6.1 PERSONAL PROTECTIVE EQUIPMENT SELECTION

All personnel performing operations on site shall be required to use the appropriate level of protection. This SSHP makes provisions for the use of Level D and Modified Level D for the hazards associated with a given task, operation, or expected contaminant level. The following field activities will be performed in Level D or Modified Level D:

- Geoprobe® soil sampling;
- Geoprobe® groundwater sampling;
- Monitor well installation;
- Groundwater sampling;
- Surveying;
- Sediment sampling;
- Surface water sampling;
- Benthic macroinvertebrate sampling;
- Fish sampling;
- Frog sampling;
- Fiddler crab sampling;
- Plant sampling;
- Earthworm sampling;
- Small mammal sampling;
- Indoor air sampling;

- Subslab soil gas sampling; and
- Subslab soil sampling.

Activities associated with unexploded ordinance (UXO) survey and screening activities are expected to be conducted in Level D.

6.2 LEVEL D PERSONAL PROTECTIVE EQUIPMENT

Level D PPE will be worn during site mobilization/demobilization, demolition activities, pump activities with no contact of contaminated materials, and support zone activities. Level D PPE consists of the following:

- Work clothes, e.g., coveralls (cotton);
- Work gloves, leather or cotton as necessary for physical hazards;
- Nitrile gloves as necessary;
- Boots, American National Standards Institute (ANSI) approved;
- Safety glasses, ANSI approved;
- Hard hat, ANSI approved; and
- Type III, V or better life vest when performing work on or near water.

6.3 MODIFIED LEVEL D PERSONAL PROTECTIVE EQUIPMENT

Modified Level D PPE will be worn when conducting activities where known or potential contact with minimally contaminated materials is expected. Modified Level D PPE consists of the following:

- Chemical resistant coveralls (Tyvek if dry matrix; Saranex or equivalent if wet matrix);
- Chemical resistant overboots or chemical boot covers;
- Gloves - nitrile or latex inner; nitrile outer;
- Eye protection - safety glasses or goggles, ANSI approved; and
- Hard hat, ANSI approved.

7.0 MEDICAL SURVEILLANCE

No unique medical surveillance requirements are anticipated for workers on this project. General medical surveillance requirements are outlined in Weston's Occupational Medical Monitoring Program.

8.0 EXPOSURE MONITORING AND AIR SAMPLING

General criteria for monitoring and sampling is found within the APP. The following section contains specific action levels and instrumentation based upon known or anticipated hazards.

8.1 ACTION LEVELS AND INSTRUMENTATION

Action levels are dependent on the nature and type of contamination present, and may be activity-specific. Monitoring equipment and action levels are presented in Table 8-1. Contaminant Material Safety Data Sheets (MSDSs) are included in Section 12.0, Attachment B of the APP.

Table 8-1
Air Monitoring Instruments and Action Levels

Hazard	**Instrument**	**Action Level**
Explosive Atmosphere (not anticipated this task effort)	combustible gas indicator (CGI) as required	<10% lower explosive limit (LEL): Continue investigation. >10% and <20% LEL (ambient air): Continue work with caution, continue monitoring. >10% LEL (confined space): Stop work and evacuate site until levels <10% are measured. >20% LEL (ambient air): Stop work and evacuate site until levels <20% are measured.
Oxygen (O_2) Content (not anticipated this task effort)	O_2 meter as required included with CGI instrument)	<19.5%: Stop work and evacuate site until levels are >19.5% and <25% (ambient air) or >19.5% and <23.5% (confined space) are measured. 19.5% to 25% (ambient air) or 19.5% to 23.5% (confined space): Acceptable levels for O_2. >25% (ambient air) or >23.5% (confined space): Fire hazard potential, stop work and consult a certified industrial hygienist (CIH) and CENAE.
Organic Vapors (where applicable)	Photoionization detector (PID)/ flame ionization detector (FID)	0 to 9.5 units PID, 0 to 8.5 units FID: Level D, continue monitoring and work activities. 9.5 to 37 units PID, 8.5 to 35 units FID: Level C, (Cartridge Change-out at 4-hour Maximum Intervals in accordance with Mine Safety Appliance (MSA) Respirator Test data for aromatic hydrocarbons). >37 units PID, > 37 units FID: Level B. Halt work, notify PSM/Site Safety and Health Officer, re-evaluate conditions. *Action levels based upon exposure limit for PCE
Particulates (where applicable)	Personal DataRam (PDR)	> 1.37 mg/m^3: Upgrade PPE to Level C. Action level based upon maximum soil contaminant concentrations. *Action level based upon Weston's Dust Exposure Calculation worksheet
Radiation (not anticipated this task effort)	Micro/R	<3 to 5 times background: Continue monitoring and work activities. >3 to 5 times background, <1 millirems per hour (mrem/hr): Continue work with caution, consult with a health physicist. >1 mrem/hr: Evacuate site, consult with a health physicist before continuing work.

8.2 PARTICULATE-BASED CONTAMINANTS

Multiple particulate-based contaminants (e.g., metals, PCBs) are expected to be present on site; however, contaminant-based action levels have been identified and monitoring instruments are specified in Table 8-1.

8.3 ORGANIC OR VOLATILE CONTAMINANTS

Several volatile organic compounds (VOCs), including TCE, PCE and chloroform, were found in former Raritan Arsenal groundwater and soil gas. The action levels have been identified and monitoring instruments are specified in Table 8-1.

8.4 AIR MONITORING

Air monitoring is not expected to be needed during current on-site activities. If there are any changes to the scope of work, the action levels and instrumentation necessary for the air monitoring are specified in Table 8-1.

9.0 HEAT AND COLD STRESS

Information associated with heat and cold stress can be found within the APP and Weston's Field Safety Officer Manual.

10.0 STANDARD OPERATING PROCEDURES, ENGINEERING CONTROLS AND WORK PRACTICES

Information associated with Standard Operating Procedures (SOPs), Engineering Controls and Work Practices to be utilized at former Raritan Arsenal can be found within the APP and Weston's Field Safety Officer Manual.

11.0 SITE CONTROL

Site control zones and criteria will be established as indicated in the APP. The boundaries of each work site area, regardless of its configuration, will be clearly identified to prevent accidental intrusion by personnel not immediately involved in site operations, and will be identified as the Exclusion Zone (EZ).

Each work site will have a Support Zone (SZ) that will be utilized as a staging area for personnel and equipment to support operations in the EZ. The SZ will include a site access control point, an area for visitors, and a break area for site workers.

Where necessary, a Contamination Reduction Zone (CRZ) will be established. The CRZ will serve as a buffer to reduce the possibility of the SZ becoming contaminated or being affected by other existing hazards. The CRZ provides additional assurance that the physical transfer of contamination of personnel, equipment, or in the air is minimized.

The Site Safety Health Officer (SSHO) will delineate and control these zones based on site conditions and activities. The zones will be marked on the site map, and the map will be posted at the entrance to each site.

11.1 EXCLUSION ZONE

The EZ is the area where the greatest potential for exposure to site hazards exists, or where known and/or potential contamination exists. A separate entry and exit checkpoint will be established at the EZ to regulate the flow of personnel and equipment into and out of the EZ.

The entry and exit check point is used to ensure that personnel and equipment are protected and the contamination is properly contained. The entry/exit point will be established with the prevailing wind to the backs of the entrants, as possible. No use of tobacco products, eating, gum-chewing, or drinking is allowed in this area.

For tasks which involve use of a boat, the exclusion zone is considered the area immediately surrounding the point of sample collection and containerization.

11.2 CONTAMINATION REDUCTION ZONE

The CRZ is located between the EZ and the SZ, and provides a transition between contaminated and clean zones. It serves as a buffer to reduce the probability of the SZ becoming contaminated or being affected by other existing hazards. It provides additional assurance that the physical transfer of contaminating substances on people, equipment, or in the air is minimized through a combination of decontamination, distance between exclusion and SZs, air dilution, zone restriction, and work functions.

The CRZ will contain the Contamination Reduction Corridor, which will serve as the exit point from the EZ. The CRZ contains all equipment and supplies necessary for decontamination of site personnel and equipment as they exit the EZ. No use of tobacco products, eating, chewing, or drinking is allowed in this area.

For tasks which involve the use of a boat, the CRZ will be established at the shoreline once the boat returns to shore. Personnel decontamination, if required beyond standard removal and containerization of used PPE, will occur at this location. Any non-disposable equipment will also be decontaminated at this location.

11.3 SUPPORT ZONE

The SZ is located outside the CRZ and is the location of the administrative and other support functions. The SZ is an area where no significant air or surface contamination exists.

The SZ includes facilities such as the change area, lunch and break areas, office spaces, and supply storage areas. Specific areas within the SZ will be designated for use of tobacco products, gum-chewing, eating, drinking, and cosmetics.

11.4 SITE MAPS

The ERCP will include site emergency equipment locations and evacuation routes.

12.0 PERSONAL HYGIENE AND DECONTAMINATION

Only personnel who have completed the requisite training and medical exams/tests may enter the EZ. Personnel decontamination facilities will be established on-site to ensure that personnel maintain a high degree of personal hygiene and minimize the possibility of exposure to chemical hazards. The personnel hygiene facilities will conform to the requirements specified in 29 CFR Part 1910 or Part 1926.

The following plan will be implemented whenever it is necessary to set up a decontamination line. Any modification to the following procedures will be identified within the APP.

A personnel decontamination line will be established in the CRZ to facilitate decontamination and protective clothing removal. Storage and disposal containers will be used for the disposal of outerwear. If there is a rip or tear in the employee's chemical protective clothing, that individual shall remove the torn garment in the decontamination area and don new protective clothing. If respiratory equipment becomes defective or damaged, the wearer shall leave the EZ immediately and repair or replace the defective part or mask.

As personnel move through the decontamination line, PPE will be removed in the order of highest to lowest potential contamination. An outside-in removal technique minimizes contamination of inner clothing or body. All personnel exiting the EZ will pass through the decontamination line. Respirators will be inspected daily, washed, and scrubbed in a detergent/water solution. Clean respirators will be left to dry in an uncontaminated protected atmosphere.

All PPE for decontamination line attendants will be removed on the decontamination line. An emergency eyewash station will be located in the CRZ adjacent to the decontamination line.

Personnel are required to wash hands, face, and other exposed skin areas prior to leaving the CRZ for breaks or lunch. Towels and soap will be provided for personnel.

The use of tobacco products, eating, or drinking will be prohibited except in a designated break area within the SZ.

13.0 EQUIPMENT DECONTAMINATION

Any equipment or vehicle taken into the EZ is assumed to be potentially contaminated and must be inspected and decontaminated in the CRZ prior to leaving the work area. The SSHO or designee is responsible to properly inspect (and approve for general cleanliness), all tools or hand-operated equipment and the frame/tires of all vehicles or heavy equipment leaving the CRZ.

In order for vehicles and heavy equipment to pass inspection, they must be free of loose dirt or stabilized material on tailgates, axles and wheels. Approval will be based on visual inspection of all exposed surfaces.

If necessary, Weston will use an equipment decontamination pad located at the entrance to the CRZ. This area will be utilized to remove soil from all equipment leaving the work area. If necessary, decontamination procedures shall consist of high-pressure steam cleaning of equipment to remove mud and/or dirt. All equipment requiring maintenance or repair will be staged in the CRZ prior to servicing. Equipment wash water residue will be collected, contained and disposed as either non-hazardous or hazardous waste based upon site conditions and results of waste classification analyses. Only clean water shall be used for decontamination of personnel, equipment, and vehicles.

Personnel assigned to vehicle decontamination will wear the protective equipment, clothing and respiratory protection consistent with the established Safety Program as defined in the APP. Seats and flooring in equipment and vehicles that are to be used in the EZ will be covered to the extent possible with disposable polyethylene (as necessary).

14.0 EMERGENCY EQUIPMENT AND FIRST AID

Information relative to emergency equipment and first aid will be found within the Emergency Response and Contingency Plan (Attachment A to the APP).

15.0 EMERGENCY RESPONSE AND CONTINGENCY PROCEDURES

Information relative to emergency response and contingency procedures will be found within the Emergency Response and Contingency Plan (Attachment A to the APP).

SECTION 13.0

CONTRACTOR INFORMATION

13.0 CONTRACTOR INFORMATION

Weston will assure compliance with the requirements of EM 385-1-1, OSHA (29 CFR 1910 and 1926) and Weston policy requirements through formal and site-specific training programs as well as routine inspections with follow-up compliance.

Specific criteria for this site will include the following subsections.

13.1 PRELIMINARY EVALUATION

Prior to work or specific tasks/activities, qualified personnel will perform a preliminary evaluation of the site's characteristics. This preliminary evaluation includes the completion of the AHA tables in Section 14.0, which identify hazardous conditions and aid in the selection of appropriate employee protection methods and PPE.

