Harbor Air Management Plan for the New York and New Jersey Harbor Deepening Project

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New York District
United States Army
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ACRONYMS AND ABBREVIATIONS

CAA	Clean Air Act
CEDEP	Corps of Engineers Dredge Estimating Program
CFR	*Code of Federal Regulations*
CHE	cargo handling equipment
CHE EI	Cargo Handling Equipment Emissions Inventory
CMVEI	Commercial Marine Vessel Emissions Inventory
CO	carbon monoxide
CO_2	carbon dioxide
cSOC	conditional Statement of Conformity
EERT	emerging emission reduction technology
EGR	exhaust gas recirculation
EI	Emission Inventory
EOP	Environmental Operating Principles
EPA	United States Environmental Protection Agency
ERT	emission reduction technology
FHWA	Federal Highway Administration
FR	*Federal Register*
FTA	Federal Transit Administration
GC	General Conformity
HAMP	Harbor Air Management Plan
HDP	Harbor Deepening Project (formerly Harbor Navigation Project)
HNP	Harbor Navigation Project (now Harbor Deepening Project)
hp	horsepower
HQ	Headquarters
KVK	Kill Van Kull Channel
KVK-5	Kill Van Kull Area 5 Deepening Project
LRR	Limited Reevaluation Report
LSD	low sulfur diesel
MA	Mitigation Alternative
MOA	Memorandum of Agreement
MOU	Memorandum of Understanding
MPO	Metropolitan Planning Organization
NAAQS	National Ambient Air Quality Standard
NJ	New Jersey
NJDEP	New Jersey Department of Environmental Protection
NJDOT/OMR	New Jersey Department of Transportation's Office of Maritime Resources
NOx	oxides of nitrogen
NYC	New York City
NYCDOT	New York City Department of Transportation
NYD	New York District Army Corps of Engineers
NYNJHS	New York/New Jersey Harbor System
NYNJLINA	New York-Northern New Jersey-Long Island nonattainment area
NYSDEC	New York State Department of Environmental Conservation
NYSERDA	New York State Energy Research and Development Authority
O&M	operation and maintenance
OMET	Open Market Emissions Trading

Acronyms and Abbreviations (continued)

PANYNJ	Port Authority of New York and New Jersey
PCA	Project Cooperation Agreement
PCE	Project Cost Effectiveness
PJ	Port Jersey
PM	particulate matter
PM-2.5	particulate matter less than 2.5 microns in diameter
PM-10	particulate matter less than 10 microns in diameter
ppm	parts per million
RAT	Regional Air Team
RIA	Regulatory Impact Analysis
ROD	Record of Decision
rpm	revolutions per minute
SCR	selective catalytic reduction
SIF	Staten Island Ferry
SIP	State Implementation Plan
SOC	Statement of Conformity
SOx	sulfur oxides
TCE	Total Cost Effectiveness
TERP	Tugboat Emission Reduction Program
tpy	tons per year
TT	terminal tractor
U.S.	United States
ULSD	ultra low sulfur diesel
USACE	U.S. Army Corps of Engineers (same as NYD, unless specified as Headquarters)
VFE	verified fuel emulsion
VOC	volatile organic compound

SECTION 1 INTRODUCTION

The Harbor Air Management Plan (HAMP) provides the basis from which the New York District Army Corps of Engineers (NYD) will evaluate various strategies and alternatives to address and meet the requirements of the General Conformity (GC) rules (40 CFR §93.150-160) of the Clean Air Act (CAA) for the Harbor Deepening Project (HDP) (formerly referred to as the Harbor Navigation Project). The HDP is the deepening of several channels in the Port of New York and New Jersey Harbor (the Port) to a depth of approximately 50 feet below mean sea level, as recommended in the Limited Reevaluation Report (LRR) (NYD 2003).

A Regional Air Team (RAT), comprised of local, state, and federal government agency representatives, has assisted in the development and evaluation of many of the components that comprise the HAMP. A more detailed description of the RAT is provided in Section 1.3.

In addition to this introduction, which provides a discussion of the project background, GC requirements, the RAT, the conditional Statement of Conformity (cSOC), related studies, and HAMP objectives, this report includes:

- A discussion of baseline emission estimates for the HDP (Section 2),
- A description of emission reduction technologies and the tiered approach used in combining them as mitigation alternatives and applying them to the HDP (Section 3),
- A description of the criteria used in evaluating the mitigation alternatives (Section 4),
- A detailed discussion of the seven mitigation alternatives considered (Section 5), and
- A discussion of the preferred plan (Section 6).

The recommendations presented in this document are contingent upon the approval and authorization of the Corps of Engineers' Headquarters, the Assistant Secretary of the Army for Civil Works, and the Port Authority of New York & New Jersey (PANYNJ) Board of Commissioners (as the non-Federal sponsor). The NYD will seek the concurrence of the regulatory agencies that the approach outlined by the HAMP is an acceptable step in its effort to demonstrate general conformity for the HDP.

1.1 Background

The HDP is a 12-year dredging project that will deepen several channels in the Port to a depth of approximately 50 feet below mean sea level. These channels, depicted in Figure 1.1, include: 1) Ambrose, 2) Anchorage, 3) Kill Van Kull (KVK), 4) Newark Bay, 5) Arthur Kill, 6) Bay Ridge, and 7) Port Jersey (PJ).

Figure 1.1: Channels Affected by the HDP

The estimated dredging volume for the project is currently 40.3 million cubic yards. The project will require the use of excavator, clamshell, and hopper dredges; dredged material transit vessels; tender tugboats; and survey and crew boats. The project's extent falls within the states of New York and New Jersey. The Port is located in the New York-Northern New Jersey-Long Island nonattainment area (NYNJLINA), which is classified by EPA as a severe nonattainment area for ozone and as a maintenance area for carbon monoxide (CO). Oxides of nitrogen (NOx) and volatile organic compounds (VOCs) are ozone precursors. Some of the project's construction areas are located adjacent to New York County (Manhattan), which is designated as moderate nonattainment for particulate matter less than 10 microns in diameter (PM-10). PM monitors in some Northern New Jersey counties and in New York City are measuring PM less than 2.5 microns in diameter (PM-2.5) values above the standard; therefore, in the future, this project may have to meet general conformity for PM-2.5.

The diesel-powered dredge equipment used in the HDP emits NOx, VOC, CO, and PM-10. Due to the amounts emitted, NOx and to a lesser extent CO are the primary pollutants of concern for purposes of the HAMP (see also Section 1.2). Note that the other pollutants, though present, are not of concern because they do not exceed the threshold limits set for general conformity.

The PANYNJ, through a permit action by the NYD and the New Jersey Department of Environmental Protection (NJDEP), has accelerated the schedule for the KVK Contract Area 5 (KVK-5). Through a separate agreement with the NJDEP, the PANYNJ has an agreed plan under the GC rule requirements for the mitigation of those emissions associated with this part of the project. The PJ portion of the project is currently being considered for acceleration as well, by the New Jersey Department of Transportation Office of Maritime Resources (NJDOT/OMR), through a permit action from the NYD and NJDEP. The NJDOT/OMR currently has the lead responsibility to mitigate the air emissions from this action to comply with the GC rule requirements.

The accelerated schedules for these two areas take advantage of dredging that is already occurring at these locations that is associated with the ongoing 41-foot deepening project (a completely separate deepening project) that predates the GC requirement (1994). As such, the two accelerated projects are distinct from the HDP. For GC and mitigation purposes KVK-5 and PJ channels have to consider emissions associated with both the HDP and the previous 35 to 45 foot deepening project.

The HAMP incorporates both KVK-5 and PJ channels because they are parts of the overall Federal action recommended in the LRR. Furthermore, KVK-5 and PJ channels and their emissions are included for the purposes of providing the NYD with an estimate of the total costs of mitigating for project impacts to the region's air quality, and to approach the air impacts from the dredging project in a holistic and systematic manner. For the purposes of the HAMP, the emission estimates, costs of mitigation, and emission reductions associated with PJ and KVK-5 channels mitigation measures are included in Section 5. Although KVK-5 and PJ channels were originally part of the HDP, these channels are now being handled as separate permit actions whose sequence has been accelerated.

1.2 General Conformity

The GC rule of the CAA applies to Federal actions, such as deepening Federal channels that occur within a nonattainment area. A nonattainment area is a region that fails to meet one or more national standards for designated air pollutants. A State Implementation Plan (SIP) is an EPA-approved plan whereby the states (in this case, New York and New Jersey) present their specific plans and schedules for bringing the nonattainment area into compliance with the national standards. The GC rule requires that a non-exempt Federal action not interfere with or hinder progress of a SIP in reaching attainment with the national standard. If the Federal action's emissions are anticipated to exceed GC trigger levels, these emissions must meet GC requirements

Trigger levels are the maximum level of a pollutant permissible under GC guidelines without the need for corrective action. The trigger levels for NOx and VOC are 25 tons per year (tpy) (for either pollutant) for a severe nonattainment area and for CO, the trigger level is 100 tpy for a maintenance area. The HDP is currently anticipated to exceed the NOx trigger level nearly every year, as presented in Section 2 of this report; therefore, GC requirements must be met, including reducing NOx levels to zero for every year of the project. The estimated VOC emissions from the HDP remain at less then half the VOC trigger level and are not expected to exceed the trigger level during the course of construction. Though CO emissions currently are shown to never exceed the CO trigger level, they approach the 100 tons trigger level in 2009 (82.9 tons; see Section 2) and therefore these emissions will need to be updated and watched closely to maintain them such that the project does not trigger GC for CO. It should also be noted that New York County (Manhattan) is designated moderate nonattainment for PM-10. This county is adjacent to some construction components of the HDP that are located in the Upper Harbor. Under the current design plans, none of the emissions associated with the Federal action enter this county and therefore GC for PM-10 does not apply to the HDP. Throughout the construction of the HDP and the updating of the HAMP it will be necessary to confirm that this does not change.

Though currently not applicable, it is likely that during the life of the HDP the NYNJLINA will be designated as nonattainment for the fine particulate (or PM-2.5) standard. When this new designation occurs, the applicability of GC will be determined as it relates to the HDP for PM-2.5 and will be incorporated in future revisions of the HAMP.

The designation of the CO maintenance area (that includes counties where the HDP will be constructed) comes from the fact that in 2002 CO was redesignated from serious nonattainment to maintenance due to lower concentrations recorded in the nonattainment area. This means that for the 10 years following redesignation, the area will remain under maintenance status so as to prevent the area from backsliding into nonattainment of the CO standard. GC will therefore apply to CO during that time.

According to the rule, there are three ways that the project can meet GC:

- The project can be a line item in the approved applicable New York and New Jersey SIPs (40 CFR §93.158(a)(1)) (this includes emission credits);
- The approved applicable SIPs can accommodate the emissions from the Federal action (i.e., there is enough room in the approved applicable SIP emissions budget that the addition of the Federal action would not negatively impact the findings of the SIP) (40 CFR §93.158(a)(5)(i)(A)); or
- The project emissions can be reduced or offset such that there is no net increase in emissions (40 CFR §93.158(a)(2)).