All known or potential physical and chemical hazards that may pose a threat to the safety and health of site workers must be identified to ensure workers are adequately protected. Emphasis is placed on identifying conditions that may cause death or serious harm. All site workers must be vigilant in identifying hazards in the work place and bringing them to the attention of supervisory personnel.

Evaluation of work site characteristics and hazards will continue throughout the duration of the project.

While all personnel share responsibility in understanding and advising on site hazards, the SSHO will be responsible for thoroughly evaluating field operations with respect to potential hazards to personnel. These potential hazards and the specific procedures to be followed to help prevent or reduce exposure will be reviewed and documented during the daily safety briefing.

The following sections contain general site safety information. OSHA regulatory requirements and Weston Field Operating Procedures, contained in the Site Health and Safety Officer's Manual maintained on-site, will also be followed. Where necessary, client requirements will be referenced or incorporated into the APP.

Hazards due to normal site activities can be reduced by using common sense and following safe practices. The following practices are expressly forbidden:

- Running and horseplay.
- Use of tobacco products, eating, drinking, applying cosmetics, or chewing gum within the EZ or any potentially contaminated area.
- Ignition of flammable materials in the work zone without the proper Hot-Work Permit. Equipment will be bonded, grounded, and explosion resistant, as appropriate.
- Performance of tasks in the restricted area individually (i.e., working alone).

Personnel must keep the following guidelines in mind when conducting field activities:

- Hazard assessment is a continuous process; personnel must be aware of their surroundings and constantly aware of the chemical and physical hazards that are or may potentially be present.
- The number of personnel in the CRZ or EZ will be the minimum number necessary to perform work tasks in a safe and efficient manner. The use of the Buddy System is mandatory for EZ work.
- Team members will be familiar with the physical characteristics of each site including wind direction, site access, and the location of communication devices and safety equipment.
- The location of overhead power lines and underground utilities must be established prior to conducting excavation or drilling activities.

Team members will be familiar with emergency hand signals:

- Hand Gripping Throat: "Respirator or breathing problems, can't breathe."
- Thumbs up: "OK, I'm all right, I understand."
- Thumbs down: "No, negative."
- Hand(s) on top of head: "Need assistance."
- Grab buddy's wrist: "Evacuate site now, ask no questions."

13.2 CHEMICAL HAZARD IDENTIFICATION

The presence of chemical hazards creates potential personnel exposure via inhalation, ingestion, absorption, or contact with contaminants present in liquids, soil, or air. The list of chemicals to which workers may be exposed will be developed through the use of several information sources, including archival research data and previous site characterization data. In preparation of the SSHP, an evaluation of known or suspect contaminants has been made to ensure all chemical hazards have been addressed.

13.3 HAZARD COMMUNICATION

In order to comply with the OSHA Hazard Communication Standard 29 CFR 1910.1200 (HCS), the following will apply to all commercial products containing hazardous substances, which are brought on-site:

- A written Hazard Communication Program will be made available to site personnel.
- MSDSs will be maintained for each product containing a hazardous substance, which is used on-site, and which meets the regulatory requirements of the Haz Com Program.

- All containers not supplied with adequate hazard labeling will have a hazard communication label affixed to the container that communicates the health and physical hazards associated with working with the material.
- Employees working with hazardous substances will be trained in accordance with the requirements of 29 CFR 1910.1200.
- An inventory of all hazardous substances used on site will be maintained.
- Personnel, to include subcontractors, affected by hazardous substances use will be informed of the hazards and of the location of appropriate MSDS.

A Site-Specific Hazard Communication Program is presented in Section 12.0, Attachment G.

13.4 PHYSICAL HAZARD IDENTIFICATION

Physical hazards that may be encountered during field activities include, but, are not limited to: cold stress, heat stress, flammable materials, munitions or explosives of concern (MEC), potential UXO, hazards related to equipment handling, uneven/unstable surfaces, excessive noise, traffic, inclement weather, site security, working in remote areas, heavy equipment operation and decontamination. Those physical hazards specifically applicable to this site are identified in the task-specific AHAs, included as Section 14.0 of this APP.

13.5 RADIATION HAZARD IDENTIFICATION

Both ionizing and non-ionizing radiation may present problems on specific sites. While ionizing radiation is commonly due to waste disposal practices, there are areas in which naturally occurring radiation may be an issue. Usually, prior knowledge of ionizing radiation concerns result from historical site reviews; however, cases of undocumented radiation contamination/disposal have been recorded. Weston's protocol for sites that do not negate the presence of ionizing radiation is to screen the site using sensitive instruments such as the mico-R meter. Should radiation be identified as a concern prior to work initiation or based upon site screening efforts, contact will be made with Weston's radiation safety specialists for assistance in planning and work efforts.

Non-ionizing radiation creates concerns during periods of intense or prolonged exposure to the sun, to instruments such as lasers, infrared sources, or upon site locations on or near high energy fields such as micro-wave or radio towers. Personnel will be instructed in appropriate PPE and/or procedures to follow in the event that non-ionizing radiation creates a concern.

13.6 MUNITIONS OR EXPLOSIVES OF CONCERN AND UNEXPLODED ORDNANCE HAZARD IDENTIFICATION

Personnel not contracted specifically as MEC/UXO personnel or recognized by Weston as a designated expert for MEC/UXO activities are not authorized to move or contact any known or suspect ordnance. Specific plans for UXO or MEC work will be as attachments to the APP as necessary.

13.7 EXCAVATION OPERATIONS

In accordance with OSHA requirements, all excavation activities will be performed in accordance with 29 CFR 1926 Subpart P. Specific requirements include routine inspections by qualified personnel to verify safe work conditions, location of utilities, and appropriate worker knowledge of safe work practices.

Protective systems for workers will be designed in accordance with Subpart P and encompass one or more of the following: sloping, shoring, or shielding. Any protective system for an excavation greater than 20 ft in depth (or as otherwise determined by site conditions or Subpart P) will require the services and approval of a registered professional engineer.

Additional criteria, and Weston's Excavation Safety procedures, can be found in the FSO Manual.

13.8 HEAVY EQUIPMENT OPERATION

Heavy equipment will be operated under the following conditions according to OSHA Regulations and Weston Field Operating Procedures.

- The operation of heavy equipment will be limited to authorized personnel specifically trained for this task.
- The operator will use the safety devices provided with the equipment, including seat belts. Backup warning indicators and horns will be operable at all times or a trained spotter will direct equipment operations.
- While heavy equipment is in operation, all personnel not directly required in the area will keep a safe distance from the equipment.
- Personnel will avoid moving into the path of operating equipment; areas blinded from the operator's vision will be avoided.
- Additional riders will not be allowed on equipment unless it is specifically designed for that purpose, i.e., there is an additional seat with a seat belt.
- The operator will document inspection of heavy equipment daily prior to operation.

13.9 MECHANICAL EQUIPMENT OPERATION

Operation of mechanical equipment presents another potential source for physical hazards and includes the following requirements, in addition to OSHA Regulations and Weston Field Operating Procedures:

- Operation will be conducted by authorized personnel familiar with the machine, its operation, and safety provisions.
- Mechanical equipment will be inspected prior to use.
- Any equipment found to be defective in any manner will be removed from service and repaired prior to use.
- Hands, feet, etc. will be kept away from all moving parts.
- Maintenance and/or adjustments to machinery will be not conducted while in operation. Power will be disconnected prior to maintenance activities.
- An adequate operating area will be provided, allowing sufficient clearance and access for operation.
- Good housekeeping practices will be followed.

13.10 MATERIAL LIFTING

Many types of objects are handled in normal day-to-day operations. Care should be taken in lifting and handling heavy or bulky items because they are the cause of many back injuries. The following fundamentals address the proper lifting of materials to avoid back injuries:

- The size, shape, and weight of the object to be lifted must be considered. A worker will not lift more than he or she can handle comfortably.
- A firm grip on the object is essential; gloves will be used if necessary, to protect the hands.
- The hands and object will be free of oil, grease, and water, which might prevent a firm grip, and the fingers will be kept away from any points that cause them to be pinched or crushed, especially when setting the object down.
- The item will be inspected for metal slivers, jagged edges, burrs, rough or slippery surfaces and pinch points.
- The feet will be place far enough apart for good balance and stability. The footing surface, should be firm.
- The worker will get as close to the load as possible. The legs will be bent at the knees.

- The back will be kept as straight as possible.
- To lift the object, the legs will be straightened from their bending position.
- A worker will never carry a load that cannot be seen over or around.
- When placing an object down, the stance and position will be identical to that for lifting. The legs will be bent at the knees, back straight, and the object lowered.

In addition, relevant Weston Field Operating Procedures will be followed. When two or more workers are required to handle an object, coordination is essential to ensure that the load is lifted uniformly and that the weight is equally divided between the individuals carrying the load. When carrying the object, each worker, if possible, will face the direction in which the object is being carried.

13.11 ELECTRICAL HAZARDS

Electrical wiring and apparatus safety procedures will be conducted in accordance with OSHA Regulations and Weston Field Operating Procedures. These requirements include, but are not limited to:

- All electrical wiring and equipment will be of a type listed by Underwriters Laboratories (UL) or Factory Mutual Engineering Corp. (FM) for the specific application.
- All installations will comply with the National Electrical Code (NEC).
- All work will be accomplished by personnel familiar with and qualified for the class of work to be performed.
- Live parts of wiring or equipment will be guarded to protect all individuals or objects from harm.
- Electric wire or flexible cord passing through work areas will be covered or elevated to protect it from damage by foot traffic, vehicles, sharp corners, or pinching.
- Temporary power lines, switch boxes, receptacle boxes, metal cabinets, and enclosures around equipment will be marked to indicate the maximum operating voltage.
- Patched, oil-soaked, worn, or frayed electric cords or cables will not be used.
- Extension cords or cables will not be fastened with staples, hung from nails, or suspended by wire.
- All electrical circuits will be grounded in accordance with the NEC.

- Portable and semi-portable electrical tools and equipment will be grounded by a multi-conductor cord having an identified grounding conductor and a multi-contact polarized plug-in receptacle.

- Semi-portable equipment, floodlights, and work lights will be grounded. The protective ground of such equipment should be maintained during moving unless supply circuits are de-energized.

- Double insulated tools will be distinctly marked and listed by UL or FM.

- Ground fault circuit interrupters (GFCIs) are required in all circuits used for portable electric tools. The GFCI will be calibrated to trip within the threshold values of 3 to 7 mA as specified in UL Standard 943. All GFCIs will be UL listed and installed in accordance with the most recent edition of the NEC. Ground fault circuit interrupters may be sensitive to some equipment such as concrete vibrators. In these instances, an assured equipment grounding conductor program is acceptable.

- Flexible cord will be of a type listed by the UL. Flexible cord sets will contain the number of conductors required for the services plus an equipment ground wire. The cords will be hard usage or extra hard usage as specified in the NEC.

- Bulbs attached to festoon lighting strings and extension cords will be protected by wire guards or equivalent.

- Temporary wiring will be guarded, buried, or isolated by elevation to prevent accidental contact by workers or equipment.

13.12 LADDERS

The following guidelines will be employed when using ladders:

- Manufactured ladders will be constructed of heavy-duty grade; Type II minimum, conforming to applicable ANSI standards.

- Ladders will not be spliced together to make a longer ladder.

- Straight ladders for egress will extend at least 3 feet above the landing and, when possible, secured.

- Ladders will be inspected prior to use and defective ladders will be removed from service and repaired.

- The base of straight ladders will be set back a safe distance from the vertical, approximately one-fourth the working length of the ladder from the vertical plane of the top of support.

- Stepladders will be fully opened to permit the spreader to lock. Stepladders will not be closed and leaned against an object for access.

- Metal ladders will not be used for electrical work or in areas where they could contact energized wiring.

- "Job-made" ladders (if allowed) will be constructed in accordance with OSHA 1926 Subpart X.

13.13 PRESSURIZED HOSES

Observe the following rules when using hoses:

- Before use, inspect hoses for defects, cuts, loose clamps, improper fittings, etc.
- Never apply air from an air hose to any part of the body or clothing.
- Use only standard fittings for all hoses.
- All quick make-up connections must be secured with safety lashing.

13.14 EXPLOSIVE ATMOSPHERE AND IGNITION SOURCES

Explosions and fires may arise spontaneously. However, more commonly, they result from site activities, such as moving drums, accidentally mixing incompatible chemicals, or introducing an ignition source (such as a spark from equipment) into an explosive or flammable environment.

Explosions and fires not only pose the obvious hazards of intense heat, open flames, smoke inhalation, and flying objects, but may also cause the release of toxic chemicals into the environment. Such releases can threaten both personnel on-site and members of the general public living or working nearby.