New York and New Jersey have determined that their overall inventories (including their marine inventory) in the currently approved SIP cannot accommodate the HDP emissions due to a number of issues. The SIPs would require revision to make the HDP a line item. This would be a lengthy process and would delay the project construction. Therefore NYD is employing the third alternative by adopting the HAMP to ensure that there will be no net increase in the emissions associated with the Federal action recommended in the LRR.

1.3 Regional Air Team (RAT)

The RAT was formed in October of 2001 to provide a forum for open communication and coordination between the project team (NYD/PANYNJ) and the resource agencies regarding air quality issues (both generally, and specifically for GC).

Members of the RAT include the following entities:

- Army Corps of Engineers New York District (NYD)
- Port Authority of New York and New Jersey (PANYNJ)
- New York State Department of Environmental Conservation (NYSDEC)
- New Jersey Department of Environmental Protection (NJDEP)
- U.S. Environmental Protection Agency – Region 2 (EPA)

Although not a member of the RAT, the New York City Department of Transportation (NYCDOT) regularly attends RAT meetings.

The RAT was formed to:

- Provide a mechanism by which the Record of Decision (ROD) for the HDP could be agreed upon and signed, ensuring that GC requirements would be met prior to the actual start of the HDP while allowing the design phase to move forward and the start date to remain unchanged
- Provide a determination of the Federal action's potential emissions impact
- Identify emission reduction strategies and technologies
- Develop an implementable mitigation plan, i.e., the HAMP, to bring the project into conformity with the CAA
- Develop monitoring and recordkeeping procedures to track emissions and reductions during the life of the project to ensure compliance with the GC rule

1.4 Conditional Statement of Conformity

The first priority of the RAT was to provide a mechanism that would allow the HDP ROD to be signed such that the final design phase could begin and the development of the Project Cooperation Agreement (PCA) between the NYD and PANYNJ could commence. The PCA is the contract between the Department of the Army and the local non-Federal sponsor (in this case the PANYNJ) to construct the project; it provides the details on which entity will do what task or activity, and delineates how much cost the NYD will share with the PANYNJ for the HDP. In order to be signed, any actions and costs to meet GC must be identified. The mechanism that was developed to accomplish this first priority was the cSOC, signed by Colonel John B. O'Dowd, U.S. Army District Engineer, on 3 April 2002 (provided as Appendix A). The cSOC laid out the strategies that would be pursued to reach conformity, and made the commitment that construction would not start until there was an agreed upon plan and until conformity could be determined. This precedent setting approach was deemed appropriate, as the overall project is too long (twelve years) to commit to all options in advance. Given the length of time of this project the plan allows for an iterative approach to developing potential solutions. Existing and new options to achieve general conformity will be reviewed throughout the life of the HDP. However to ensure the project is always in conformance with CAA, Statements of Conformity would be prepared prior to constructing any element of the project.

It is important to note that the cSOC also addresses that should HDP emissions for CO eclipse the GC trigger level, they too would need to be controlled in order to meet the requirements. In 2009 CO is currently estimated to reach its peak level at just over 82 tons (see Section 2). Throughout the HDP, projected NOx and CO emissions are going to have to be updated and should estimates exceed the GC trigger level, then these emissions would have to be brought into compliance with the rule. See Section 6 for further details.

The emissions estimates and the SOC report for the KVK-5 project are provided in Appendix B. When the PJ emission estimates and SOC is issued by the PANYNJ, it will be incorporated into the HAMP.

Since its signing, the NYD and PANYNJ have been working to fulfill the commitments and provisions outlined in the cSOC. Table 1.1 summarizes these cSOC items and provides the status of each. This table is not intended to represent a recommended plan for achieving conformity nor does it commit the NYD to pursue options that are not technically feasible or cost-effective. The recommended alternative, which must be technically feasible, cost-effective, implemented within the established schedule, and have the concurrence of the local sponsor (PANYNJ), is described in Section 6 of this report.

Table 1.1: Status of Conditional Statement of Conformity Commitments

cSOC Provision	Lead Agency and Status	Status Summary
"Some technologies for possible use in the harbor could include the use of: 1) Electric dredges…	NJDOT/OMR Ongoing	The feasibility and costs associated with the installation of the landside and waterside components for use of electric dredges is being evaluated for the PJ component of the HDP. The summary finding report will be released January 2004 (the HAMP will incorporate the findings of this report). At this time it does not appear to be a cost-effective strategy, nor to have general applicability throughout the project area, as discussed in Section 3.2.1.
2) The use of low sulfur diesel fuel in dredges, tugboats, and other diesel-powered equipment…	NYD/PANYNJ Complete	The use of ultra low sulfur diesel (ULSD) has been evaluated and is presented in Section 3.2.1. ULSD, by itself, does not contribute to any reductions associated with NOx (or CO); however, it is used to enable other emission reduction technologies (ERTs) to be effectively utilized.
3) Fuel additives to create diesel emulsions … during the later stages of construction, once their use has been approved…	NYD/PANYNJ Ongoing	The use of verified fuel emulsions (VFEs) has been extensively explored. This effort has included looking at their uses at other ports, contacting vendors, evaluating production capacities and pricing regimes, and meeting with VFE vendor and dredge operators. VFEs are included as an emission reduction strategy in Section 3.2.1. An operational demonstration project is currently being evaluated by the NYD and a schedule will be released in the first quarter of 2004.
4) Engine retrofits and filters… a. Particulate filters… b. Oxidation catalyst and diesel particulate filter retrofits…"	NYD/PANYNJ Complete	The use of diesel particulate filters and oxidation catalyst was evaluated and is presented in Section 3.2.2. Oxidation catalyst can substantially reduce CO, hydrocarbons, with modest PM reductions, while diesel particulate filters reduce particulate matter, CO and hydrocarbons with higher efficiency than oxidation catalysts.

Table 1.1: Status of Conditional Statement of Conformity Commitments (continued)

cSOC Provision	Lead Agency and Status	Status Summary
"A detailed assessment of alternative technologies and fuels for the construction and dredged material management equipment will be undertaken to identify those reduction measures which are most appropriate for implementation in the HNP [sic]."	PANYNJ/NYD Complete	The PANYNJ and NYD commissioned a findings study[1] that identified various technologies that could potentially be used to reduce emissions from diesel engines and project related sources. The study report was coordinated, reviewed, commented on, and approved by the RAT members and a final report was issued in November 2002. Additional reports may be prepared in the future as new technologies emerge or the operability/efficacy of other technologies improves.
"A pilot/demonstration project will be considered, as appropriate, to further evaluate or refine the more promising control technologies."	NYD Ongoing	NYD is currently developing plans for an ERT operability test. A schedule for the operability demonstration will be released in the first quarter of 2004.
"…USACE will revisit the use of alternative technologies and fuels to reduce the emissions from dredges and tugboats every year during the construction project."	NYD Ongoing	The NYD has committed to the RAT to annually revisit alternative technologies and fuels that could be used as part of the HAMP, and alter current plans, as appropriate. This provision will not be complete until the last year of the HDP.

[1] *Emission Reduction Strategies Findings Report for the New York/New Jersey Harbor Navigation Project*, Starcrest, November 2002.

Table 1.1: Status of Conditional Statement of Conformity Commitments (continued)

cSOC Provision	Lead Agency and Status	Status Summary
"USACE will solicit ideas to achieve compliance from the dredging industry and port facility operators, and will have the industries implement these measures, where practicable."	NYD Ongoing	As noted above, the NYD has held dredging industry meetings (three) to discuss the use of VFEs, and has received input from the industry on other ERTs such as electrification and selective catalytic reduction (SCR) devices. The first meeting was held on August 7, 2002; the second meeting on April 9, 2003, and the third on August 8, 2003. Additional meetings, building from the first three discussions, may be planned once a mitigation alternative has been selected. Copies of the meeting notes are provided in Appendix C.
"The PANYNJ will also consider means of achieving emissions reductions for each pollutant of concern for port facility equipment, as may be necessary, to reduce project emissions."	PANYNJ Complete	Port facility equipment plays a significant role in the HAMP as being either a primary or contingency emission source group in the various mitigation alternatives presented in Section 5. The PANYNJ examined other equipment associated with port activities such as airport equipment and also various stationary source facilities it owns or operates, or that is located on tenant facilities. However, these sources were already targeted for emission reductions by other departments or in agreements with tenants and/or have received other federal or state funding. An example is the recent purchase of 200 Compressed Natural Gas (CNG) vehicles for the PANYNJ fleet, some of which were purchased with federal assistance and others with NJ state assistance. To avoid the potential of double counting, these sources were not further explored. Further information is provided in Appendix D.

Table 1.1: Status of Conditional Statement of Conformity Commitments (continued)

cSOC Provision	Lead Agency and Status	Status Summary
"The PANYNJ will commit to preparing a report that will include an emissions inventory for port equipment, and existing technologies to potentially reduce those emissions in support of the NYNJ Harbor Navigation Project General Conformity Determination."	PANYNJ Complete	The following report was coordinated and reviewed by the RAT to complete this commitment: *The Port of New York and New Jersey Emissions Inventory for Container Cargo Handling Equipment, Automarine Terminal Vehicles, and Associated Locomotives*, Starcrest, 2003.
"This inventory will become the basis of a study to investigate a grant program to assist Port tenants to decrease emissions from port equipment."	PANYNJ Complete	Through the PANYNJ's GreenPorts program, the PANYNJ may use the CHE EI as a baseline to determine the conversion of port equipment to more environmentally responsive fuels, re-powering, retrofits, and/or replacement as warranted. For example, the RAT has identified the conversion of a portion of the terminal tractor fleet from diesel to VFE as either a primary or contingency strategy. The potential implementation method for these strategies could include a grant program.
"USACE will evaluate alternatives on reducing emissions at their facilities as another way of reducing project impacts and will also examine logistical alternatives such as revised schedules and other project constraints that may help reduce overall emissions."	NYD Ongoing	The emissions associated with the Caven Point Fleet were identified and incorporated into the Commercial Marine Vessel Emissions Inventory[2] (CMVEI). The emissions for their fleet of ten marine vessels (of varying sizes) were estimated to be just over 80 tpy NOx, a relatively small output that would have the little effect on achieving HDP conformity. These vessels, like those selected for the tugboat program, may also be candidates for repowering.

[2] *The New York, Northern New Jersey, Long Island Nonattainment Area Commercial Marine Vessel Emissions Inventory*, Starcrest, April 2003.

Table 1.1: Status of Conditional Statement of Conformity Commitments (continued)

cSOC Provision	Lead Agency and Status	Status Summary
"This review[3] determined that the [states'] nonattainment area SIP's [marine source category inventories] may be able to accommodate project emissions within the existing emissions inventory. In order to verify this possibility, USACE-PANYNJ will provide an updated marine vessel emissions inventory of the New York/New Jersey Harbor before construction of the 50-foot project."	NYD Complete	The following report was coordinated and reviewed with the RAT, completing this commitment: *Marine and Land-Based Mobile Source Emission Estimates for the Consolidated Schedule for the Harbor Navigation Project*, January 2004.
"It is anticipated that the updated inventory and analysis of the results can be completed in sufficient time for the nonattainment area states to include them in the next major scheduled revision (s), (e.g. MOBILE6 and/or Mid Course Review)."	PANYNJ Complete	The above mentioned inventory report provided 2001 baseline emission estimates, as well as back cast and out year projections for the years 1990, 1996, 1999, 2000, 2002, 2005, 2007, and 2015. The information provided in the CMVEI meets the requirements to be included in the next major revision.
"An air emissions consultation committee will be formed and chaired by USACE for the project that will be comprised of representatives from USEPA, PANYNJ and the states of New York and New Jersey."	NYD Complete/Ongoing	This was completed by the formation of the RAT and is ongoing throughout the HDP. Currently the RAT meets once a month.
"The PANYNJ has committed to providing the affected States with the tools necessary by which they can update their marine vessel emissions inventory during the construction of the project."	PANYNJ Ongoing	At the time of this document, the PANYNJ, NYSDEC, and NJDEP have approved a scope of work for a CMVEI Tool that will allow the state agencies the updating and future year emission estimate capabilities that they require for all SIP-related emissions inventories. The project is currently in the start-up phase.

[3] *Analysis of Marine Emission Estimates in the New York and New Jersey State Implementation Plans (SIP)*, Starcrest, September 2001.

Table 1.1: Status of Conditional Statement of Conformity Commitments (continued)

cSOC Provision	Lead Agency and Status	Status Summary
"A new marine vessel inventory will be provided to the States one year after the completion of the project."	To Be Determined	This provision will be completed a year after the HDP is completed.
"Another option for mitigating air quality impacts is pursuing the availability of existing emission credits… USACE-PANYNJ will purchase available credits, as necessary to mitigate all remaining project emissions, including coverage of the *de minimus* amount, that could not be reduced by other measures, or accommodated by the States in their SIPs."	PANYNJ Ongoing	The PANYNJ purchased shutdown emission credits in New Jersey to meet the GC requirements for the KVK-5 permit action. These credits are shown in all of the mitigation alternatives presented in Section 5. PANYNJ owns 200 tons of NOx emission shutdown credits from the Proctor & Gamble site located on Staten Island. These credits could be made available for the HDP with the appropriate approvals. NJDEP is terminating its open market emissions trading (OMET) program and so future credits will not likely become available. The NYSDEC program is currently limited on the quantity of shutdown credits and their use for nonroad projects has been discouraged. The issue of additional use of credits for the HDP still needs to be worked out by the agencies. Resolution arrived at it will be incorporated into the HAMP.
"As this is a lengthy project, more accurate data on actual emissions will be collected, existing technologies will be evaluated, and new technologies to reduce emissions will be assessed during the life of this project (i.e. during construction phase). USACE will commit to reduce, to the extent possible, to attain conformity, using the best available information, all emissions possible (to be determined by advancements in and approval of technology and credit availability) prior to construction of any project element."	NYD Ongoing	The HAMP and all the supporting reports and studies are designed to meet this provision of the cSOC.

Table 1.1: Status of Conditional Statement of Conformity Commitments (continued)

cSOC Provision	Lead Agency and Status	Status Summary
"The USACE will not proceed to construction on the 50-foot deepening project until such time that the project can demonstrate conformity under the General Conformity Rule."	NYD Ongoing	The NYD will not begin the HDP without an approved initial SOC that details how the project will perform during the first constructible element. The HAMP will provide the technical details and assessment of alternatives on which the first, and all subsequent SOCs, will be based. It should be noted that KVK-5 and PJ are starting ahead of the remaining HDP construction contracts. To do this and comply with GC requirements, separate permits were issued for these projects. See Appendix B.
"To continue to update and distribute the information collected as part of this ongoing conformity determination effort, the USACE will perform supplemental conformity determinations, with detailed compliance plans as necessary, for each element of construction of the 12 year project and release Public Notices to notify interested parties and regulatory agencies of any changes to this conditional proposal."	NYD Ongoing	The NYD will use the RAT as the vehicle by which to provide resource agencies with the supplemental conformity determinations and any revisions to the HAMP. The detailed compliance plans will be developed as SOCs.
"In summary, the USACE will achieve conformity for NOx and CO through offsetting of the project's emissions. Compensation will occur through the use of emission reduction technologies, where practical, the purchase of credits, operational modifications to reduce emissions, and through possible accommodation by the States in their SIPs."	NYD Ongoing	This provision will be demonstrated and documented within the HAMP.

1.5 Related Studies

The HAMP is a living document founded on reports that have been previously prepared for the HDP. These reports include:

- *Emission Reduction Strategies Findings Report for the New York/New Jersey Harbor Navigation Project*, Starcrest, November 2002
- *Marine and Land-Based Mobile Source Emission Estimates for the Consolidated Schedule for the Harbor Navigation Project*, Starcrest, January 2004
- *The New York, Northern New Jersey, Long Island Nonattainment Area Commercial Marine Vessel Emissions Inventory* (CMVEI), Starcrest, April 2003
- *The Port of New York and New Jersey Emissions Inventory for Container Cargo Handling Equipment, Automarine Terminal Vehicles, and Associated Locomotives* (CHE EI), Starcrest, June 2003

The first two reports, like the HAMP, are living documents and will be updated throughout the HDP.

1.6 HAMP Objectives

The primary objective of the HAMP is to present several mitigation alternatives that employ one or more of the strategies identified in the cSOC. This will allow the NYD, as the lead Federal agency (in coordination with the RAT and in concert with the local sponsor, PANYNJ), to choose an effective, cost-efficient and technically feasible alternative for meeting the GC requirements without compromising the scheduled PCA signing in May 2004. The descriptions of the mitigation alternatives will include a timeline of when each strategy will need to be implemented, the estimated emission reductions, the costs associated with each strategy, the net emissions from implementation of the alternative, and the advantages and disadvantages of each alternative.

Once an alternative has been selected, the HAMP's primary objective will be to focus on the implementation and reporting of how the alternative is performing vs. the emissions that are being generated by the HDP, in accordance with monitoring and record keeping procedures developed by the RAT. As noted above in Section 1.4, there are several ongoing provisions of the cSOC that will need to be updated and implemented as time passes. The HAMP will be the record that tracks how and when these provisions are met. The HAMP will be updated annually with the latest emission estimates, estimated reductions, and new mitigation strategies; and will track compliance with the GC rules, while also serving as the technical basis for future SOCs.

SECTION 2 BASELINE EMISSIONS

This section reviews the source types considered under the Federal action associated with the HDP and the estimated emissions from those sources for the entire project. The information presented in this section is from the *Marine and Land-Based Mobile Source Emission Estimates for the Consolidated Schedule for the Harbor Navigation Project*, Starcrest, January 2004.

2.1 Source Types

There are direct and indirect emission sources associated with the HDP Federal action. The direct sources are the dredge equipment and its support vessels and the indirect emission sources are the dredged material transport vessels, which consist of tugboats and scows. Nonroad equipment used to unload the scows at the dredged material upland facilities and employee vehicles were originally also included as indirect emission sources, however in further review, the NYD has determined that the deepening permit does not provide the NYD any continuing (federal) authority over the dredged material placement facility. This is because the NYD does not dictate to the PANYNJ where the upland dredged material is to be taken, and therefore continuing authority is released. In addition, as the placement facilities also come under the jurisdiction of the CAA and SIP, their operating permits will have already been issued and thus they will be in compliance with CAA.

As for employee vehicles, the dredging crews and the dredged material transport crews are assumed to use licensed onroad vehicles that are included by the Metropolitan Planning Organization in their onroad emissions inventory. The New Jersey Transportation Organization is currently reviewing this finding for concurrence; their response to the HAMP will be incorporated into a later version of the HAMP.

2.2 Estimated Emissions

Tables 2.1 through 2.4 present the estimated HDP emissions, by calendar year, and by pollutant for NOx, CO, VOC, and PM-10, respectively. The GC trigger level for NOx and VOC is 25 tons per year and 100 tons per year for CO. As stated in Section 1.2 above, the HDP will not be constructed in a PM-10 attainment area and therefore this pollutant is not considered under GC, but is provided for completeness.

From the tables, it is apparent that only NOx levels exceed their trigger and therefore must be reduced to zero for every year of the HDP.

Though these emissions are estimated and presented annually, it is important to note that they will be generated, and must be reduced or offset continuously, throughout the entire construction phase of the project. The project will operate on a 24 hour per day, seven-day per week schedule. It is not enough to end a year with offsets counteracting emissions. They must also, to the degree practicable, cancel out each other as they are being produced. Therefore, as practicable, the preferred plan will be designed and executed to contemporaneously offset emissions as they are being generated as stated in GC.

Table 2.1: HDP NOx Emission Estimates (tons per calendar year)

Emission Sources	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
						Emissions (tons)						
NOx												
Dredge & Support Vessels	-	-	13.29	**147.06**	226.66	**274.29**	247.91	291.92	300.07	177.12	34.86	0.00
Dredged Material Transport Vessels	-	-	3.13	**52.86**	126.13	**92.18**	74.03	148.41	109.57	24.88	39.76	15.66
Total HAMP	-	-	16.41	**199.92**	352.80	**366.47**	321.95	440.33	409.64	202.00	74.62	15.66
(tpd)	-	-	*0.04*	***0.55***	*0.97*	***1.00***	*0.88*	*1.21*	*1.12*	*0.55*	*0.20*	*0.04*
Total KVK5 (PANYNJ)	81.80	121.11	39.54	-	-	-	-	-	-	-	-	-
	0.22	*0.33*	*0.11*	-	-	-	-	-	-	-	-	-
Total PJ (NJDOTOMR)	-	-	89.31	**139.25**	76.41	-	-	-	-	-	-	-
	-	-	*0.24*	***0.38***	*0.21*	-	-	-	-	-	-	-
TOTAL HDP	81.80	121.11	145.26	**339.17**	429.21	**366.47**	321.95	440.33	409.64	202.00	74.62	15.66
	0.22	*0.33*	*0.40*	***0.93***	*1.18*	***1.00***	*0.88*	*1.21*	*1.12*	*0.55*	*0.20*	*0.04*
2,947.20	**total tons**											

Table 2.2: HDP CO Emission Estimates (tons per calendar year)