Weston performs the following activities to protect against these hazards: monitoring for explosive atmospheres and flammable vapors using a combustible gas indicator; separation of all potential ignition sources from an explosive or flammable environment; use of non-sparking, explosion-proof equipment; and following safe practices when performing any task that might result in the agitation or release of chemicals. Some potential causes of explosions and fires include:

- Chemical reactions that produce explosion, fire or heat;
- Ignition of explosive or flammable chemical gases or vapors;
- Ignition of materials due to oxygen enrichment;
- Agitation of shock or friction-sensitive compounds; and
- Sudden release of materials under pressure.

13.15 HAND TOOLS

Hand tools will be used according to OSHA Regulations and Weston Field Operating Procedures. Only tools that are in good condition will be used. Improper and defective tools contribute to incidents. The following safe practices will be observed when using hand tools:

- Use tools in the manner for which they were designed;
- Be sure of footing before using any tool;
- Do not use tools that have split handles, mushroom heads, worn jaws, or other defects;
- Do not use makeshift tools or other improper tools; and
- Use spark-proof tools where there are explosive vapors, gases, or residue.

13.16 SANITATION

Applicable sanitation requirements are contained in OSHA Regulations and Weston Field Procedures and include the following unless otherwise approved:

- Field office/break trailers will be equipped with power and water. At a minimum, washing facilities will be set up using handi-wipes or a suitable equivalent.

- Appropriate numbers of portable sanitation facilities will be obtained. The units will be serviced as necessary.

- All work areas, to include the office/break trailer, will have trash receptacles. Areas will be kept free of trash and any equipment not being used will be removed and stored in the office/break trailer.

13.17 ILLUMINATION

Most work will be conducted during daylight hours. If field activities will be conducted between dusk and dawn, appropriate lighting will be supplied to allow illumination according to OSHA Regulations and Weston Field Procedures.

13.18 HEAT STRESS

One of the most common types of stress that can affect field personnel is heat stress. Heat stress may be one of the most serious hazards to workers at remediation sites due to the PPE required. Engineering controls should be considered as the first measure to be taken to reduce hazards rather than the donning of PPE.

Weston's policy and response procedures can be found within the FSO Manual.

13.19 COLD STRESS

Persons working in temperatures at or below freezing may be frostbitten. Experiencing extreme cold for a short time may cause severe injury to exposed body surfaces or result in profound generalized cooling, causing death. Areas of the body that have high surface area-to-volume ratios, such as fingers, toes, and ears, are the most susceptible.

Policy and procedures for cold stress conditions are found within the FSO Manual.

13.20 WASTE STORAGE, SHIPPING, AND TRANSPORTATION

The following procedures should be used to minimize hazards during shipping and transportation of hazardous materials:

- Drums and containers will be identified, classified, and segregated to assure material compatibility.
- Drum or container staging areas will be prepared, maintained, and kept to the minimum number necessary to safely identify and classify materials and prepare them for transport. Compliance with EPA Resource Conservation and Recovery Act (RCRA) requirements will be required at a minimum.
- Staging areas will be provided with adequate access and egress routes.
- Bulking of hazardous wastes will be permitted only after a thorough characterization of the materials has been completed.
- Drums and containers used during site removal will meet the applicable U.S. Department of Transportation (DOT), OSHA, and EPA regulations for the types of wastes they contain.

Shipment of materials to off-site treatment, storage, or disposal facilities involves the entry of waste hauling vehicles into the site. DOT hazardous materials regulations (49 CFR Parts 171-178) and EPA hazardous waste transporter standards (40 CFR Part 263) for shipment of hazardous wastes must be complied with. The following guidelines can enhance the safety of these operations:

- Locate the final staging (bulking) area as close as possible to the site exit. Prepare a circulation plan that minimizes conflict between cleanup teams and waste haulers. Install traffic signs, lights, and other control devices as necessary.
- Prepare a Transportation Security Plan in accordance with Weston's Dangerous Goods Shipping Manual and DOT requirements.
- Provide adequate area for on-site and hauling vehicles to turn around. Where necessary, build or improve on-site roads.
- Stage hauling vehicles in a safe area until ready for loading with drivers remaining in cab. Minimize the time that drivers spend in hazardous areas.
- Hauling-vehicle drivers must have the applicable training and appropriate protective equipment for areas of the site they utilize.

- If drums are shipped, tightly seal the drums prior to loading. Over-pack leaking or deteriorated drums prior to shipment. Under most circumstances, over-pack drums used for hazardous wastes may not be reused [49 CFR Part 173.3(c)]. Make sure that truck bed and walls are clean and smooth to prevent damage to drums. Do not double stack drums. Secure drums to prevent shifting during transport.

- Keep bulk solids several inches below the top of the truck container. Cover loads with a layer of clean soil, foam, and/or tarp. Secure the load to prevent shifting or release during transport.

- Weigh vehicles periodically to ensure that vehicle and road weight limits are not exceeded.

- Decontaminate vehicle tires prior to leaving the site to ensure that contamination is not carried onto public roads.

- Check periodically to ensure that vehicles are not releasing dust or vapor emissions off the site.

- Develop procedures for responding quickly to off-site vehicle breakdown and incidents to ensure minimal public impact.

13.21 BIOLOGICAL HAZARD IDENTIFICATION

Biological hazards which may be encountered in the field include poisonous plants, wild and/or rabid animals, snakes, ticks, and insects. The degree of hazard can range from annoyance to death from bites or anaphylactic shock. Recognition and avoidance are critical in maintaining a safe work site.

13.21.1 Tick Bites

The Center for Disease Control has noted the increase of Lyme disease and Rocky Mountain Spotted Fever (RMSF), which are caused by bites from infected ticks that live in and near wooded areas, tall grass, and brush. Ticks are small, ranging from the size of a comma up to about one quarter inch. They are sometimes difficult to see. The tick season extends from spring through summer.

Lyme disease has occurred in almost all states and is caused by ticks infected with a type of spirochete bacteria. Deer ticks are about one quarter inch in size, and black or brick red in color. Male deer ticks are smaller, and all black. The deer tick larva are extremely small, approximately the size of a period (.).

RMSF has occurred in over one-half of the states, with the heaviest concentrations in Oklahoma, North Carolina, South Carolina, and Virginia. It is caused by Rocky Mountain wood ticks and dog ticks that have become infected with rickettsia bacteria. Both are black or tan in color.

Standard field gear (work boots, socks, and light-colored coveralls) provide good protection against tick bites, particularly if the joints are taped. However, even when wearing field gear, the following precautions should be taken when working in areas that might be infested with ticks:

- When in the field, check yourself often for ticks, particularly on your lower legs and areas covered with hair. Look for "a freckle that moves".
- Spray outer clothing, particularly your pant legs, crotch, boots, and socks, but not your skin, with an insect repellent that contains permethrin or permanone.
- Follow manufacture’s instructions if using an insect repellant on the skin. For sampling activities be aware of potential cross-contamination of samples.
- When walking in wooded areas, avoid contract with bushes, tall grass, or brush as much as possible.
- If you suspect that a tick is present, remove it with tweezers only, and not with matches or a lit cigarette. Grasp the tick near the head with the tweezers and pull gently. Do not use nail polish or any other type of chemical. Be sure and remove all parts of the tick's body. Once removed, disinfect the area with alcohol or a similar antiseptic. Report the incident to the SSHO.
- Look for signs of the onset of Lyme disease, such as a rash that looks like a bullseye or an expanding red circle surrounding a light area, frequently with a small welt in the center. This rash can appear from several days to several weeks after the tick bite.
- Also look for signs of the onset of RMSF, an inflammation which is visible in the form of a rash comprised of many red spots under the skin, which appears three to 10 days after the tick bite. The rash frequently occurs on the ankles and wrists.
- The first symptoms of either disease are flu-like chills, fever, headache, dizziness, fatigue, stiff neck, and bone pain. If immediately treated by a physician, most individuals recover fully in a short period of time. If not treated, more serious symptoms can occur.

If any of the signs and symptoms noted above appears, contact the SSHO.

13.21.2 Snakes

If bitten by a snake, remain calm and keep the affected area below the level of the heart and walk, do not run, to the nearest aid station for assistance. The SSHO will immediately transport the victim to the closest medical facility for treatment or send for appropriate medical assistance, whichever is faster.

The use of snakebite kits is not authorized. If at all possible, the snake should be identified to assure prompt medical treatment by the physician.

13.21.3 Poisonous Plants

Site personnel must be alert to the presence of poisonous plants. The most common types of poisonous plant are poison ivy, poison oak, and poison sumac. Skin contact with these plants can cause skin sensitization resulting in reddening, swelling, and itching of the affected areas. Skin exposure can result from either direct contact with the plant or contact with clothing or equipment previously exposed to the plant.

Site personnel will receive training in the recognition of poisonous plants and methods for preventing exposure during the site-specific safety briefing.

13.21.4 Animal or Insect Bites

Animal bites or stings are usually nuisances (localized swelling, itching, and minor pain) that can be handled by First Aid treatment. The bites of certain snakes, lizards, spiders, and scorpions contain sufficient poison to warrant medical attention. In addition, there are several species of caterpillars that contain stinging hairs that may cause a rash on contact or respiratory distress if the hairs are inhaled.

There are diseases that can be transmitted by insect and animal bites (e.g., RMSF, Lyme disease [tick], rabies [mainly dogs, skunks, raccoons, and foxes], malaria, and equine encephalitis [mosquitoes]). The greatest hazard and most common cause of fatalities from animal bites, particularly bees, wasps, and spiders, is from a sensitivity reaction. Shock due to stings can lead to severe reactions in the circulatory, respiratory, and central nervous systems, which also can result in death.

If an assigned employee has a history of allergic reactions to bites, he or she is required to have the prescribed treatment in the field, and First Aid personnel will know where it is located. All stings or bites will be taken seriously. Anyone stung or bitten will be required to stop work while that person is observed for signs of severe swelling, shortness of breath, nausea, or shock. If there is any doubt, medical attention will be obtained.

All wild animals are to be avoided, particularly wild animals that are unusually passive or aggressive. Any such animals will be reported to appropriate site personnel. Skunks, raccoons, foxes, and bats are wild animals most frequently found to be infected with rabies; however, any warm-blooded animal could be infected. If an individual is bitten by an animal suspected of rabies infection, an attempt will be made to keep the animal under surveillance until appropriate assistance is called to take care of the animal. The animal should then be tested. A dead animal suspected of infection should also be preserved and tested. Health departments are often sources of testing or obtaining information about where testing can be done.

The bite area should be washed with soap and water and disinfected with 70 percent alcohol as quickly as possible, followed by treatment by a doctor or emergency room.

Rabies is preventable, even after being bitten, if treatment is begun soon enough. Hence, prompt medical attention and determining whether the animal that has bitten you is infected are very important. Rabies is not curable once symptoms or signs appear.

SECTION 14.0

SITE-SPECIFIC HAZARDS AND CONTROLS

14.0 SITE-SPECIFIC HAZARDS AND CONTROLS

14.1 ACTIVITY HAZARD ANALYSES

AHAs for all tasks identified to date are included in the following tables. Should additional field activites be required for the completion of remedial activities at the former Raritan Arsenal, task-specific AHAs will be developed and included in this APP.

All AHAs will be reviewed on a regular basis (or upon a change in site conditions) and updated as necessary.

Activity 1 — UXO Survey and Screening

Task	**Hazards**	**Hazard Control**
UXO screening will be performed in advance of any intrusive activities in areas of the site where UXO could potentially be encountered (based on past site activities). UXO screening will also be conducted in areas of the site that have not yet been investigated, for which intrusive activities are planned. UXO screening should not be necessary for subslab soil sampling or subslab soil gas sampling, since the depths to be sampled are immediately below the slab. The exception is any building falling within an area where past site activities indicate the potential for UXO to be encountered. Such buildings will be evaluated by USACE on a case-by-case basis. Additional background is included in Section 12.0, Attachment I.	***Chemical Hazards*** — It is anticipated that the potential for exposure is low.	Level D PPE will be worn during UXO screening activities. See FLD 21.
	Physical Hazards — Slip, trips, falls, tools, terrain or vegetation; uneven walking surfaces.	The work area will be visually inspected. Slip, trip, and fall hazards will be either removed or marked and barricaded. Sufficient illumination will be maintained. Site personnel will conduct walkover in groups of two as a minimum. Site personnel will refer to and follow Weston FLDs 02-Inclement weather and 39-Illumination. Also, see FLD 11 and 12.
	Traffic	Wear reflective safety vest and cordon off work areas where vehicle traffic is present. Refer to FLD 20.
	Manual lifting/handling	Utilize proper lifting techniques and use a buddy to lift larger loads. Refer to FLD 10
	Inclement weather, wind, heat/cold stress	Workers will be briefed and cognizant of heat and cold stress symptoms. Fluids will be available to workers. See FLD 05 and 06. Work rest periods will be established according to ACGIH and NIOSH guidelines. Outdoor work will be suspended during inclement weather with high wind or lightning, see FLD 02.
	Biological Hazards **–** Stinging and biting insects; possibility of exposure to poison ivy, sumac, and/or oak.	Use appropriate insect repellants, i.e., DEET. Learn to identify plants. Avoid contact. Use barrier creams. Review recognition of poisonous plants, insects, or snakes typical of this area. Use appropriate measures as required. Adhere to Weston BBP Exposure Control Plan—First Aid Procedures and FLD 43 in Section 12.0, Attachment M.
	Radiological Hazards — Potential sunburn/sun poisoning hazard on bright, sunny days.	Use sunblock and long sleeves as appropriate. Avoid direct exposure to sun for long periods of time.