Emission Sources	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
						Emissions (tons)						
CO												
Dredge & Support Vessels	-	-	2.53	**27.73**	42.52	**51.84**	46.99	54.93	56.60	33.60	6.64	0.00
Dredged Material Transport Vessels	-	-	0.60	**9.88**	23.69	**17.42**	14.06	27.97	20.65	4.78	7.64	3.01
Total HAMP	-	-	3.13	**37.61**	66.21	**69.26**	61.06	82.90	77.24	38.38	14.28	3.01
(tpd)	-	-	*0.01*	***0.10***	*0.18*	***0.19***	*0.17*	*0.23*	*0.21*	*0.11*	*0.04*	*0.01*
Total KVK5 (PANYNJ)	23.72	33.73	10.04	-	-	-	-	-	-	-	-	-
	0.07	*0.09*	*0.03*	-	-	-	-	-	-	-	-	-
Total PJDP (NJDOTOMR)	-	-	20.34	**30.52**	16.81	-	-	-	-	-	-	-
	-	-	*0.06*	*0.08*	*0.05*	-	-	-	-	-	-	-
TOTAL HDP	23.72	33.73	33.51	**68.13**	83.02	**69.26**	61.06	82.90	77.24	38.38	14.28	3.01
	0.07	*0.09*	*0.09*	***0.19***	*0.23*	***0.19***	*0.17*	*0.23*	*0.21*	*0.11*	*0.04*	*0.01*
588.23	**total tons**											

Table 2.3: HDP VOC Emission Estimates (tons per calendar year)

Emission Sources	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
	Emissions (tons)											
VOC												
Dredge & Support Vessels	-	-	0.29	**2.87**	4.29	**5.69**	5.27	5.74	6.11	3.95	0.77	0.00
Dredged Material Transport Vessels	-	-	0.07	**0.68**	1.81	**1.50**	1.33	2.29	1.68	0.54	0.86	0.34
Total HAMP	-	-	0.36	**3.55**	6.10	**7.18**	6.59	8.03	7.80	4.49	1.63	0.34
(tpd)	-	-	*0.00*	***0.01***	*0.02*	***0.02***	*0.02*	*0.02*	*0.02*	*0.01*	*0.00*	*0.00*
Total KVK5 (PANYNJ)	**3.06**	**4.23**	**1.28**	-	-	-	-	-	-	-	-	-
(tpd)	*0.01*	*0.01*	*0.00*	-	-	-	-	-	-	-	-	-
Total PJ (NJDOTOMR)	-	-	2.29	**3.55**	1.94	-	-	-	-	-	-	-
(tpd)	-	-	*0.01*	***0.01***	*0.01*	-	-	-	-	-	-	-
TOTAL HDP	3.06	4.23	3.93	**7.10**	8.04	**7.18**	6.59	8.03	7.80	4.49	1.63	0.34
	0.01	*0.01*	*0.01*	***0.02***	*0.02*	***0.02***	*0.02*	*0.02*	*0.02*	*0.01*	*0.00*	*0.00*
62.42	**total tons**											

Table 2.4: HDP PM-10 Emission Estimates (tons per calendar year)

Emission Sources	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
	Emissions (tons)											
PM10												
Dredge & Support Vessels	-	-	0.33	**3.69**	5.80	**6.89**	6.17	7.42	7.59	4.44	0.85	0.00
Dredged Material Transport Vessels	-	-	0.07	**1.29**	3.06	**2.21**	1.76	3.58	2.64	0.58	0.92	0.36
Total HAMP	-	-	0.40	**4.98**	8.87	**9.10**	7.93	11.00	10.23	5.02	1.77	0.36
(tpd)	-	-	*0.00*	***0.01***	*0.02*	***0.02***	*0.02*	*0.03*	*0.03*	*0.01*	*0.00*	*0.00*
Total KVK5 (PANYNJ)	**2.14**	**3.17**	**1.02**	-	-	-	-	-	-	-	-	-
	0.01	*0.01*	*0.00*	-	-	-	-	-	-	-	-	-
Total PJ (NJDOTOMR)	-	-	2.53	**3.93**	2.17	-	-	-	-	-	-	-
	-	-	*0.01*	***0.01***	*0.01*	-	-	-	-	-	-	-
TOTAL HDP	2.14	3.17	3.95	**8.91**	11.04	**9.10**	7.93	11.00	10.23	5.02	1.77	0.36
	0.01	*0.01*	*0.01*	***0.02***	*0.03*	***0.02***	*0.02*	*0.03*	*0.03*	*0.01*	*0.00*	*0.00*
74.62	**total tons**											

2.3 Estimated Fuel Consumption

Table 2.5 presents the NYD's estimated fuel consumption volumes by channel and by year. This information is used in Section 5 to determine the cost of replacing the regular nonroad diesel normally used in dredging projects with a VFE.

The volumes of fuel required were developed from the Corps of Engineers Dredge Estimating Program (CEDEP). CEDEP is a cost estimating tool. Quantity of fuel consumed is a portion of the overall cost of work. CEDEP calculates fuel based upon the horsepower of the primary and auxiliary engines, the number of hours a piece of apparatus is expected to operate, and a factor that considers the type of apparatus in question.

Table 2.5: Estimated Fuel Consumption by Channel and Year (gallons)

	HDP Fuel Consumption										
Channel	2004 (gals)	2005 (gals)	2006 (gals)	2007 (gals)	2008 (gals)	2009 (gals)	2010 (gals)	2011 (gals)	2012 (gals)	2013 (gals)	TOTAL (gals)
Ambrose Channel	0	1,387,000	2,752,000	1,485,000	822,000	2,752,000	2,051,000	0	0	0	**11,249,000**
Anchorage	0	82,000	1,240,000	852,000	180,000	1,184,000	1,046,000	0	0	0	**4,584,000**
Kill Van Kull (47-52)	150,000	1,369,000	311,000	1,263,000	1,419,000	10,000	790,000	1,211,000	0	0	**6,523,000**
Newark Bay (47-52)	0	2,429,000	10,042,000	11,003,000	10,696,000	17,178,000	22,409,000	19,808,000	1,051,000	0	**94,616,000**
Port Jersey	176,000	1,293,000	1,368,000	510,000	0	0	0	0	0	0	**3,347,000**
Arthur Kill	0	0	132,000	838,000	1,079,000	10,856,000	11,640,000	1,865,000	0	0	**26,410,000**
Bay Ridge	0	0	0	0	0	0	59,000	350,000	901,000	1,264,000	**2,574,000**
	326,000	**6,560,000**	**15,845,000**	**15,951,000**	**14,196,000**	**31,980,000**	**37,995,000**	**23,234,000**	**1,952,000**	**1,264,000**	**149,303,000**

SECTION 3 EMISSION REDUCTION TECHNOLOGIES AND TIERED APPROACH

This section summarizes the emission reduction technologies (ERTs) that were evaluated and the tiered approach that was developed to categorize the various mitigation strategies based on the ERT being used, including those that were eliminated as no longer practical or feasible or not accepted. There is no single ERT that can be used to mitigate the HDP's emissions. Rather, a combination of ERTs must be implemented. The selection criteria described in Section 4 are used to develop, in Section 5, a number of alternative combinations of ERTs that could be used to achieve GC. Section 6 presents and discusses the preferred plan.

In preparation of the HAMP and in initial coordination with the RAT, 19 source categories were identified and evaluated as potential emission reduction candidates:

- Ferries
- Port facilities (cargo handling equipment)
- Buses
- Construction equipment (landside equipment)
- Barges
- Sludge ships
- Passenger cruise ships
- Airport equipment-ground support equipment
- Trailer electrification sites
- Electrification of dredges
- Coast guard vessels
- Garbage trucks
- Pilot boats
- Repowering tugboats
- Government vehicle fleets
- Alternative fuel programs
- Tour boats/Circle Lines/entertainment boats
- Recreational fishing boats
- Locomotive engines

These 19 potential source categories fell within three classifications:

- Stationary sources such as power plants, industrial facilities, boilers, etc.
- Onroad emissions sources such as buses, vehicles, heavy-duty trucks, etc. (i.e., any vehicle that is licensed to drive on public roads and streets).
- Nonroad emissions sources such as cargo handling equipment, construction equipment, marine vessels, etc. (i.e., any vehicle or piece of equipment that is not licensed to drive on public roads and streets).

Of these three source categories, stationary and onroad sources have been actively regulated over the past years and until recently, nonroad sources have had little regulation. In addition, nonroad sources are typically powered by large diesel engines that have long operational lives (typically over 25 years). Since the recent nonroad regulations are not applicable to existing diesel engines, the nonroad source category of existing engines provides a significant opportunity to reduce emissions from unregulated sources. This is in direct contrast to the stationary and onroad categories, which have been actively regulated and offer little opportunity for emission reductions on the scale needed to offset the HDP's emissions.

From the initial list, the following options have been subsequently excluded for the reasons stated below:

- Ferries – private ferries were dismissed because they are already engaged in emission reduction efforts led by the NYCDOT and New York State Energy Research and Development Authority (NYSERDA). NYCDOT was the recipient of Federal Highway Administration (FHWA) and Federal Transit Administration (FTA) grants to initiate an emission reduction program for the private ferries.
- Port facilities (cargo handling equipment) - Review of the diesel crane inventory indicates that the conversion from diesel cranes to electric cranes is well on its way, such that the application for possible offsets falls outside of what could be used for this project. For example some electric cranes have been purchased in advance of the HDP time window, and some have been purchased by tenants (some with NJ state tax allowances). However, cargo-handling equipment, especially yard tractors, could be considered as a primary or contingency plan.
- Buses and heavy duty onroad diesel trucks – this source group is already heavily regulated to reduce emissions, and was dismissed on the basis of several factors including: cost effectiveness; the number of buses/trucks that would have to be included in an emission reduction program; recordkeeping, reporting, and enforcement issues; and the number of outside public and private entities that would need to agree to the limitations of such a program.
- Construction equipment – equipment used on the HDP itself remains a contingency measure; equipment not related to HDP was for the most part disregarded because of the transitory nature of the equipment as it moves from job to job, which may or may not remain in the nonattainment area as required by GC. In addition, the tracking, verification of operational use, and use of an emission reduction technology would be extremely difficult and costly.
- Barges – barges were not considered a significant, reliable emission reductions source for the HDP, similar to construction equipment they are transitory in nature and may leave the area and tracking/verification of any emission reductions from the source would be difficult compared to some other sources.
- Sludge ships – this proposal was presented by NJDEP where trash from New York that is currently trucked into/through New Jersey would be moved by barges, thus removing the truck traffic and reducing emissions. This strategy initially has some significant reductions, but the reduction benefits erode (as modeled) as the fleet of trucks is turned over, resulting in trucks having much cleaner engines than the barges. Furthermore, this strategy was not pursued when it was found that New York City has been looking into this project as a means to reduce costs and emissions.
- Passenger cruise ships – these large oceangoing vessels have been looked at by many ports as a potential opportunity to reduce emissions since they use a significant

"house load" (up to 15 megawatts) which is powered by diesel generators. Electrification has been accomplished in Alaska on certain ships. In Houston and Los Angeles, shore power has been investigated but is still not a reality. For the short term, cruise ships are not a viable candidate because of lead-time, engineering complications, ship electrical design issues, expense, and coordination with the line owners. In the future, cruise ships may be candidates for long-term contingency plans, should electrification be more prevalent then it presently is.