Activity 1 — UXO Survey and Screening (Continued)

Equipment Expected To Be Used	**Inspection Requirements**	**Training Requirements**
Pickup trucks Level D PPE Safety vest UXO survey equipment Motor vehicle	***Site Inspection:*** Daily inspection by SSHO. Periodic inspection by Program Safety Manager (PSM). ***Motor Vehicles:*** Before initial use, Operator will inspect and ensure safe operating condition of vehicles. ***Equipment:*** Ensure equipment is tested and inspected by a qualified person before it is placed into use. Conduct inspections and tests in accordance with manufacturer’s instructions. Ensure operator of equipment in use inspects the equipment daily.	***Site-Specific:*** OSHA HAZWOPER Initial site-specific orientation Daily tailgate safety meetings Hazard communication UXO Training ***Supervisory Personnel:*** OSHA supervisor’s training ***Motor Vehicles:*** Operators will hold a valid license for the type and class of vehicle they are operating. ***Instrumentation and Equipment General:*** Employees will be qualified and trained to operate or service equipment.

Activity 2 — Soil Sampling

Task	**Hazards**	**Hazard Control**
Soil sampling will be conducted in accordance with the soil sampling, sample preservations, volume and containers, and sample receipt, handling, and custody protocols listed in the CSAP, the NJDEP TRSR (July 2005) and FSPM (August 2005). Samples will be collected either by hand or with an approved drilling method, such as Geoprobe.	***Chemical Hazards*** — The potential for exposure is to site contaminants is low to moderate, based upon contact with potentially contaminated soils with high levels of particulates and VOCs.	Level D PPE will be worn during soil sampling activities. An upgrade to modified level D will be determined by the SSHO. Air monitoring will be performed to evaluate exposure potential to particulates (PDR or Mini RAM) and VOCs (PID). Utilize action levels outlined in SSHP.
	Physical Hazards — Slip, trips, falls, tools, terrain or vegetation; uneven walking surfaces. Weather hazards, such as wind, lightning, and poor visibility. Poor housekeeping.	The work area will be visually inspected. Slip, trip, and fall hazards will be either removed or marked and barricaded. Sufficient illumination will be maintained. Site personnel will conduct walkover in groups of two as a minimum. Site personnel will refer to and follow Weston FLDs 02-Inclement weather and 39-Illumination. Also, see FLD 11 and 12. Materials will be stored to prevent intrusion into the work areas. Work areas will be kept organized. See FLD 12.
	Hands or fingers caught between objects; abrasions and lacerations. Use of tools.	Personnel will be made aware of the hazard and asked to coordinate carefully the handling and placement of heavy objects. Materials and objects being handled will be inspected for rough or sharp edges, and appropriate precautions will be taken to avoid contact. Personnel will wear work gloves and avoid placing hands between objects. Refer to FLDs 29 and 38.
	Noise from equipment	Workers shall wear hearing protection during high-noise activities. Refer to FLD 01.
	Traffic	Wear reflective safety vest and cordon off work areas where vehicle traffic is present. Refer to FLD 20.
	Working in a Remote Area	Ensure functioning method of contact with field team lead/SSHO/PM. Utilize buddy system at all times. Refer to FLD 15.
	Manual lifting/handling	Utilize proper lifting techniques and use a buddy to lift larger loads. Refer to FLD 10
	Moving mechanical parts from heavy equipment operations.	Personnel will be made aware of the hazard and will coordinate carefully during equipment handling operations. Guards will be kept in place during operation. Maintain safe distance from moving mechanical parts. Always use appropriate PPE. See FLD 22.
	Potential for Fire (from equipment)	Keep a 20-pound fire extinguisher within the field vehicle or in the immediate vicinity of the work area. Refer to FLD 32.
	Drilling safety	Remain safe distance from all mechanized parts. Cordon off drilling area. Inspect drill rig upon arrival and at regular intervals throughout duration of activity. Refer to the Weston Drilling Guide, Section 2.5 of the Safety Officer's Manual.
	Utilities (overhead and underground)	Verify all utility locations in drilling area by at least three sources, if available. Ensure NJ One Call mark-out has been performed. Refer to FLD 34.

Activity 2 — Soil Sampling (Continued)

Task	Hazards	Hazard Control
	Heat/Cold stress	Workers will be briefed and cognizant of heat and cold stress symptoms. Fluids will be available to workers. See FLD 05 and 06. Work rest periods will be established according to ACGIH and NIOSH guidelines.
	Biological Hazards — Poisonous plants, insects, snakes.	Review recognition of poisonous plants, insects, or snakes typical of this area. Use appropriate measures as required. Adhere to Weston BBP Exposure Control Plan—First Aid Procedures and FLD 43 in Section 12.0, Attachment M.
	Radiological Hazards — Potential sun burn/sun poisoning hazard on bright, sunny days.	Use sunblock and long sleeves as appropriate. Avoid direct exposure to sun for long periods of time.

Equipment Expected To Be Used	Inspection Requirements	Training Requirements
Heavy equipment Bladed or cutting tools Level D PPE Hand tools Maps Pickup trucks and/or passenger vehicles Scoops/trowels Sample bottles	***Site Inspection:*** Daily inspection by SSHO. Periodic inspection by PSM. ***Motor Vehicles:*** Before initial use, Operator will inspect and ensure safe operating condition of vehicles. ***Equipment:*** Ensure equipment is tested and inspected by a qualified person before it is placed into use. Conduct inspections and tests in accordance with manufacturer's instructions. Ensure operator of equipment in use inspects the equipment daily.	***Site-Specific:*** OSHA HAZWOPER Initial site-specific orientation Daily tailgate safety meetings Hazard communication ***Supervisory Personnel:*** OSHA supervisor's training ***Motor Vehicles:*** Operators will hold a valid license for the type and class of vehicle they are operating. ***Instrumentation and Equipment General:*** Employees will be qualified and trained to operate or service equipment.

Activity 3 — Geoprobe® Groundwater Sample Collection

Task	Hazards	Hazard Control
Use of a Geoprobe® to collect grab groundwater samples in the shallow groundwater at the former Arsenal in accordance with the CASP. Shallow groundwater sampling will follow NJDEP methods presented in the NJDEP *Alternative Ground Water Sampling Techniques Guide*, (July 1994).	***Chemical Hazards*** — The potential for exposure is to site contaminants is low to moderate based upon presence of contaminated groundwater.	Level D PPE will be worn during groundwater sampling activities. An upgrade to modified level D will be determined by the SSHO. Utilize splash protection as necessary. Air monitoring will be performed to evaluate exposure potential to VOCs (PID). Utilize action levels outlined in SSHP.
	Physical Hazards — Slip, trips, falls, tools, terrain or vegetation; uneven walking surfaces. Weather hazards, such as wind, lightning, and poor visibility. Poor housekeeping.	The work area will be visually inspected. Slip, trip, and fall hazards will be either removed or marked and barricaded. Sufficient illumination will be maintained. Site personnel will conduct walkover in groups of two as a minimum. Site personnel will refer to and follow Weston FLDs 02-Inclement weather and 39-Illumination. Also, see FLD 11 and 12. Materials will be stored to prevent intrusion into the work areas. Work areas will be kept organized. See FLD 12.
	Hands or fingers caught between objects; abrasions and lacerations. Use of tools.	Personnel will be made aware of the hazard and asked to coordinate carefully the handling and placement of heavy objects. Materials and objects being handled will be inspected for rough or sharp edges, and appropriate precautions will be taken to avoid contact. Personnel will wear work gloves and avoid placing hands between objects. Refer to FLDs 29 and 38.
	Noise from equipment	Workers shall wear hearing protection during high-noise activities. Refer to FLD 01.
	Traffic	Wear reflective safety vest and cordon off work areas where vehicle traffic is present. Refer to FLD 20.
	Potential for Fire (from equipment)	Keep a 20-pound fire extinguisher within the field vehicle or in the immediate vicinity of the work area. Refer to FLD 32.
	Working in a Remote Area	Ensure functioning method of contact with field team lead/SSHO/PM. Utilize buddy system at all times. Refer to FLD 15.
	Manual lifting/handling	Utilize proper lifting techniques and use a buddy to lift larger loads. Refer to FLD 10
	Moving mechanical parts from heavy equipment operations.	Personnel will be made aware of the hazard and will coordinate carefully during equipment handling operations. Guards will be kept in place during operation. Maintain safe distance from moving mechanical parts. Always use appropriate PPE. See FLD 22.

Activity 3 — Geoprobe® Groundwater Sample Collection (Continued)

Task	Hazards	Hazard Control
	Drilling safety	Remain safe distance from all mechanized parts. Cordon off drilling area. Inspect drill rig upon arrival and at regular intervals throughout duration of activity. Refer to the Weston Drilling Guide, Section 2.5 of the Safety Officer's Manual.
	Utilities (overhead and underground)	Verify all utility locations in drilling area by at least three sources, if available. Ensure NJ One Call mark-out has been performed. Refer to FLD 34.
	Heat/Cold stress	Workers will be briefed and cognizant of heat and cold stress symptoms. Fluids will be available to workers. See FLD 05 and 06. Work rest periods will be established according to ACGIH and NIOSH guidelines.
	Biological Hazards — Poisonous plants, insects, snakes.	Review recognition of poisonous plants, insects, or snakes typical of this area. Use appropriate measures as required. Adhere to Weston BBP Exposure Control Plan—First Aid Procedures and FLD 43 in Section 120, Attachment M.
	Radiological Hazards — Potential sunburn/sun poisoning hazard on bright, sunny days.	Use sunblock and long sleeves as appropriate. Avoid direct exposure to sun for long periods of time.

Equipment Expected To Be Used	Inspection Requirements	Training Requirements
Geoprobe® Macrocore Level D PPE, nitrile glove Hand tools Sample bottles Pickup trucks and/or passenger vehicles Pump and tubing	***Site Inspection:*** Daily inspection by SSHO. Periodic inspection by PSM. ***Motor Vehicles:*** Before initial use, Operator will inspect and ensure safe operating condition of vehicles. ***Equipment:*** Ensure equipment is tested and inspected by a qualified person before it is placed into use. Conduct inspections and tests in accordance with manufacturer's instructions. Ensure operator of equipment in use inspects the equipment daily.	***Site-Specific:*** OSHA HAZWOPER Initial site-specific orientation Daily tailgate safety meetings Hazard communication ***Supervisory Personnel:*** OSHA supervisor's training ***Motor Vehicles:*** Operators will hold a valid license for the type and class of vehicle they are operating. ***Instrumentation and Equipment General:*** Employees will be qualified and trained to operate or service equipment.

Activity 4— Monitor Well Installation

Task	Hazards	Hazard Control
Installation of monitoring wells include drilling of the borehole for the well, construction of the well, and development of the well. Well installation will be conducted in accordance with their respective sections of the CSAP and NJDEP TRSR (July 2005) and FSPM (August 2005).	***Chemical Hazards*** — The potential for exposure is to site contaminants is low to moderate based on potential exposure to contaminated site soils.	Level D PPE will be worn during well installation activities. An upgrade to modified level D will be determined by the SSHO. Air monitoring will be performed to evaluate exposure potential to particulates (PDR or Mini RAM) and VOCs (PID). Utilize action levels outlined in SSHP.
	Physical Hazards — Slip, trips, falls, tools, terrain or vegetation; uneven walking surfaces. Weather hazards, such as wind, lightning, and poor visibility. Poor housekeeping.	The work area will be visually inspected. Slip, trip, and fall hazards will be either removed or marked and barricaded. Sufficient illumination will be maintained. Site personnel will conduct walkover in groups of two as a minimum. Site personnel will refer to and follow Weston FLDs 02-Inclement weather and 39-Illumination. Also, see FLD 11 and 12. Materials will be stored to prevent intrusion into the work areas. Work areas will be kept organized. See FLD 12.
	Hands or fingers caught between objects; abrasions and lacerations.	Personnel will be made aware of the hazard and asked to coordinate carefully the handling and placement of heavy objects. Materials and objects being handled will be inspected for rough or sharp edges, and appropriate precautions will be taken to avoid contact. Personnel will wear work gloves and avoid placing hands between objects.
	Noise from equipment	Workers shall wear hearing protection during high-noise activities. Refer to FLD 01.
	Traffic	Wear reflective safety vest and cordon off work areas where vehicle traffic is present. Refer to FLD 20.
	Potential for Fire (from equipment)	Keep a 20-pound fire extinguisher within the field vehicle or in the immediate vicinity of the work area. Refer to FLD 32.
	Working in a Remote Area	Ensure functioning method of contact with field team lead/SSHO/PM. Utilize buddy system at all times. Refer to FLD 15.
	Manual lifting/handling	Utilize proper lifting techniques and use a buddy to lift larger loads. Refer to FLD 10
	Moving mechanical parts from heavy equipment operations.	Personnel will be made aware of the hazard and will coordinate carefully during equipment handling operations. Guards will be kept in place during operation. Maintain safe distance from moving mechanical parts. Always use appropriate PPE. See FLD 22.