- Airport equipment-ground support equipment - Port Authority Airport (JFK, EWR, LGA, TEB) projects' equipment are currently under a separate program and accordingly, those emission reduction opportunities are not available as air emission offsets for the HDP. These offsets are being targeted and used by the tenants and Port for emission reductions. Further details are provided in Appendix D.
- Trailer electrification sites – the container terminals currently provide power to the refrigerated trailers from plug-in slots that use utility supplied power.
- Coast Guard vessels – it was determined during the CMVEI that the primary candidates from the Coast Guard fleet spend a significant amount of their active time outside the nonattainment area and thus would not be as cost effective as other sources.
- Garbage trucks - the NYC sanitation department is currently looking at reducing emissions from their garbage truck fleet independently. Expanding on their progress, this may present an opportunity as a contingency plan.
- Pilot boats – it was determined that the large pilot boats operate either outside the nonattainment area or operate using shore power when at their Staten Island facility.
- Government vehicle fleet – this was not pursued as it focused on reducing emissions from a high number of onroad vehicles that had significant variations in vehicle miles traveled, and the problems associated with being able to track what portion of those miles were outside the nonattainment area.
- Alternative fuel programs – alternative fuel programs for nonroad sources are typically expensive due to the infrastructure, maintenance, and frequent refueling required. They could if needed be considered as a contingency measure.
- Tour boats/Circle Lines/entertainment boats - in addition to private ferries, there are several tour/excursion boats that provide dinner cruises and sight seeing around Manhattan. These were not selected for emission reduction sources due to their operational variabilities and seasonal changes in schedule, engine size, relatively small emission baseline potential, and their private ownership. Their private ownership also reduces the long-term reliability that they will continue to operate under their current schedules.
- Recreational fishing boats – these were dismissed for the same reasons as the tour boats.
- Locomotive engines – the primary candidates for this source category are switch engines that operate and remain in the yards assembling trains. These could be potential contingency measures if needed.

The remaining primary groups are the Staten Island Ferry (SIF) fleet, tugboats and harbor vessels, cargo handling equipment (e.g., yard tractors), project related sources, and dredge electrification.

3.1 Emission Reduction Technologies

For the purposes of the HAMP, ERTs can be divided into two classes: verified and non-verified technologies. Those technologies that are verified by the EPA or the California Air Resources Board (CARB) have an emissions reduction value that can be used by a state regulatory agency for SIP-approvable reductions without requiring any additional source testing or monitoring for a defined period of time. The benefit of verified technologies is that they can be implemented immediately and the cost and time demands associated with implementation are driven solely by the ERT vendor and the source owner. Verified ERTs include diesel oxidation catalysts and diesel particulate filters. The only currently verified ERT for NOx is the emulsified diesel fuel PuriNOx, produced by the Lubrizol Corporation. PuriNOx has been verified by both EPA and CARB.

Non-verified technologies are those ERTs that have not yet been verified by EPA or CARB and thus require additional source testing to determine what level of NOx reduction they will yield. Their use in the HAMP is thus restricted as their effect on reducing emissions is uncertain compared to the verified technologies, and uncertainty adds to the risk of potentially failing to meet GC. However, there are several promising NOx-based non-verified technologies like selective catalytic reduction (SCR), direct water injection, humid air motor, exhaust gas recirculation (EGR), NOx adsorbers, and lean NOx catalyst.[4] Should these and other non-verified ERTs become verified during the course of the HDP, they will receive further consideration as potential mitigation strategies.

To meet the short-term goals of the HAMP, the strategies employed for years 2004 through 2008 focus on the use of verified ERTs to reduce the risk of delays and improve the likelihood of greater success of implementation, cost effectiveness, and agreement on the reductions. One exception is the proposed use of SCR. SCR has not been verified but offers a very promising and unique opportunity for significant reductions in conjunction with the SIF fleet (presented in detail in Section 3.2.2). The demonstration of one Austen class ferry is currently being conducted to measure the actual existing emissions levels from the ferry, measure the emission reductions from the installation of the SCR, and provide information to reassess the potential reductions from full fleet conversion. The emission estimates for the SIF fleet presented in this report are based on generic emission factors that are approved for SIP purposes, but might not be representative for individual vessels. Therefore, it is important to measure the baseline emissions from the ferries in order to realistically predict emission reductions.

In the long-term portion of the HDP, between 2008 and 2013, the verified (NOx-focused) ERT lists should expand as currently non-verified ERTs become verified and play a more significant role as mitigation strategies in the HAMP. The *Emission Reduction Strategies Findings Report for the New York/New Jersey Harbor Navigation Project* referenced in Section 1.5 provides an in depth look at both currently verified and non-verified ERTs.

[4] *Emission Reduction Strategies Findings Report for the New York/New Jersey Harbor Navigation Project*, Starcrest, November 2002 (see Section A1, pages 7-30 and Table 2, pg. 30).

The initial phase of the HDP consists of the KVK-5 dredging contract. The permit condition for allowing the contract to proceed required the PANYNJ, prior to starting construction, to purchase emission reduction credits and to repower two twin-engine tugboats that operate in the nonattainment area. These conditions were coordinated with NJDEP and EPA Region 2. The repowering program that is currently underway has proven to be a valuable pilot project for implementing emission reduction strategies. All mitigation alternatives presented in the HAMP build from the emission credit purchase and the tugboat emission reduction programs.

3.2 Tiered Approach

A tiered approach was developed in coordination with the RAT to help prioritize and categorize the emission reduction strategies. Six tiers were established, numbered zero (0) through five (V), each representing a different mitigation strategy. A description is provided below for each strategy, including the lead agency, implementation method, description, and the lead times/schedule (cost effectiveness for each strategy is discussed in Section 5).

3.2.1 Tier 0: Reducing Project Related Sources with Verified Emission Reduction Technologies

Tier 0 represents emission reductions targeted at project related sources (dredges, tugboats, support vessels, etc.) using verified ERTs and strategies such that emission reductions can be confirmed without having to perform additional significant emissions testing (i.e., the ERT or strategy has already been verified). These verified ERTs and strategies are:

- Tugboat Emission Reduction Program (TERP)

  Lead Agency: PANYNJ
  Implementation Method: Contractual Agreement with Source Owner

  Tugboat repowering involves scrapping an existing engine and replacing it with a new cleaner engine, with the change in emissions being the offset. In effect, a project source of emissions is directly reduced. This emission reduction strategy has proven to be an effective strategy (tons reduced/dollars spent) in California, Texas, and most recently, New Jersey.

  The current tugboat repowering program, led by the PANYNJ and coordinated with the NJDEP and RAT, was the first repowering program of its type in the NYNJLINA. This program is being employed as a mitigation strategy used for the KVK-5 deepening project, in conjunction with the purchase of stationary source credits. As part of the contractual agreement with the tugboat owner, the owner is required to keep the tugboat operating at a minimum of 90% of the time in the nonattainment area for ten years. The emissions offsets continue during the lifespan of the project, beyond when KVK-5 is completed. Currently, the selection process is completed and the project is in the implementation phase.

Based on the implementation of and lessons learned from the PANYNJ tugboat repower project, guidelines for setting up a repower project are provided in Appendix B.

Lead Time: Six months from initiation to offsets

- EPA/CARB NOx Verified ERTs

Lead Agency:	NYD
Implementation Method:	HDP Contract Specification

Currently there is only one VFE for NOx on either list, PuriNOx, developed and marketed by the Lubrizol Corporation. A fact sheet on PuriNOx, which is currently verified to reduce NOx from nonroad engines by 18-20%, is provided in Appendix E.

Lead Time: 6 to 9 months

- Electrification

Lead Agency:	PANYNJ, NJDOT/OMR
Implementation Method:	Agreement with Public Service Enterprise Group

Electrification replaces an existing diesel engine with a grid-powered electric motor. For the purposes of the GC rule, grid power is inherently included in a SIP and therefore, the emissions resulting from the generation of that power do not need to be included in the GC determination. Thus the offset obtained by electrification is the total reduction of emissions from the diesel engine being replaced. PANYNJ is preparing an initial report on their findings for this strategy for the Port Jersey channel (provided in Appendix F).

Implementation of this strategy requires a substantial initial investment in an onshore power source, cabling from the landside substation to the dredge, extensive enhancements for the dredge to accept landside supplied power, and the operational costs associated with the price of landside supplied power versus diesel power. In addition, there would be additional costs for converting diesel-hydraulic dredges, as they are more complicated than the diesel-electric (clamshells). The dredge companies have indicated that they would charge the downtime associated with the dredge during set up and removal of these modifications. This will add to overall project costs beyond engine retrofits and establishing a power source. These costs are included in the numbers provided in Section 5.

It is also likely that a contractor would not go through the time and cost to modify a dredge unless they were awarded the contract, adding substantially to the start of operations and potentially impacting this and following contract schedules. If, on the other hand, the contract specifications require the use of a modified dredge then there are the risks that no company will make the investment, and the contract will not be bid on or the shore-based power supply will not be available for use in time for the selected contractor to apply it.

Additional information will be available pending the PANYNJ report release.

Lead Time: Six to nine months from initiation to offsets

- Ultra Low Sulfur Diesel (ULSD)

Lead Agency:	NYD, PANYNJ
Implementation Method:	HDP Contract Language/Contract with Source Owner

ULSD primarily reduces PM emissions associated with the sulfur content in consumed fuel and is used in those ERTs that are sulfur- limited, such as SCR. Sulfur poisons the catalyst and thus can significantly reduce its life. ULSD is a Tier 0 alternative if a sulfur-limited ERT is used on project equipment; however, ULSD on its own does not reduce any NOx and therefore does not help meet the GC requirements, unless a sulfur-limited ERT is part of the HAMP.

Lead Time: Six months prior to needed offsets

3.2.2 Tier I: Staten Island Ferries (SIF) Retrofit with Selective Catalytic Reduction (SCR) Technology

This Tier I strategy, retrofit of the Staten Island Ferries with SCR technology, represents the single largest maritime opportunity for significantly reducing emissions from a small number of vessels (seven), that are operated by a public entity (NYCDOT), that are within the area of the HDP and the nonattainment area. This strategy also has the potential to significantly reduce the amount of emissions greater than what would be generated by the project. This strategy incorporates the use of SCR systems on the propulsion engines (not the auxiliary engines) for the ferries by class as follows: Austen (two ferries with two propulsion engines each), the Barberi (two ferries with four propulsion engines each), and the new Centennial (three ferries with three propulsion engines each). The auxiliary engines are not considered in this strategy, but do represent a potential candidate for a contingency strategy.

Lead Agency:	PANYNJ
Implementation Method:	After successful demonstration, Memorandum of Agreement (MOA) with NYCDOT for the demonstration ferry project, then an MOA with NYCDOT for the remaining six ferries

As a result of the CMVEI, the SIF fleet was identified as a unique emission reduction opportunity that could offset nearly (with the exception of years 2004 and 2005) all the HDP emissions through the installation of SCR. In contrast, the private ferry fleet is comprised of smaller vessels, is under fragmented ownership, is less certain regarding long-term emission reduction benefits (a company could go out of business or reduce service) and is currently being addressed by NYCDOT and NYSERDA under a different program.