Activity 4— Monitor Well Installation (Continued)

Task	Hazards	Hazard Control
	Drilling safety	Remain safe distance from all mechanized parts. Cordon off drilling area. Inspect drill rig upon arrival and at regular intervals throughout duration of activity. Refer to the Weston Drilling Guide, Section 2.5 of the Safety Officer's Manual.
	Utilities (overhead and underground)	Verify all utility locations in drilling area by at least three sources, if available. Ensure NJ One Call mark-out has been performed. Refer to FLD 34.
	Heat/Cold stress	Workers will be briefed and cognizant of heat and cold stress symptoms. Fluids will be available to workers. See FLD 05 and 06. Work rest periods will be established according to ACGIH and NIOSH guidelines.
	Biological Hazards — Poisonous plants, insects, snakes.	Review recognition of poisonous plants, insects, or snakes typical of this area. Use appropriate measures as required. Adhere to Weston Bloodborne Pathogens Exposure Control Plan—First Aid Procedures and FLD 43 in Section 12.0, Attachment M.
	Radiological Hazards — Potential sunburn/sun poisoning hazard on bright, sunny days.	Use sunblock and long sleeves as appropriate. Avoid direct exposure to sun for long periods of time.

Equipment Expected To Be Used	**Inspection Requirements**	**Training Requirements**
Drill Rig Hand and power tools Level D PPE Plastic sheeting Drums Decon equipment/materials Air monitoring equipment Well construction materials	***Site Inspection:*** Daily inspection by SSHO. Periodic inspection by PSM. ***Motor Vehicles:*** Before initial use, operator will inspect and ensure safe operating condition of vehicles. ***Equipment:*** Ensure equipment is tested and inspected by a qualified person before it is placed into use. Conduct inspections and tests in accordance with manufacturer's instructions. Ensure operator of equipment in use inspects the equipment daily.	***Site-Specific:*** OSHA HAZWOPER Initial site-specific orientation Daily tailgate safety meetings Hazard communication ***Supervisory Personnel:*** OSHA supervisor's training ***Motor Vehicles:*** Operators will hold a valid license for the type and class of vehicle they are operating. ***Instrumentation and Equipment General:*** Employees will be qualified and trained to operate or service equipment.

Activity 5— Groundwater Sampling

Task	Hazards	Hazard Control
Groundwater sampling will be conducted in accordance with the groundwater sampling, sample preservations, volume and containers, and sample receipt, handling, and custody protocols (CSAP).	***Chemical Hazards*** — Groundwater is known to contain contaminants. The potential for exposure is to site contaminants is low if proper PPE is worn to mitigate the hazard.	Level D PPE will be worn during groundwater sampling activities. An upgrade to modified level D will be determined by the SSHO. Utilize splash protection as necessary. Air monitoring will be performed to evaluate exposure potential to VOCs (PID). Utilize action levels outlined in SSHP.
	Physical Hazards — Slip, trips, falls, tools, terrain or vegetation; uneven walking surfaces. Weather hazards, such as wind, lightning, and poor visibility. Poor housekeeping.	The work area will be visually inspected. Slip, trip, and fall hazards will be either removed or marked and barricaded. Sufficient illumination will be maintained. Site personnel will conduct walkover in groups of two as a minimum. Site personnel will refer to and follow Weston FLDs 02-Inclement weather and 39-Illumination. Also, see FLD 11 and 12. Materials will be stored to prevent intrusion into the work areas. Work areas will be kept organized. See FLD 12.
	Hands or fingers caught between objects; abrasions and lacerations. Use of hand tools.	Personnel will be made aware of the hazard and asked to coordinate carefully the handling and placement of heavy objects. Materials and objects being handled will be inspected for rough or sharp edges, and appropriate precautions will be taken to avoid contact. Personnel will wear work gloves and avoid placing hands between objects. Refer to FLDs 29 and 38.
	Noise from equipment	Workers shall wear hearing protection during high-noise activities. Refer to FLD 01.
	Traffic	Wear reflective safety vest and cordon off work areas where vehicle traffic is present. Refer to FLD 20.
	Use of electrical equipment	Keep electrical equipment and sources dry. Refer to FLD 35.
	Potential for Fire (from equipment)	Keep a 20-pound fire extinguisher within the field vehicle or in the immediate vicinity of the work area. Refer to FLD 32.
	Working in a Remote Area	Ensure functioning method of contact with field team lead/SSHO/PM. Utilize buddy system at all times. Refer to FLD 15.
	Moving mechanical parts from heavy equipment operations.	Personnel will be made aware of the hazard and will coordinate carefully during equipment handling operations. Guards will be kept in place during operation. Maintain safe distance from moving mechanical parts. Always use appropriate PPE. See FLD 22.

Activity 5— Groundwater Sampling (Continued)

Task	Hazards	Hazard Control
	Heat/Cold stress	Workers will be briefed and cognizant of heat and cold stress symptoms. Fluids will be available to workers. See FLD 05 and 06. Work rest periods will be established according to ACGIH and NIOSH guidelines.
	Biological Hazards — Poisonous plants, insects, snakes.	Review recognition of poisonous plants, insects, or snakes typical of this area. Use appropriate measures as required. Adhere to Weston BBPExposure Control Plan—First Aid Procedures and FLD 43 in Section 12.0, Attachment M.
	Radiological Hazards — Potential sunburn/sun poisoning hazard on bright, sunny days.	Use sunblock and long sleeves as appropriate. Avoid direct exposure to sun for long periods of time.

Equipment Expected To Be Used	**Inspection Requirements**	**Training Requirements**
Pump Generator or other power source Bladed or cutting tools Level D PPE and nitrile gloves Hand tools Tubing Pickup trucks and/or passenger vehicles Flow-thru cell Water quality meter Sample bottles Water level meter	***Site Inspection:*** Daily inspection by SSHO. Periodic inspection by PSM. ***Motor Vehicles:*** Before initial use, Operator will inspect and ensure safe operating condition of vehicles. ***Equipment:*** Ensure equipment is tested and inspected by a qualified person before it is placed into use. Conduct inspections and tests in accordance with manufacturer's instructions. Ensure operator of equipment in use inspects the equipment daily.	***Site-Specific:*** OSHA HAZWOPER Initial site-specific orientation Daily tailgate safety meetings Hazard communication ***Supervisory Personnel:*** OSHA supervisor's training ***Motor Vehicles:*** Operators will hold a valid license for the type and class of vehicle they are operating. ***Instrumentation and Equipment General:*** Employees will be qualified and trained to operate or service equipment.

Activity 6—Survey

Task	Hazards	Hazard Control
Surveying will be conducted in accordance with the surveying protocols (CSAP).	***Chemical Hazards*** — This task is non-intrusive. Therefore, the potential for exposure will be low.	Level D PPE will be worn during survey activities.
	Physical Hazards — Slip, trips, falls, tools, terrain or vegetation; uneven walking surfaces. Weather hazards, such as wind, lightning, and poor visibility.	The work area will be visually inspected. Slip, trip, and fall hazards will be either removed or marked and barricaded. Sufficient illumination will be maintained. Site personnel will conduct walkover in groups of two as a minimum. Site personnel will refer to and follow Weston FLDs 02 and 39. Also, see FLD 11 and 12.
	Housekeeping.	Materials will be stored to prevent intrusion into the work areas. Work areas will be kept organized. See FLD 12.
	Traffic	Wear reflective safety vest and cordon off work areas where vehicle traffic is present. Refer to FLD 20.
	Strains and sprains from manually lifting and moving.	Use proper lifting techniques such as keeping straight back, lifting with legs; avoid twisting back; use mechanical equipment or get help from others. See FLD 10.
	Heat/cold stress	Workers will be briefed and cognizant of heat and cold stress symptoms. Fluids will be available to workers. See FLD 05 and 06. Work rest periods will be established according to ACGIH and NIOSH guidelines. Outdoor work will be suspended during inclement weather with high wind or lightning, see FLD 02.
	Working in a Remote Area	Ensure functioning method of contact with field team lead/SSHO/PM. Utilize buddy system at all times. Refer to FLD 15.
	Hands or fingers caught between objects; abrasions and lacerations. Use of tools.	Personnel will be made aware of the hazard and asked to coordinate carefully the handling and placement of heavy objects. Materials and objects being handled will be inspected for rough or sharp edges, and appropriate precautions will be taken to avoid contact. Personnel will wear work gloves and avoid placing hands between objects. Refer to FLDs 29 and 38.
	Biological Hazards — Poisonous plants, insects, snakes.	Review recognition of poisonous plants, insects, or snakes typical of this area. Use appropriate measures as required. Adhere to Weston BBP Exposure Control Plan—First Aid Procedures. See also FLD 43 in Section 12.0, Attachment M.
	Radiological Hazards — Potential sunburn/sun poisoning hazard on bright, sunny days.	Use sunblock and long sleeves as appropriate. Avoid direct exposure to sun for long periods of time.

Activity 6 — Surveying (Continued)

Equipment Expected To Be Used	**Inspection Requirements**	**Training Requirements**
Level D PPE Hand tools Maps Pickup trucks and/or passenger vehicles Survey equipment Marking paint/flags	***Site Inspection:*** Daily inspection by SSHO. Periodic inspection by PSM. ***Motor Vehicles:*** Before initial use, operator will inspect and ensure safe operating condition of vehicles. ***Equipment:*** Ensure equipment is tested and inspected by a qualified person before it is placed into use. Conduct inspections and tests in accordance with manufacturer's instructions. Ensure operator of equipment in use inspects the equipment daily.	***Site-Specific:*** OSHA HAZWOPER Initial site-specific orientation Daily tailgate safety meetings Hazard communication ***Supervisory Personnel:*** OSHA supervisor's training ***Motor Vehicles:*** Operators will hold a valid license for the type and class of vehicle they are operating. ***Instrumentation and Equipment General:*** Employees will be qualified and trained to operate or service equipment.

Activity 7— Sediment Sampling

Task	Hazards	Hazard Control
Sediment samples will be collected following the sediment sampling protocols outlined in the CSAP. Sediment sampling will follow *in-situ* surface water measurements collected at each location and will also follow surface water sample collection where applicable. Sediment samples will be collected from surficial (0-6 inch) depths with either a decontaminated stainless steel auger or Ponar dredge, whichever is most effective at a given location.	***Chemical Hazards*** — The potential for exposure is to site contaminants is low.	Level D PPE will be worn during sediment sampling activities. An upgrade to modified level D will be determined by the SSHO. Utilize splash protection as necessary.
	Physical Hazards — Slip, trips, falls, tools, terrain or vegetation; uneven walking surfaces. Weather hazards, such as wind, lightning, and poor visibility.	The work area will be visually inspected. Slip, trip, and fall hazards will be either removed or marked and barricaded. Sufficient illumination will be maintained. Site personnel will conduct walkover in groups of two as a minimum. Site personnel will refer to and follow Weston FLDs 02-Inclement weather and 39-Illumination. Also, see FLD 11 and 12.
	Poor housekeeping.	Materials will be stored to prevent intrusion into the work areas. Work areas will be kept organized. See FLD 12.
	Working in a Remote Area	Ensure functioning method of contact with field team lead/SSHO/PM. Utilize buddy system at all times. Refer to FLD 15.
	Strains and sprains from manually lifting and moving.	Use proper lifting techniques such as keeping straight back, lifting with legs; avoid twisting back; use mechanical equipment or get help from others. See FLD 10.
	Heat/cold stress	Workers will be briefed and cognizant of heat and cold stress symptoms. Fluids will be available to workers. See FLD 05 and 06. Work rest periods will be established according to ACGIH and NIOSH guidelines. Outdoor work will be suspended during inclement weather with high wind or lightning, see FLD 02.
	Use of boat/working over water.	Utilize or make available personal floatation devices for all personnel. Utilize the buddy system at all times. Only licensed and qualified personnel may operate boats. All work will be performed in accordance with FLDs 18 and 19.
	Hands or fingers caught between objects; abrasions and lacerations.	Personnel will be made aware of the hazard and asked to coordinate carefully the handling and placement of heavy objects. Materials and objects being handled will be inspected for rough or sharp edges, and appropriate precautions will be taken to avoid contact. Personnel will wear work gloves and avoid placing hands between objects.
	Biological Hazards — Poisonous plants, insects, snakes.	Review recognition of poisonous plants, insects, or snakes typical of this area. Use appropriate measures as required. Adhere to Weston BBP Exposure Control Plan—First Aid Procedures. See also FLD 43 in Section 12.0, Attachment M.
	Radiological Hazards — Potential sunburn/sun poisoning hazard on bright, sunny days.	Use sunblock and long sleeves as appropriate. Avoid direct exposure to sun for long periods of time.

Activity 7— Sediment Sampling (Continued)

Equipment Expected To Be Used	**Inspection Requirements**	**Training Requirements**
Motor vehicles/boats PFDs Hand and power tools Level D PPE and nitrile gloves Scoops/dredge Sample bottles	***Site Inspection:*** Daily inspection by SSHO. Periodic inspection by PSM. ***Motor Vehicles/Boats:*** Before initial use, operator will inspect and ensure safe operating condition of vehicles. ***Equipment:*** Ensure equipment is tested and inspected by a qualified person before it is placed into use. Conduct inspections and tests in accordance with manufacturer's instructions. Ensure operator of equipment in use inspects the equipment daily.	***Site-Specific:*** OSHA HAZWOPER Initial site-specific orientation Daily tailgate safety meetings Hazard communication Boating safety ***Supervisory Personnel:*** OSHA supervisor's training Boating safety ***Motor Vehicles:*** Operators will hold a valid license for the type and class of vehicle they are operating. If a motorboat is used, a valid boating license. ***Instrumentation and Equipment General:*** Employees will be qualified and trained to operate or service equipment.

Activity 8 — Surface Water Sampling

Task	Hazards	Hazard Control
In-situ water quality measurements will be taken at each of the aquatic sampling locations, provided there is sufficient surface water in which to take measurements. *In-situ* measurements will be collected using an electronic meter pre-calibrated prior to sampling.	***Chemical Hazards*** — The potential for exposure will be low.	Level D PPE will be worn during surface water sampling activities. An upgrade to modified level D will be determined by the SSHO. Utilize splash protection as necessary.
	Physical Hazards — Slip, trips, falls, tools, terrain or vegetation; uneven walking surfaces. Weather hazards, such as wind, lightning, and poor visibility.	The work area will be visually inspected. Slip, trip, and fall hazards will be either removed or marked and barricaded. Sufficient illumination will be maintained. Site personnel will conduct walkover in groups of two as a minimum. Site personnel will refer to and follow Weston FLDs 02-Inclement weather and 39-Illumination. Also, see FLD 11 and 12.
	Poor housekeeping.	Materials will be stored to prevent intrusion into the work areas. Work areas will be kept organized. See FLD 12.
	Use of boat/working over water.	Utilize or make available personal floatation devices for all personnel. Utilize the buddy system at all times. Only licensed and qualified personnel may operate boats. All work will be performed in accordance with FLDs 18 & 19.
	Working in a Remote Area	Ensure functioning method of contact with field team lead/SSHO/PM. Utilize buddy system at all times. Refer to FLD 15.
	Strains and sprains from manually lifting and moving.	Use proper lifting techniques such as keeping straight back, lifting with legs; avoid twisting back; use mechanical equipment or get help from others. See FLD 10.
	Heat/cold stress	Workers will be briefed and cognizant of heat and cold stress symptoms. Fluids will be available to workers. See FLD 05 and 06. Work rest periods will be established according to ACGIH and NIOSH guidelines. Outdoor work will be suspended during inclement weather with high wind or lightning, see FLD 02.
	Hands or fingers caught between objects; abrasions and lacerations. Use of tools.	Personnel will be made aware of the hazard and asked to coordinate carefully the handling and placement of heavy objects. Materials and objects being handled will be inspected for rough or sharp edges, and appropriate precautions will be taken to avoid contact. Personnel will wear work gloves and avoid placing hands between objects. Refer to FLDs 29 and 38.
	Biological Hazards — Poisonous plants, insects, snakes.	Review recognition of poisonous plants, insects, or snakes typical of this area. Use appropriate measures as required. Adhere to Weston BBP Exposure Control Plan—First Aid Procedures. See also FLD 43 in Section 12, Attachment M.
	Radiological Hazards — Potential sunburn/sun poisoning hazard on bright, sunny days.	Use sunblock and long sleeves as appropriate. Avoid direct exposure to sun for long periods of time.

Activity 8 — Surface Water Sampling (Continued)

Equipment Expected To Be Used	Inspection Requirements	Training Requirements
Motor Vehicles/Boats PFDs Hand and power tools Level D PPE and nitrile gloves Sample collector Sample bottles	***Site Inspection:*** Daily inspection by SSHO. Periodic inspection by PSM. ***Motor Vehicles/Boats:*** Before initial use, operator will inspect and ensure safe operating condition of vehicles. Boat Safety is included in Section 12.0, Attachment K. ***Equipment:*** Ensure equipment is tested and inspected by a qualified person before it is placed into use. Conduct inspections and tests in accordance with manufacturer's instructions. Ensure operator of equipment in use inspects the equipment daily.	***Site-Specific:*** OSHA HAZWOPER Initial site-specific orientation Daily tailgate safety meetings Hazard communication Boating safety ***Supervisory Personnel:*** OSHA supervisor's training Boating safety ***Motor Vehicles:*** Operators will hold a valid license for the type and class of vehicle they are operating. If a motorboat is used, a valid boating license. ***Instrumentation and Equipment General:*** Employees will be qualified and trained to operate or service equipment.

Activity 9 — Benthic Microinvertebrate Sampling

Task	Hazards	Hazard Control
Benthic macroinvertebrates are collected from freshwater streams as per sampling protocols found in the CSAP. From each location, three replicate samples will be collected using a petite Ponar dredge. Samples will be sieved in the field to reduce the amount of fine sediment particles in the sample, placing the sample into stainless steel mesh bottom-lined bucket, and submerging the bottom of the bucket in the ambient water. Material remaining in the bucket will be transferred to 32-ounce polyethylene containers and preserved with 70% denatured ethanol.	***Chemical Hazards*** — Low risk of exposure. Only during sediment sample collection.	Level D PPE will be worn during benthic microinvertebrate sampling activities.
	Physical Hazards — Slip, trips, falls, tools, terrain or vegetation; uneven walking surfaces. Weather hazards, such as wind, lightning, and poor visibility.	The work area will be visually inspected. Slip, trip, and fall hazards will be either removed or marked and barricaded. Sufficient illumination will be maintained. Site personnel will conduct walkover in groups of two as a minimum. Site personnel will refer to and follow Weston FLDs 02-Inclement weather and 39-Illumination. Also, see FLD 11 and 12.
	Poor housekeeping.	Materials will be stored to prevent intrusion into the work areas. Work areas will be kept organized. See FLD 12.
	Use of boat/working over water.	Utilize or make available personal floatation devices for all personnel. Utilize the buddy system at all times. Only licensed and qualified personnel may operate boats. All work will be performed in accordance with FLDs 18 & 19.
	Working in a Remote Area	Ensure functioning method of contact with field team lead/SSHO/PM. Utilize buddy system at all times. Refer to FLD 15.
	Strains and sprains from manually lifting and moving.	Use proper lifting techniques such as keeping straight back, lifting with legs; avoid twisting back; use mechanical equipment or get help from others. See FLD 10.
	Heat/cold stress	Workers will be briefed and cognizant of heat and cold stress symptoms. Fluids will be available to workers. See FLD 05 and 06. Work rest periods will be established according to ACGIH and NIOSH guidelines. Outdoor work will be suspended during inclement weather with high wind or lightning, see FLD 02.
	Hands or fingers caught between objects; abrasions and lacerations.	Personnel will be made aware of the hazard and asked to coordinate carefully the handling and placement of heavy objects. Materials and objects being handled will be inspected for rough or sharp edges, and appropriate precautions will be taken to avoid contact. Personnel will wear work gloves and avoid placing hands between objects.
	Biological Hazards — Poisonous plants, insects, snakes.	Review recognition of poisonous plants, insects, or snakes typical of this area. Use appropriate measures as required. Adhere to Weston BBPExposure Control Plan—First Aid Procedures. See also FLD 43 in Section 12.0, Attachment M.
	Radiological Hazards — Potential sunburn/sun poisoning hazard on bright, sunny days.	Use sunblock and long sleeves as appropriate. Avoid direct exposure to sun for long periods of time.

Activity 9 — Benthic Microinvertebrate Sampling (Continued)

Equipment Expected To Be Used	**Inspection Requirements**	**Training Requirements**
Motor vehicles/boats Hand and power tools Level D PPE and nitrile gloves Scoops/dredge Sample bottles	***Site Inspection:*** Daily inspection by SSHO. Periodic inspection by PSM. ***Motor Vehicles/Boats:*** Before initial use, operator will inspect and ensure safe operating condition of vehicles. Boat Safety is included in Section 12.0, Attachment K. ***Equipment:*** Ensure equipment is tested and inspected by a qualified person before it is placed into use. Conduct inspections and tests in accordance with manufacturer's instructions. Ensure operator of equipment in use inspects the equipment daily.	***Site-Specific:*** OSHA HAZWOPER Initial site-specific orientation Daily tailgate safety meetings Hazard communication Boating safety ***Supervisory Personnel:*** OSHA supervisor's training Boating safety ***Motor Vehicles:*** Operators will hold a valid license for the type and class of vehicle they are operating. If a motorboat is used, a valid boating license. ***Instrumentation and Equipment General:*** Employees will be qualified and trained to operate or service equipment.

Activity 10— Fish Sampling

Task	Hazards	Hazard Control
A variety of collection techniques may be used to obtain a sufficient number of fish for tissue analysis. The preference is to use boat electroshocking (or backpack electrochocking, where applicable) due to its effectiveness in shallow water bodies such as are found across the former Arsenal.	***Chemical Hazards*** — This task is non-intrusive. Therefore, the potential for exposure will be low.	Level D PPE will be worn during fish sampling activities.
	Physical Hazards — Slip, trips, falls, tools, terrain or vegetation; uneven walking surfaces. Weather hazards, such as wind, lightning, and poor visibility.	The work area will be visually inspected. Slip, trip, and fall hazards will be either removed or marked and barricaded. Sufficient illumination will be maintained. Site personnel will conduct walkover in groups of two as a minimum. Site personnel will refer to and follow Weston FLDs 02-Inclement weather and 39-Illumination. Also, see FLD 11 and 12.
	Poor housekeeping.	Materials will be stored to prevent intrusion into the work areas. Work areas will be kept organized. See FLD 12.
	Strains and sprains from manually lifting and moving.	Use proper lifting techniques such as keeping straight back, lifting with legs; avoid twisting back; use mechanical equipment or get help from others. See FLD 10.
	Heat/cold stress	Workers will be briefed and cognizant of heat and cold stress symptoms. Fluids will be available to workers. See FLD 05 and 06. Work rest periods will be established according to ACGIH and NIOSH guidelines. Outdoor work will be suspended during inclement weather with high wind or lightning, see FLD 02.
	Use of boat/working over water.	Utilize or make available personal floatation devices for all personnel. Utilize the buddy system at all times. Only licensed and qualified personnel may operate boats. All work will be performed in accordance with FLDs 18 & 19.
	Working in a Remote Area	Ensure functioning method of contact with field team lead/SSHO/PM. Utilize buddy system at all times. Refer to FLD 15.
	Use of electricity.	All work will be performed in accordance with FLD 35 when electric equipment is used.
	Hands or fingers caught between objects; abrasions and lacerations. Use of tools.	Personnel will be made aware of the hazard and asked to coordinate carefully the handling and placement of heavy objects. Materials and objects being handled will be inspected for rough or sharp edges, and appropriate precautions will be taken to avoid contact. Personnel will wear work gloves and avoid placing hands between objects.
	Biological Hazards — Poisonous plants, insects, snakes.	Review recognition of poisonous plants, insects, or snakes typical of this area. Use appropriate measures as required. Adhere to Weston BBP Exposure Control Plan—First Aid Procedures. See also FLD 43 in Section 12.0, Attachment M.
	Radiological Hazards — Potential sunburn/sun poisoning hazard on bright, sunny days.	Use sunblock and long sleeves as appropriate. Avoid direct exposure to sun for long periods of time.