The current propulsion emission estimates used in the HAMP for the SIF fleet are based on the CMVEI, which used default load factors (e.g., 79% for propulsion engines over 1,000 horsepower (hp), as is mentioned in the 1999 EPA Regulatory Impact Analysis (RIA)). The CMVEI is a SIP level inventory which is reflective of large fleets, however, when examining a particular vessel or engine, the exact load/duty cycle can vary substantially, depending on engine make and typical in-use operating profiles. This is why the SIF demonstration project will be collecting actual duty-cycle data and performing actual emission testing to determine the two most significant unknowns from the CMVEI inventory; load factor and actual baseline engine emission rates. For example, based on information collected during the CMVEI, the load factor for the SIF may be closer to 57%; however, the information provided was not sufficient to depart from the RIA approved load factor. When the duty cycle and emission testing results have been quality assured and accepted by the RAT then the results will be incorporated into the HAMP emission estimates for the SIF fleet. See Section 5 for further details on the assumptions used to estimate the baseline and emission reductions from the SIF fleet.

The PANYNJ and the NYCDOT have entered into a demonstration agreement to retrofit one Austen class ferry with an SCR system. If successful, other ferries would be retrofitted. The current timeline calls for installation and verification of the SCR system in summer 2004, with the magnitude of emission offsets dependent on the results of the baseline and verification testing. The SIF SCR project would include ULSD, which allows for the efficient operation of the SCR.

Another important consideration when evaluating the potential emission reductions is that all seven SIF ferries operate in a coordinated and managed system. There are both mandatory and incidental times where each ferry must be taken out of service for repairs. The duration of ferries being out of service varies depending on what inspection or maintenance must be performed. In addition, the different classes of ferries also are used at different times throughout the day depending on passenger loads. Therefore, if this tiered strategy is implemented, it should include the retrofitting of all seven ferries, as this is the only way to ensure that there is sufficient contingency to address the potential overestimates of reductions discussed previously, that the emission offsets are continual and uninterruptible, and that the reductions truly offset project emissions (which are produced continuously 24 hours per day, seven days per week).

Pertinent information from the SIF demonstration project will be added to the HAMP as the project continues. This will aid in implementation for the other six ferries and maximize efficiency of NOx reductions, as well as setting the actual NOx reductions that could be applied towards offsetting project emissions. As stated in Section 3.1, NOx emissions for the ferries are estimated based on existing emission factors applied to the SIF fleet and may not be reflective of individual vessels. These estimates are used to gauge the potential emission reductions that one might expect from the SIF fleet.

At this time, the load factor used to estimate the emissions from these ferries is based upon EPA guidance, which may not necessarily represent actual use. Information gathered during the CMVEI from the operators was inconclusive and therefore the EPA guidance number was used. As part of the PANYNJ Austen Class demonstration project, load measurements are to be collected and the findings would be used to revise the existing load factors to better represent real operational conditions. The SIF reductions presented in Section 5 may tend to overestimate the reductions from SCR; the estimated change associated with the new load factor will most likely reduce the reductions by 10 to 25%. The HAMP baseline emissions will be revised once the load factor data from the PANYNJ has been collected and quality assured.

The demonstration project will be used to align the estimated emission reductions with verified reductions, once the measured findings (duty cycle and emission testing results) are released. It is likely, due to the trend of conservatively high emission factors, that the baseline emissions and the emission offsets will be lower than currently estimated.

Lead Time: Ferry emission offsets are expected to be online according to the following timetable:

- Alice Austen – summer 2004
- John Noble – spring 2005
- Three Centennial class – 2005 - 2006
- Two Barberi class – 2005

Since the first demonstration project has just started, the lead times listed above are based on current knowledge and expectations and will needed to be updated as the project moves into later phases. In addition, when the first demonstration project is proven to be a success, the PANYNJ will enter into a Memorandum of Understanding (MOU) that would establish implementation timelines.

3.2.3 Tier II: Non-Project Related Sources with Verified Emission Reduction Technologies

Tier II represents emission reductions targeted at emission sources that operate within the same nonattainment area as the HDP using verified ERTs and strategies such that emission reductions can be confirmed without having to perform additional significant emissions testing (i.e., the ERT or strategy has already been verified). These verified ERTs and strategies are:

- Tugboat Emission Reduction Program (TERP)

  Lead Agency: PANYNJ
  Implementation Method: Contract Agreement with Source Owner

  As mentioned above, the Tier II PANYNJ KVK-5 tugboat repower project is an example of a Tier II emission reduction strategy. In discussions with tugboat operators and after reviewing the results of the CMVEI, there are a limited number of tugboats that spend a significant (greater than 90%) of their time in the nonattainment area. Those tugboats that are used for ocean going vessel assists also, during downtimes, move or shift loads within the harbor. Several of these vessels are already slated for repowering as the tugboat companies have begun to move to more modern and complex propulsion drive systems to make these assist tugs more maneuverable. Therefore, none of the mitigation alternatives presented in Section 5 rely on more then 225 tpy NOx of the total emission reductions coming from repowering.

  It is important to note that only tugboats not planning to repower their engines in the same timeframe that Tier II strategies would provide for should be considered for this strategy. This addresses the inherent need to ensure that emissions reductions are surplus, i.e., not otherwise required or that would not occur without the sponsors' participation.

- VFEs in Other Marine Facility Sources

  Lead Agency: To Be Determined
  Implementation Method: Contract Agreement with Source Owner or grant program

  Another Tier II strategy could be to utilize VFEs in marine facility sources, for example, CHE (i.e., terminal tractors) that serve the ships that are benefiting from the deepening of the channels. VFEs could be used to replace diesel fuel in various populations of terminal tractors within the container yard facilities. Terminal tractors are the best candidates, as compared to other types of cargo handling equipment found on container terminals, as they have been successfully converted at other container ports in the United States. The magnitude of the this measure is limited to at most, 80% of the terminal tractor fleet, thus providing 20% of the fleet as contingency should there be a small number that are unable to function while using the VFEs or that are moved to other port facilities outside the area (a standard practice to meet changing needs). At the Port of Houston, none of the terminal tractors that have used a VFE have experienced operational problems, and at the Port of Los Angeles only a small portion (less than roughly 5%) have not been able to mechanically operate with VFEs. The terminal tractors are owned by the terminal operators and not the PANYNJ. This means that any program to use VFEs would be voluntary and subject to both acceptance by all the operators and assurances regarding liability issues in the event the use of VFEs adversely affects the equipment's use or value. This could significantly affect the time that would be required to reach the 80% level, if reached at all.

There is an important issue that must be observed in the future when employing VFEs as an emission reduction strategy: as the fleets of equipment are turned over or replaced with newer equipment, the baseline emissions will start to diminish as the nonroad diesel engine standards are implemented (starting 2004). Therefore, the emission reductions resulting from the use of VFEs will still be appropriate but it will be reducing a smaller amount of baseline of emissions. This will likely create an eroding effect (i.e., it will take more pieces of new equipment on VFEs to equal the reductions of older equipment on VFEs to get the same emission reduction) on the use of VFEs in 2007 and beyond. Since the HAMP is a living document and at this time there are no other VFEs, one should view VFEs in the out years as a planning or budget cap in which another verified ERT (one that perhaps is not verified today) could replace PuriNOx as the ERT in a Tier II measure.

Finally, as the project progresses and additional verified ERTs come online, any selected Tier II strategy should be reviewed to see if there are more effective verified ERTs. This review should take place as part of the annual review of ERTs proposed in the cSOC.

Lead Time: Six months from initiation to offsets for tugboat repowering
12 - 18 months from initiation to offsets for VFEs

3.2.4 Tier III: Emerging Emission Reduction Technologies

Tier III involves using emission reduction technologies in project and non-project related sources (dredges, tugboats, support vessels, government/public vessels, commercial vessels, etc.), which operate within the same nonattainment area, using emerging emission reduction technologies (EERTs). The significant difference of Tier III in comparison with Tier 0 and I is that the EERTs will require additional testing/verification to document the magnitude of the emission reduction and the duration or life of the technology (since it has not yet been verified by EPA).

Lead Agency: PANYNJ

Implementation Method: Contract Agreement with Source Operator

EERTs are those that are not currently on either of the verified technology lists, but have the potential to significantly reduce NOx emissions. Tier III represents the use of such ERTs on non-project related emission sources (excluding the SIF demonstration project) to offset HDP emissions. Given that these emission reduction strategies are not verified by either EPA or CARB, there are some additional reduction verification procedures that needed to be undertaken to verify actual reduction levels. These procedures will impact the implementation of EERTs by incurring time delays, the potential for varying degrees of actual emission reductions, and cost of emission reduction verification testing. The scope and cost associated with project verification of Tier III ERTs has not been fully developed by the states and EPA.

There is the potential risk that such a strategy will not achieve the reductions that were initially anticipated and therefore the shortfall in emission offsets would need to be filled or the HDP could be halted. Due to the uncertainty regarding the value of EERTs, relative to the success of the KVK-5 tugboat repowering project and the potential significant reductions associated with the SIF demonstration project, Tier III initiatives are considered as a mid- to long- term strategy, requiring more information before their effectiveness and implementability can be ascertained.

Lead Time: Twelve months from initiation to offsets

3.2.5 Tier IV: Emission Reduction Credits

Tier IV represents the use of emission reduction credits as a means of offsetting contemporaneous emissions generated by the HDP construction, and is detailed below.

Lead Agency: PANYNJ
Implementation Method: Written agreement with NJDEP and/or NYSDEC

Tier IV was used by the PANYNJ for KVK-5 in order to provide contemporaneous emission reductions so that dredging, which was underway, could begin before actual emission reductions could be generated from the repower of two tugboats. The issue of additional use of credits for the HDP still needs to be worked out by the agencies. When a resolution is arrived at, it will be incorporated into the HAMP. Since the purchase of the emission credits for the KVK-5 project, the NJDEP has eliminated their OMET program and therefore this alternative is no longer available in New Jersey. The PANYNJ purchased 95.68 tons NOx shutdown credits in early 2003 for $113,065.

The PANYNJ owns 200 tons of NOx emission reduction credits from the Proctor & Gamble site on Staten Island that could be made available for the HDP. Should NYSDEC approval be obtained, the PANYNJ can turn over the credits as quickly as the process allows.

Lead Time: This process took eight months from initiation to procurement of credits for the KVK-5 project

3.2.6 Tier V: State Implementation Plans

Tier V represents the option, defined in the GC rule, that the HDP can meet conformity if the emissions can be accommodated or included as a line item in the applicable approved SIP.

Lead Agencies: NYSDEC, NJDEP
Implementation Method: SIP Revision - Case for Accommodation

The CAA requires that, for those areas in which a NAAQS is violated, certain actions must be taken by the States to ensure the attainment of that NAAQS by a date specified in the CAA. Chief among these actions is the development of a SIP. A SIP evaluates regional emissions and contains specific control measures, as determined by the State, to reduce emissions so that the NAAQS is attained in that region by the date specified. The section of the CAA that requires conformity of federal actions to SIPs serves to ensure that no Federal action may interfere with a State's planned actions to achieve air quality by the required attainment date.

For an area classified as being in severe nonattainment of the ozone NAAQS, such as the tri-state New York-Northern New Jersey-Long Island Area, the first requirement in the SIP process requires each of the three states to develop a baseline for 1990, for all emissions sources in their State portion of the nonattainment area. This baseline estimate is subject to technical, legal, and public review, comment, and revision on both state and federal levels prior to approval. Once a baseline is established, each State then individually develops steps, i.e., a plan, to reduce these emissions by 3% per year, as required by the CAA. These steps must be approved by EPA and included in the SIP. Again, as a revision to the SIP, these steps are subject to technical, legal and public review, comment, input and revision on both state and Federal levels. Finally, the three States together must produce an attainment demonstration, to be included in their SIPs, that proves that a 3% reduction per year is in fact sufficient to bring the entire tri-state region into attainment.

Tier V is not an emission reduction strategy *per se*, rather it is an evaluation of the SIP to determine if the HDP may be accommodated or included in some way that does not interfere with the region gaining attainment by the CAA mandated date.

For the New York Metropolitan Area, the SIP process began in 1991 following the designation of the region as a severe nonattainment area for the ozone NAAQS. It concluded over a decade later on 4 February 2002 with EPA's published approval. However, before granting the 4 February 2002 approval of the individual SIPs, the EPA performed its own analyses of the SIPs, including the regional attainment demonstration for the tri-state nonattainment region, and determined that further emission reductions beyond those already in the SIP were necessary for attainment.

As a result, the States had to commit to institute additional emission reductions on the levels of the tens of tons per day. Both New York and New Jersey are just concluding the implementation of rules to regulate the VOC content and releases from items such as consumer products, paints and gas cans, and to regulate NOx emissions from certain stationary sources in order to secure the additional emission reductions required by the EPA. It is clear that neither regional emissions were over-estimated, nor were benefits from emission control measures underestimated. Therefore, the HDP may not be accommodated in the existing SIPs.

A SIP Mid-Course Review is scheduled for late 2004. It is a review of monitoring data as a comparison to estimated emission reductions from established control programs. If the Mid-Course Review does not show that progress is being made to attain the 1-hour ozone standard, it may become necessary to re-open the SIP to add control measures, not to accommodate additional emissions.

Given the fact that the States need all the emission reductions possible in order to meet the 1-hour ozone standard by 2007, neither New York nor New Jersey view the option of accommodation of the HDP in their SIPs as viable.

In order to incorporate the HDP into the SIPs, a full recalculation of the 1990 baseline to include the newly prepared CMVEI would need to be performed. In doing so, the States must demonstrate that the three percent emission reduction per year, or the rate-of-progress, is still being met. Since the methodologies for onroad and nonroad mobile sources, as well as for some stationary and area sources, have changed since the SIP was submitted to the EPA in 1998, updating the baseline to include the HDP would necessitate a recalculation of all sources, not just harbor-related. This recalculation is as likely to show that emission levels were underestimated as it is to show that they were overestimated, requiring the time intensive development of additional control measures, such as regulations or rulemakings, and it imposes a significant risk of project delays leading to an uncertain outcome.

Furthermore, if the 1990 baseline were to be re-calculated, a full SIP revision would be required as it would be considered a substantive change to the SIP, and not supplemental.

Finally, the EPA is in the process of designating nonattainment areas for the more stringent 8-hour ozone standard. The NYNJLI area will be in nonattainment for this standard as well and therefore the states will need even more emission reductions.

Lead Time: The states of New York and New Jersey estimate that it would currently take, at a minimum, three to four years to process a SIP revision. The states would need to identify additional sources to regulate, and implement rules to secure emission reductions in order to incorporate this project in their SIPs.

3.3 Summary Findings

Based on the factors discussed in this section, a number of the initial strategies and implementation options identified by the RAT have been modified or eliminated from further consideration as a viable component to the HAMP. The options eliminated are:

- Stationary and onroad sources (buses, trucks, power stations, etc.)
- Airport ground equipment and cogeneration plant
- Private ferries, tour boats and pilot vessels
- Additional purchased emission credits
- SIP revision

Additional options that have been modified for use in developing the HAMP are:

- Limiting tugboat repower to 60% of the total emission reduction for any of the mitigation alternatives presented in Section 5
- Limiting cargo handling equipment using VFEs to 80% of the terminal tractor fleet

In addition, the use of EERTs has been deferred until such time as their effectiveness and implementability can be ascertained. At that time they may be considered as a mid to long-term strategy.

SECTION 4 EVALUATION CRITERIA

This section discusses the evaluation criteria used to compare mitigation alternatives, and formulate a recommended plan, with each alternative being comprised of a different combination of tiered emission reduction strategies. A wide variety of emission sources that could be targeted for emission reduction to meet GC were identified in Section 3. Several of these source types were deemed to be inapplicable, already regulated, or not practicable for use in mitigating HDP emission impacts. Of those emission sources and ERTs that were found to be most promising, the following criteria was used to further refine the list of options that could be implemented as various strategies for the mitigation alternatives (that meets the requirements of GC) for the HDP:

1) Consistency with Corps Headquarters guidelines (see December 2002 memoranda, Appendices G and H)
2) Consistency with cSOC
3) Cost effectiveness
4) Maintaining project execution schedules
5) Implementation complexity
6) Relative risk
7) Consistency with long-term environmental (air) benefits
8) Local sponsor concurrence

While compliance with the GC rule does not require the meeting of any cost effectiveness criteria, the NYD, under its own policy and guidelines, must identify the most cost effective alternative among the several emission reduction strategies and mitigation alternatives that could be implemented to meet conformity. However, the most cost effective mitigation alternative might have a high level of risk exposure associated with its approach. For example, if a mitigation alternative commits to generating over 75% of its reductions from a single strategy, then that alternative has a high level of risk exposure should the sources under that strategy experience changes in activity levels (i.e., reduced activity directly reduces the emission offsets generated). As another example, if the mitigation alternative requires numerous strategies to be implemented with a significant number of different source owners, then the complexity and management of the mitigation alternative could raise the cost and exposure to risk of failure to achieve the required emission reduction. Finally, the use of non-verified emission reduction strategies increases the risk of the reductions being less than anticipated and/or requiring emission testing to verify the reductions. Because of the variability of risk associated with different alternatives, cost effectiveness is not the only consideration. And finally, since this is a partnership with a non-Federal sponsor (PANYNJ), they too must concur in the recommendation and be willing to cost-share in its implementation.

4.1 Consistency with Corps Headquarters Guidelines

In December 2002, in response to a NYD proposal on how to approach conformity, Corps Headquarters (HQ) approved a guidance memorandum (see Appendix G for the guidance and Appendix H for the approval) that laid out the following priorities to mitigate air impacts (patterned after traditional wetlands mitigation planning):

- Reduce or minimize project emissions
- Mitigate for unavoidable impacts as close to impact area as possible
- If nearby opportunities are not available, select from those within the same air shed (nonattainment area)
- Select offsets generated from public facilities in preference to those from private facilities.

4.2 Consistency with the cSOC

Although the cSOC is not a requirement of the GC rule, the NYD and PANYNJ signed the document in order to facilitate the signing of the ROD for the HDP. Each of the seven alternatives presented in Section 5 address all aspects of the cSOC (listed in Table 1.1) and are fully and equally consistent with its approach.

4.3 Cost Effectiveness

There are two inherent cost effectiveness measures that were calculated for the various emission reduction strategies and for the entire suite of mitigation alternatives. Each of these measures includes capital costs and operation and maintenance (O&M) costs. The first cost effectiveness measure is Total Cost Effectiveness (TCE) and is defined by the following equation:

TCE = [ΣCapital Costs ($) + ΣO&M Costs ($)] / ΣTotal tons NOx Reduced

The period of the summation of capital and O&M costs was from 2002 through 2013. O&M costs include any downtime, change over, or other owner/operator expenses that are incurred as result of the mitigation strategy. Interest, capital recovery factor, and other economic variables were not included in the calculations because the NYD takes these factors into account in later steps when it develops the LRR.

Several of the emission reduction strategies, such as repowering, involve a capital cost in the beginning but continue to produce emission offsets for many years. Since the strategies must incorporate significant reductions to overcome two peak emission periods, strategies such as repowering or the use of SCRs on the SIF fleet will inevitably produce significant emission offsets after the peaks when the project emissions are declining. Therefore, the total cost effectiveness includes emissions beyond what is strictly required to meet GC.

The second cost effectiveness measure is Project Cost Effectiveness (PCE), and is defined by the following equation:

PCE = [ΣCapital Costs ($) + ΣO&M Costs ($)] / Σtons NOx Generated by HDP

From Section 2.1, there will be an estimated 2,947 tons NOx generated by the HDP. Therefore, the PCE will always be more than the TCE as each mitigation alternative produces reductions beyond what is needed to offset the 2,947 tons of NOx generated by the project. This inevitable surplus can directly benefit the project by building in a safety cushion of additional emission reductions beyond what is required by GC. This safety cushion will provide a contingency to meet unanticipated increases in emissions and/or decreases in reductions. In addition, any unused surplus will also have an indirect effect in improving the overall air quality of the region. Both of these factors are considered further in the subsections on implementation (Section 4.5), risk (Section 4.6), and benefits (Section 4.7).

4.4 Maintaining Project Execution Schedules

The mitigation alternative selected should not impact in any way the HDP schedule. A mitigation alternative that could delay the schedule would have significant impacts to the cost and logistics for the project. Therefore, relative risk to the project schedule will be a significant evaluation criterion for selecting a mitigation option to meet GC.

The one factor that most directly affects the schedule is electrification. This option requires completion of an onshore power source in time for the PJ contract in 2004. In addition, it is unlikely that a contractor would invest in the time and cost to modify a dredge until they were selected for a contract. This would add to the time needed to start the contract and potentially to the schedule completion of that and subsequent contracts.

4.5 Implementation Complexity

Since the critical portion of the HDP is from 2004 through 2006 (due to the relatively short lead time to get emission reduction strategies implemented) the alternatives were developed to keep the implementation complexity to a minimum. Complexity could have a direct effect on the implementation schedule, which ultimately affects project execution, success, and cost. Factors influencing implementation complexity include ERT verification, number of source owners and/or operators that are affected, government vs. public sector sourcing, number of strategies to be implemented, and the schedule for implementation. Therefore, mitigation alternatives that include a large number of private entities, a large number of emission sources to be reduced, or are technically challenging would have a high level of implementation complexity and would add to the relative risk of successful alternative implementation (i.e., the more complicated the alternative, the more likely for something to go wrong).

This can be exemplified with the option that utilizes fuel additives in Port tenant tractors. Since this would be a voluntary program that includes multiple owners, the ability to successfully implement would decrease as the target percentage increased; the lower the proportion of the fleet that is required to meet a given need the more likely that need will be met.