Activity 10 – Fish Sampling (Continued)

Equipment Expected To Be Used	**Inspection Requirements**	**Training Requirements**
Motor Vehicles/Boats Hand and power tools Level D PPE Fish shocking/netting devices	***Site Inspection:*** Daily inspection by SSHO. Periodic inspection by PSM. ***Motor Vehicles/Boats:*** Before initial use, operator will inspect and ensure safe operating condition of vehicles. Boat Safety is included in Section 12.0, Attachment K. ***Equipment:*** Ensure equipment is tested and inspected by a qualified person before it is placed into use. Conduct inspections and tests in accordance with manufacturer's instructions. Ensure operator of equipment in use inspects the equipment daily.	***Site-Specific:*** OSHA HAZWOPER Initial site-specific orientation Daily tailgate safety meetings Hazard communication Boating safety ***Supervisory Personnel:*** OSHA supervisor's training Boating safety ***Motor Vehicles:*** Operators will hold a valid license for the type and class of vehicle they are operating. If a motorboat is used, a valid boating license. ***Instrumentation and Equipment General:*** Employees will be qualified and trained to operate or service equipment.

Activity 11— Frog Sampling

Task	Hazards	Hazard Control
Frogs will be primarily captured at night. A portable spotlight will be used from a boat or shore in order to spot and net frogs while they are blinded.	***Chemical Hazards*** — This task is non-intrusive. Therefore, the potential for exposure will be low.	Level D PPE will be worn during frog sampling activities.
	Physical Hazards — Slip, trips, falls, tools, terrain or vegetation; uneven walking surfaces. Weather hazards, such as wind, lightning, and poor visibility.	The work area will be visually inspected. Slip, trip, and fall hazards will be either removed or marked and barricaded. Sufficient illumination will be maintained. Site personnel will conduct walkover in groups of two as a minimum. Site personnel will refer to and follow Weston FLDs 02-Inclement weather and 39-Illumination. Also, see FLD 11 and 12.
	Poor housekeeping.	Materials will be stored to prevent intrusion into the work areas. Work areas will be kept organized. See FLD 12.
	Working in a Remote Area	Ensure functioning method of contact with field team lead/SSHO/PM. Utilize buddy system at all times. Refer to FLD 15.
	Strains and sprains from manually lifting and moving.	Use proper lifting techniques such as keeping straight back, lifting with legs; avoid twisting back; use mechanical equipment or get help from others. See FLD 10.
	Heat/cold stress	Workers will be briefed and cognizant of heat and cold stress symptoms. Fluids will be available to workers. See FLD 05 and 06. Work rest periods will be established according to ACGIH and NIOSH guidelines. Outdoor work will be suspended during inclement weather with high wind or lightning, see FLD 02.
	Hands or fingers caught between objects; abrasions and lacerations.	Personnel will be made aware of the hazard and asked to coordinate carefully the handling and placement of heavy objects. Materials and objects being handled will be inspected for rough or sharp edges, and appropriate precautions will be taken to avoid contact. Personnel will wear work gloves and avoid placing hands between objects.
	Biological Hazards — Poisonous plants, insects, snakes.	Review recognition of poisonous plants, insects, or snakes typical of this area. Use appropriate measures as required. Adhere to Weston BBP Exposure Control Plan—First Aid Procedures. See also FLD 43 in Section 12.0, Attachment M.
	Radiological Hazards — Potential sunburn/sun poisoning hazard on bright, sunny days.	Use sunblock and long sleeves as appropriate. Avoid direct exposure to sun for long periods of time. Low exposure potential if activities will be performed at night.

Activity 11— Frog Sampling (Continued)

Equipment Expected To Be Used	**Inspection Requirements**	**Training Requirements**
Motor Vehicles Hand and power tools Level D PPE and nitrile gloves Spotlight Nets	***Site Inspection:*** Daily inspection by SSHO. Periodic inspection by PSM. ***Motor Vehicles:*** Before initial use, operator will inspect and ensure safe operating condition of vehicles. ***Equipment:*** Ensure equipment is tested and inspected by a qualified person before it is placed into use. Conduct inspections and tests in accordance with manufacturer's instructions. Ensure operator of equipment in use inspects the equipment daily.	***Site-Specific:*** OSHA HAZWOPER Initial site-specific orientation Daily tailgate safety meetings Hazard communication ***Supervisory Personnel:*** OSHA supervisor's training ***Motor Vehicles:*** Operators will hold a valid license for the type and class of vehicle they are operating. ***Instrumentation and Equipment General:*** Employees will be qualified and trained to operate or service equipment.

Activity 12 - Fiddler Crab Sampling

Task	**Hazards**	**Hazard Control**
Fiddler crabs will be primarily captured by hand or net at low tide across the intertidal flats at each sampling location.	***Chemical Hazards*** — This task is non-intrusive. Therefore, the potential for exposure will be low.	Level D PPE will be worn during crab sampling activities.
	Physical Hazards — Slip, trips, falls, tools, terrain or vegetation; uneven walking surfaces. Weather hazards, such as wind, lightning, and poor visibility.	The work area will be visually inspected. Slip, trip, and fall hazards will be either removed or marked and barricaded. Sufficient illumination will be maintained. Site personnel will conduct walkover in groups of two as a minimum. Site personnel will refer to and follow Weston FLDs 02-Inclement weather and 39-Illumination. Also, see FLD 11 and 12.
	Housekeeping.	Materials will be stored to prevent intrusion into the work areas. Work areas will be kept organized. See FLD 12.
	Working in a Remote Area	Ensure functioning method of contact with field team lead/SSHO/PM. Utilize buddy system at all times. Refer to FLD 15.
	Strains and sprains from manually lifting and moving.	Use proper lifting techniques such as keeping straight back, lifting with legs; avoid twisting back; use mechanical equipment or get help from others. See FLD 10.
	Heat/cold stress	Workers will be briefed and cognizant of heat and cold stress symptoms. Fluids will be available to workers. See FLD 05 and 06. Work rest periods will be established according to ACGIH and NIOSH guidelines. Outdoor work will be suspended during inclement weather with high wind or lightning, see FLD 02.
	Hands or fingers caught between objects; abrasions and lacerations. Use of tools.	Personnel will be made aware of the hazard and asked to coordinate carefully the handling and placement of heavy objects. Materials and objects being handled will be inspected for rough or sharp edges, and appropriate precautions will be taken to avoid contact. Personnel will wear work gloves and avoid placing hands between objects.
	Biological Hazards — Poisonous plants, insects, snakes.	Review recognition of poisonous plants, insects, or snakes typical of this area. Use appropriate measures as required. Adhere to Weston BBP Exposure Control Plan—First Aid Procedures. See also FLD 43 in Section 12.0, Attachment M.
	Radiological Hazards — Potential sunburn/sun poisoning hazard on bright, sunny days.	Use sunblock and long sleeves as appropriate. Avoid direct exposure to sun for long periods of time.

Activity 12 — Fiddler Crab Sampling (Continued)

Equipment Expected To Be Used	**Inspection Requirements**	**Training Requirements**
Motor Vehicles Hand tools Level D PPE and nitrile gloves Nets	***Site Inspection:*** Daily inspection by SSHO. Periodic inspection by PSM. ***Motor Vehicles:*** Before initial use, Operator will inspect and ensure safe operating condition of vehicles. ***Equipment:*** Ensure equipment is tested and inspected by a qualified person before it is placed into use. Conduct inspections and tests in accordance with manufacturer's instructions. Ensure operator of equipment in use inspects the equipment daily.	***Site-Specific:*** OSHA HAZWOPER Initial site-specific orientation Daily tailgate safety meetings Hazard communication ***Supervisory Personnel:*** OSHA supervisor's training ***Motor Vehicles:*** Operators will hold a valid license for the type and class of vehicle they are operating. ***Instrumentation and Equipment General:*** Employees will be qualified and trained to operate or service equipment.

Activity 13— Plant Sampling

Task	**Hazards**	**Hazard Control**
At each location a sample of *Phragmites* root tissue will be collected using decontaminated equipment (e.g., shovel and knife). Each sample will be rinsed with distilled water and then placed into a labeled resealable plastic bag or glass jar.	***Chemical Hazards*** — This task is minimally intrusive. Therefore, the potential for exposure will be low.	Level D PPE will be worn during plant sampling activities.
	Physical Hazards — Slip, trips, falls, tools, terrain or vegetation; uneven walking surfaces. Weather hazards, such as wind, lightning, and poor visibility.	The work area will be visually inspected. Slip, trip, and fall hazards will be either removed or marked and barricaded. Sufficient illumination will be maintained. Site personnel will conduct walkover in groups of two as a minimum. Site personnel will refer to and follow Weston FLDs 02-Inclement weather and 39-Illumination. Also, see FLD 11 and 12.
	Poor housekeeping.	Materials will be stored to prevent intrusion into the work areas. Work areas will be kept organized. See FLD 12.
	Strains and sprains from manually lifting and moving.	Use proper lifting techniques such as keeping straight back, lifting with legs; avoid twisting back; use mechanical equipment or get help from others. See FLD 10.
	Working in a Remote Area	Ensure functioning method of contact with field team lead/SSHO/PM. Utilize buddy system at all times. Refer to FLD 15.
	Heat/cold stress	Workers will be briefed and cognizant of heat and cold stress symptoms. Fluids will be available to workers. See FLD 05 and 06. Work rest periods will be established according to ACGIH and NIOSH guidelines. Outdoor work will be suspended during inclement weather with high wind or lightning, see FLD 02.
	Hands or fingers caught between objects; abrasions and lacerations. Use of tools.	Personnel will be made aware of the hazard and asked to coordinate carefully the handling and placement of heavy objects. Materials and objects being handled will be inspected for rough or sharp edges, and appropriate precautions will be taken to avoid contact. Personnel will wear work gloves and avoid placing hands between objects.
	Biological Hazards — Poisonous plants, insects, snakes.	Review recognition of poisonous plants, insects, or snakes typical of this area. Use appropriate measures as required. Adhere to Weston BBP Exposure Control Plan—First Aid Procedures. See also FLD 43 in Section 12.0, Attachment M.
	Radiological Hazards — Potential sunburn/sun poisoning hazard on bright, sunny days.	Use sunblock and long sleeves as appropriate. Avoid direct exposure to sun for long periods of time.

Activity 13— Plant Sampling (Continued)

Equipment Expected To Be Used	**Inspection Requirements**	**Training Requirements**
Motor vehicles Hand tools Level D PPE and nitrile gloves Shovel	***Site Inspection:*** Daily inspection by SSHO. Periodic inspection by PSM. ***Motor Vehicles:*** Before initial use, Operator will inspect and ensure safe operating condition of vehicles. ***Equipment:*** Ensure equipment is tested and inspected by a qualified person before it is placed into use. Conduct inspections and tests in accordance with manufacturer's instructions. Ensure operator of equipment in use inspects the equipment daily.	***Site-Specific:*** OSHA HAZWOPER Initial site-specific orientation Daily tailgate safety meetings Hazard communication ***Supervisory Personnel:*** OSHA supervisor's training ***Motor Vehicles:*** Operators will hold a valid license for the type and class of vehicle they are operating. If a motor boat is used, a valid boating license. ***Instrumentation and Equipment General:*** Employees will be qualified and trained to operate or service equipment.

Activity 14— Earthworm Sampling

Task	Hazards	Hazard Control
Earthworms will be collected using a clean shovel decontaminated between locations, used to unearth organic soil. The worms will be collected by hand, rinsed with distilled water and composited into samples for analysis.	***Chemical Hazards*** — This task is minimally intrusive. Therefore, the potential for exposure will be low.	Level D PPE will be worn during earthworm sampling activities.
	Physical Hazards — Slip, trips, falls, tools, terrain or vegetation; uneven walking surfaces. Weather hazards, such as wind, lightning, and poor visibility.	The work area will be visually inspected. Slip, trip, and fall hazards will be either removed or marked and barricaded. Sufficient illumination will be maintained. Site personnel will conduct walkover in groups of two as a minimum. Site personnel will refer to and follow Weston FLDs 02-Inclement weather and 39-Illumination. Also, see FLD 11 and 12.
	Poor housekeeping.	Materials will be stored to prevent intrusion into the work areas. Work areas will be kept organized. See FLD 12.
	Strains and sprains from manually lifting and moving.	Use proper lifting techniques such as keeping straight back, lifting with legs; avoid twisting back; use mechanical equipment or get help from others. See FLD 10.
	Working in a Remote Area	Ensure functioning method of contact with field team lead/SSHO/PM. Utilize buddy system at all times. Refer to FLD 15.
	Heat/cold stress	Workers will be briefed and cognizant of heat and cold stress symptoms. Fluids will be available to workers. See FLD 05 and 06. Work rest periods will be established according to ACGIH and NIOSH guidelines. Outdoor work will be suspended during inclement weather with high wind or lightning, see FLD 02.
	Hands or fingers caught between objects; abrasions and lacerations. Use of tools.	Personnel will be made aware of the hazard and asked to coordinate carefully the handling and placement of heavy objects. Materials and objects being handled will be inspected for rough or sharp edges, and appropriate precautions will be taken to avoid contact. Personnel will wear work gloves and avoid placing hands between objects.
	Biological Hazards — Poisonous plants, insects, snakes.	Review recognition of poisonous plants, insects, or snakes typical of this area. Use appropriate measures as required. Adhere to Weston BBP Exposure Control Plan—First Aid Procedures. See also FLD 43 in Section 12.0, Attachment M.
	Radiological Hazards — Potential sunburn/sun poisoning hazard on bright, sunny days.	Use sunblock and long sleeves as appropriate. Avoid direct exposure to sun for long periods of time.

Activity 14— Earthworm Sampling (Continued)

Equipment Expected To Be Used	**Inspection Requirements**	**Training Requirements**
Motor Vehicles Hand tools Level D PPE and nitrile gloves Shovel	***Site Inspection:*** Daily inspection by SSHO. Periodic inspection by PSM. ***Motor Vehicles:*** Before initial use, operator will inspect and ensure safe operating condition of vehicles. ***Equipment:*** Ensure equipment is tested and inspected by a qualified person before it is placed into use. Conduct inspections and tests in accordance with manufacturer's instructions. Ensure operator of equipment in use inspects the equipment daily.	***Site-Specific:*** OSHA HAZWOPER Initial site-specific orientation Daily tailgate safety meetings Hazard communication ***Supervisory Personnel:*** OSHA supervisor's training ***Motor Vehicles:*** Operators will hold a valid license for the type and class of vehicle they are operating. ***Instrumentation and Equipment General:*** Employees will be qualified and trained to operate or service equipment.

Activity 15— Small Mammal Sampling

Task	**Hazards**	**Hazard Control**
Small mammal trapping will consist of setting trap lines, each with 10 traps. Of the 10 traps set along each line, five will consist of Victor or Museum Special snap traps and five will consist of Sherman live box traps. When placed, the traps will generally be set alternately (i.e., every other one will be a Sherman trap).	***Chemical Hazards*** — This task is non-intrusive. Therefore, the potential for exposure will be low.	Level D PPE will be worn during small mammal sampling activities.
	Physical Hazards — Slip, trips, falls, tools, terrain or vegetation; uneven walking surfaces. Weather hazards, such as wind, lightning, and poor visibility.	The work area will be visually inspected. Slip, trip, and fall hazards will be either removed or marked and barricaded. Sufficient illumination will be maintained. Site personnel will conduct walkover in groups of two as a minimum. Site personnel will refer to and follow Weston FLDs 02-Inclement weather and 39-Illumination. Also, see FLD 11 and 12.
	Housekeeping.	Materials will be stored to prevent intrusion into the work areas. Work areas will be kept organized. See FLD 12.
	Working in a Remote Area	Ensure functioning method of contact with field team lead/SSHO/PM. Utilize buddy system at all times. Refer to FLD 15.
	Strains and sprains from manually lifting and moving.	Use proper lifting techniques such as keeping straight back, lifting with legs; avoid twisting back; use mechanical equipment or get help from others. See FLD 10.
	Heat/cold stress	Workers will be briefed and cognizant of heat and cold stress symptoms. Fluids will be available to workers. See FLD 05 and 06. Work rest periods will be established according to ACGIH and NIOSH guidelines. Outdoor work will be suspended during inclement weather with high wind or lightning, see FLD 02.
	Hands or fingers caught between objects; abrasions and lacerations.	Personnel will be made aware of the hazard and asked to coordinate carefully the handling and placement of heavy objects. Materials and objects being handled will be inspected for rough or sharp edges, and appropriate precautions will be taken to avoid contact. Personnel will wear work gloves and avoid placing hands between objects.
	Biological Hazards — Poisonous plants, insects, snakes, small mammals.	Review recognition of poisonous plants, insects, or snakes typical of this area. Use appropriate measures as required. Adhere to Weston BBP Exposure Control Plan—First Aid Procedures. Use caution to avoid small mammal bites. See also FLD 43 in Section 12.0, Attachment M.
	Radiological Hazards — Potential sunburn/sun poisoning hazard on bright, sunny days.	Use sunblock and long sleeves as appropriate. Avoid direct exposure to sun for long periods of time.

Activity 15— Small Mammal Sampling (Continued)

Equipment Expected To Be Used	**Inspection Requirements**	**Training Requirements**
Motor Vehicles Hand tools Level D PPE and nitrile gloves Lines and traps	***Site Inspection:*** Daily inspection by SSHO. Periodic inspection by PSM. ***Motor Vehicles:*** Before initial use, operator will inspect and ensure safe operating condition of vehicles. ***Equipment:*** Ensure equipment is tested and inspected by a qualified person before it is placed into use. Conduct inspections and tests in accordance with manufacturer's instructions. Ensure operator of equipment in use inspects the equipment daily.	***Site-Specific:*** OSHA HAZWOPER Initial site-specific orientation Daily tailgate safety meetings Hazard communication ***Supervisory Personnel:*** OSHA supervisor's training ***Motor Vehicles:*** Operators will hold a valid license for the type and class of vehicle they are operating. ***Instrumentation and Equipment General:*** Employees will be qualified and trained to operate or service equipment.

Activity 16 - Indoor and Ambient Air Sampling

Task	**Hazards**	**Hazard Control**
This task involves collecting indoor air and background samples over a 24-hour period.	***Chemical Hazards*** — This task is non-intrusive. Therefore, the potential for exposure will be low.	Level D PPE will be worn during air sampling.
	Physical Hazards — Slip, trips, falls.	The work area will be visually inspected. Slip, trip, and fall hazards will be either removed or marked and barricaded. Sufficient illumination will be maintained. Site personnel will conduct walkover in groups of two as a minimum.
	Poor housekeeping.	Materials will be stored to prevent intrusion into the work areas. Work areas will be kept organized. See FLD 12.
	Strains and sprains from manually lifting and moving.	Use proper lifting techniques such as keeping straight back, lifting with legs; avoid twisting back; use mechanical equipment or get help from others. See FLD 10.
	Hands or fingers caught between objects; abrasions and lacerations.	Personnel will be made aware of the hazard and asked to coordinate carefully the handling and placement of heavy objects. Materials and objects being handled will be inspected for rough or sharp edges, and appropriate precautions will be taken to avoid contact. Personnel will wear work gloves and avoid placing hands between objects.

Equipment Expected To Be Used	**Inspection Requirements**	**Training Requirements**
Level D PPE Hand tools Pickup trucks and/or passenger vehicles Sample media	***Site Inspection:*** Daily inspection by SSHO. Periodic inspection by PSM. ***Motor Vehicles:*** Before initial use, operator will inspect and ensure safe operating condition of vehicles. ***Equipment:*** Ensure equipment is tested and inspected by a qualified person before it is placed into use. Conduct inspections and tests in accordance with manufacturer's instructions. Ensure operator of equipment in use inspects the equipment daily.	***Site-Specific:*** OSHA HAZWOPER Initial site-specific orientation Daily tailgate safety meetings Hazard communication ***Supervisory Personnel:*** OSHA supervisor's training ***Motor Vehicles:*** Operators will hold a valid license for the type and class of vehicle they are operating. ***Instrumentation and Equipment General:*** Employees will be qualified and trained to operate or service equipment.

Activity 17— Subslab Soil Gas Sampling

Task	**Hazards**	**Hazard Control**
The subslab soil gas sampling point installation procedure will be performed in accordance with the "*Draft Guidance for Soil Gas Sampling*" (NJDEP 2004).	***Chemical Hazards*** —It is anticipated that the potential for exposure will be low.	Level D PPE will be worn during subslab sampling activities.
	Physical Hazards — Slip, trips, falls, tools, uneven walking surfaces.	The work area will be visually inspected. Slip, trip, and fall hazards will be either removed or marked and barricaded. Sufficient illumination will be maintained. Site personnel will conduct walkover in groups of two as a minimum. Site personnel will refer to and follow Weston FLDs 02-Inclement weather and 39-Illumination. Also, see FLD 11 and 12.
	Poor housekeeping.	Materials will be stored to prevent intrusion into the work areas. Work areas will be kept organized. See FLD 12.
	Utilities underground.	Personnel will verify utility locations in work area (FLD 34).
	Strains and sprains from manually lifting and moving.	Use proper lifting techniques such as keeping straight back, lifting with legs; avoid twisting back; use mechanical equipment or get help from others. See FLD 10.
	Use of hand and power tools	Personnel will adhere to FLDs 35 and 38.
	Hands or fingers caught between objects; abrasions and lacerations.	Personnel will be made aware of the hazard and asked to coordinate carefully the handling and placement of heavy objects. Materials and objects being handled will be inspected for rough or sharp edges, and appropriate precautions will be taken to avoid contact. Personnel will wear work gloves and avoid placing hands between objects.

Activity 17— Subslab Soil Gas Sampling (Continued)

Equipment Expected To Be Used	**Inspection Requirements**	**Training Requirements**
Level D PPE Hand and power tools Pickup trucks and/or passenger vehicles Sample media Tubing Putty Geoprobe or other drilling mechanism, as necessary	***Site Inspection:*** Daily inspection by SSHO. Periodic inspection by PSM. ***Motor Vehicles:*** Before initial use, operator will inspect and ensure safe operating condition of vehicles. ***Equipment:*** Ensure equipment is tested and inspected by a qualified person before it is placed into use. Conduct inspections and tests in accordance with manufacturer's instructions. Ensure operator of equipment in use inspects the equipment daily. The Drilling Safety is in Section 12, Attachment J.	***Site-Specific:*** OSHA HAZWOPER Initial site-specific orientation Daily tailgate safety meetings Hazard communication ***Supervisory Personnel:*** OSHA supervisor's training ***Motor Vehicles:*** Operators will hold a valid license for the type and class of vehicle they are operating. ***Instrumentation and Equipment General:*** Employees will be qualified and trained to operate or service equipment.

Activity 18— Subslab Soil Sampling

Task	**Hazards**	**Hazard Control**
Soil borings will be completed to a depth of 5 to 8 feet using a Geoprobe® macro-core sampler that will be driven by a hand-operated Bosch hammer drill. Continuous soil samples will be collected at each boring location using 4-foot-long Geoprobe® macro-cores with acetate sleeve liners.	***Chemical Hazards*** — The potential for exposure is to site contaminants is low.	Level D PPE will be worn during subslab sampling activities.
	Physical Hazards — Slip, trips, falls, tools, uneven walking surfaces.	The work area will be visually inspected. Slip, trip, and fall hazards will be either removed or marked and barricaded. Sufficient illumination will be maintained. Site personnel will conduct walkover in groups of two as a minimum. Site personnel will refer to and follow Weston FLDs 02-Inclement weather and 39-Illumination. Also, see FLD 11 and 12.
	Poor housekeeping.	Materials will be stored to prevent intrusion into the work areas. Work areas will be kept organized. See FLD 12.
	Utilities underground.	Personnel will verify utility locations in work area (FLD 34).
	Strains and sprains from manually lifting and moving.	Use proper lifting techniques such as keeping straight back, lifting with legs; avoid twisting back; use mechanical equipment or get help from others. See FLD 10.
	Use of hand and power tools	Personnel will adhere to FLDs 35 and 38.
	Hands or fingers caught between objects; abrasions and lacerations.	Personnel will be made aware of the hazard and asked to coordinate carefully the handling and placement of heavy objects. Materials and objects being handled will be inspected for rough or sharp edges, and appropriate precautions will be taken to avoid contact. Personnel will wear work gloves and avoid placing hands between objects.

Activity 18— Subslab Soil Sampling (Continued)

Equipment Expected To Be Used	**Inspection Requirements**	**Training Requirements**
Level D PPE and nitrile gloves Hand and power tools Pickup trucks and/or passenger vehicles Sample bottles Scoops/trowels Air monitoring equipment Geoprobe® or other drilling mechanisms, as necessary Macrocores	***Site Inspection:*** Daily inspection by SSHO. Periodic inspection by PSM. ***Motor Vehicles:*** Before initial use, operator will inspect and ensure safe operating condition of vehicles. ***Equipment:*** Ensure equipment is tested and inspected by a qualified person before it is placed into use. Conduct inspections and tests in accordance with manufacturer's instructions. Ensure operator of equipment in use inspects the equipment daily.	***Site-Specific:*** OSHA HAZWOPER Initial site-specific orientation Daily tailgate safety meetings Hazard communication ***Supervisory Personnel:*** OSHA supervisor's training ***Motor Vehicles:*** Operators will hold a valid license for the type and class of vehicle they are operating. ***Instrumentation and Equipment General:*** Employees will be qualified and trained to operate or service equipment.

ATTACHMENT 1

LIST OF SAFETY AND HEALTH OFFICERS

Site Health and Safety Officers
Former Raritan Arsenal, Edison, New Jersey

Name	**Task**		
	Groundwater/Soil	**Ecology**	**Indoor Air/Soil Gas**
Melissa Bader			X
Ryan Brown		X	
Thomas Brownell	X		
Eric Brown	X		
Wen-Jei Fang	X		
Kerri Farrar	X		X
Jeffrey Lynes	X		
George Molnar		X	