4.6 Relative Risk

Relative risk is evaluated qualitatively, looking primarily at the percent reduction by tiered emission strategy and at the variables that could significantly impact the performance of the mitigation alternative and therefore negatively affect the project schedule. A potentially high relative risk alternative, for example, might invest 80 percent of the reductions in a single tiered reduction strategy. This would require further examination of that tiered strategy and any surplus emission offsets that it creates.

An example of a relatively low risk alternative would be the installation of SCR on all seven of the SIF ferries. Even if the technology was to operate at a low 70 percent reduction, the surplus emission reductions are high enough that they could sustain significant downturns in operational capacity. As stated in Section 3.2.2, limiting the SCRs only to the minimum number of ferries that are needed to offset project emissions would constitute a greater risk if ferry use or even availability declined and there were no other ferries that could be retrofitted to replace the emission offsets that were lost. This would result in slowing or stopping the project. The SIF operates in a system that uses vessels in the fleet in various numbers throughout the week. The Austen class ferries are used for non-peak time hours, while the larger Barberi and Kennedy (soon to be replaced by the Centennial class) ferries are used during the peak passenger hours. It should be noted that the Centennial class has more installed horsepower for propulsion and a completely different propulsion system then the Kennedy class ferries. Further, the Barberi and Kennedy classes do not operate during the weekends or at night. Retrofitting only one class would limit the offsets obtained over the full 24-hour operations schedule for the dredges. The ferry system if fully retrofitted will take into account scheduled downtime and maintenance and can adjust if an unforeseen mechanical/electrical problem is found. Again, the risk of retrofitting less than seven ferries could significantly increase the relative risk in meeting the emission offset requirements under GC. Fitting the SIF fleet with SCR provides the best opportunity to achieve conformity due to its being an integral public service that is not likely to be discontinued, and its operating schedule best mirrors the construction schedule for the HDP (i.e., 24 hours/day, 7 days/week). In addition, the SIF fleet is owned and operated by a public entity (NYC), which reduces the risk of the ferries stopping or reducing service in response to changes in market conditions and is consistent with the NYD's guidance of favoring governmental sources over private emission sources.

Conversely, an alternative that relies on emission reductions from tugboats for a high proportion of its reductions may be a relatively medium to high risk alternative because that alternative would have exposure to maritime industry swings associated with the economy and with the movement of tugboats among ports, minimizing the time in the project area. Therefore, unlimited repowering of private tugboats is highly risky and mitigation alternatives were limited to less then 225 tpy NOx total reductions for any one mitigation strategy (excluding the two from the KVK-5 repower project).

Another significant relative risk is related to how close the mitigation alternative comes to the emissions expected to be generated from the HDP. In other words, how much overage is built into the emission reduction plan? This is important for several reasons, including: baseline emission estimate assumptions vs. actual construction operations, ERT performance, operational changes, accidents, scheduled downtimes, etc. One of the most significant assumptions is the baseline emission estimates. These are based on the latest design plans; however there could be a significant difference between what is assumed and what will actually be needed to complete each contract. Therefore, the emission baseline estimates will be changed and updated as the project progresses. Should any of the baseline estimates change significantly, or any of the other issues discussed previously occur, such that the mitigation alternative has a shortfall, project construction would have to halt until the GC requirements could be met. Another safety factor for all of the mitigation alternatives are a number of contingency plans. In the event that a primary measure fails to achieve the predicted results, then a secondary strategy could be employed such that the project schedule would not be impacted.

An assessment of the relative risks or advantages and disadvantages are provided for each alternative.

4.7 Consistency with Long-Term Environmental Benefits

In March 2002, the Corps' Chief of Engineers released a set of Environmental Operating Principles (EOPs) to guide how the Corps should do business in support of the environment. These principles are outlined below:

- Strive to achieve environmental sustainability. An environment maintained in a healthy, diverse and sustainable condition is necessary to support life.
- Recognize the interdependence of life and the physical environment. Proactively consider environmental consequences of Corps programs and act accordingly in all appropriate circumstances.
- Seek balance and synergy among human development activities and natural systems by designing economic and environmental solutions that support and reinforce one another.
- Continue to accept corporate responsibility and accountability under the law for activities and decisions under our control that impact human health and welfare and the continued viability of natural systems.
- Seek ways and means to assess and mitigate cumulative impacts to the environment; bring systems approaches to the full life cycle of our processes and work.
- Build and share an integrated scientific, economic, and social knowledge base that supports a greater understanding of the environment and impacts of our work.
- Respect the views of individuals and groups interested in Corps activities, listen to them actively, and learn from their perspective in the search to find innovative win-win solutions to the nation's problems that also protect and enhance the environment.

Taken as a whole, these principles influenced the development of the mitigation alternatives, encouraging choices that add to the sustainability and balance of economics and the environment.

4.8 Local Sponsor Concurrence

The local non-Federal sponsor for the HDP is the PANYNJ. Their sponsorship requires substantial investment of funds in a set ratio, established by Congress. The schedule by which the various channels come online with deeper depths directly affects the Port's ability to move cargo and maintain clients. In addition, delays are costly in terms of overall project costs increasing and benefits being delayed, and also in terms of the long-term consequences of adversely impacting dredging reaches already limited by seasonal windows. Consequently, the PANYNJ has a vital say, as a partner, in the final plan selection, and their input plays very strongly in the selection of alternatives.

SECTION 5 MITIGATION ALTERNATIVES

This section presents seven mitigation alternatives using the tiered strategies (see Section 3). These mitigation alternatives have a wide variety of NOx emission reductions, costs, and implementation complexities. Table 5.1 presents the combinations of the tiered strategies, designated as Mitigation Alternatives (MA) #1 through #7, considered. Each of these alternatives would fully offset the emissions from the HDP Federal action. For the sake of comparison, the targeted emissions reduction to reach conformity over the life of the project is 2,947 tons of NOx. All alternatives meet this level of reduction and so would achieve conformity with the GC rule. More importantly, they do so at a rate consistent with the rate at which the emissions are produced.

It is important to understand that air quality mitigation is not an exact science like, for example, wetlands mitigation. If a project requires the mitigation of 345 acres of impacted wetlands, it is understood that 345 acres of wetlands in another area must be secured, or that there are established habitat evaluation measures that determine the value of the loss and its replacement. For air emission reductions, a completely different approach has to be taken. As outlined in Section 4.6, there are risks associated with the potential emission reductions from any strategy due to the variability of the source itself, the ERT, and the potential for operational changes that could suddenly render a strategy ineffective. Therefore, responsible air mitigation must include a combination of strategies that not only meet the target reduction goal, but also significantly aim for minimally 15 to 20% over that target. Thus if any of the strategy risks are realized, the schedule will not be impacted. In addition, since the HDP schedule is extremely critical, a mitigation plan should have contingency measures such that if a primary strategy fails there is a secondary (contingency) strategy that can be engaged within such a time so as to not cause a schedule delay. If a mitigation alternative is accomplished without realizing any of the potential risk factors, then an additional environmental benefit will be achieved.

Based on the previous mitigation of NOx from nonroad sources elsewhere in the nation, it is assumed that an ERT is cost effective if it costs less than the industry standard of $13,600 per ton NOx reduced.[5] All the alternatives that were developed are well below this metric. The costs presented are those associated with implementing the alternative and do not include costs to monitor and coordinate operations to confirm the necessary reductions are being generated to meet the actual project emissions. Depending on the alternative, this effort could cost as much as $200,000 per year plus a significant and intense effort to manage the operations and effect any needed adjustments. The work would include reviewing HDP reporting and recordkeeping; updating HDP emission estimates; tracking MA progress, and making the appropriate adjustments; quantifying emission reductions; compiling relevant information for GC determinations; and briefing the RAT on the HDP GC progress. Appendix I provides further details on emission reduction estimates and cost methods.

[5] *The Carl Moyer Memorial Air Quality Standards Attainment Program Guidelines, Proposed Revisions 2003*, California Air Resources Board, March 2003. This is the economically feasible standard that is commonly used for reducing NOx emissions from nonroad sources.

MA#1, #3, #5, and #7 are built around the SIF fleet being retrofitted with SCR technology to the propulsion engines. As discussed in Section 3.2.2, the load factor used to estimate the emissions from these ferries is based upon EPA guidance, which may not necessarily represent actual use. As part of the PANYNJ Austen Class demonstration project, load measurements are to be collected and the findings would be used to revise the existing load factors to better represent real operational conditions. In summary, the SIF reductions currently presented in this section may tend to over estimate the reductions from SCR, however the mitigation levels above the estimated HDP emissions have been elevated to help ensure that if there is a reduction it will not impact the performance of the implementation plan. The HAMP will be revised once the load factor data is received and again when baseline emission testing from the PANYNJ has been collected, quality assured, and approved by the RAT. In year 2004 the estimated change could be as high as three tons NOx reduced from the total years' emission reduction strategy (i.e., not a significant reduction for any of the MAs).

It is important to note that for the MAs that use the SIF strategy, auxiliary engines are not included; only those engines associated with the propulsion of the ferries are used for emission reductions.

The TERP strategy is currently based on the findings of the continuing KVK-5 repower project. The two tugboats selected for that repower program are estimated to generate NOx reductions on by 25 tpy on average. Therefore, in those MAs that use this strategy, it is assumed that each tugboat represents a 25 tpy NOx reduction. It is important to note that it could take fewer or more actual tugboats, based on the applications that are received at the time. The key is to determine the total NOx reduction that is needed by the strategy and then find the tugboats to get that reduction.

Finally, in all MAs there is a shortfall in 2003, associated with the KVK-5 project. The emission credits purchased and the tugboat repowering fall short in completely offsetting emissions for that year. To rectify this situation, emission reductions from the TERP will be decremented from the 2004 reductions to cover the amount needed to cover the 2003 shortfall. This agreement is specifically directed at the unique circumstances associated with the HDP and does not represent a precedent setting agreement.

The following sections present each alternative in detail.

Table 5.1: Mitigation Alternative Matrix

MA#	Risk		Tiered Strategies									Emission Reductions		Cost	
Alternative	Relative Risk	Complexity (No. of Strategies Employed)	Tier 0 - Verified Fuel Emulsion in HDP Equipment (% Equipment)	Tier 0 - PJ Electrification	Tier I - Staten Island Ferry	Tier II - KVK-5 Tugboat Repower (Tugboats)	Tier II – TERP (Tugboats)	Tier II - VFE in CHE (% TT)	Tier III - SCR on HDP Eqp/ ULSD	Tier IV – Emission Credits	Tier V - SIP	Total NOx Reductions (tons)	Surplus NOx Reductions (tons)	Estimated Cost (Inc $2M Mgt Cost) ($1,000's)	Cost per ton of NOx Reduced ($) (Inc $2M Mgt Cost)
1	Moderate	5	■ 80%	■	■	■ 2				■		7,930	4,983	$18,763 ($20,763)	$2,366 ($2,627)
2	Moderate	6	■ 20-60%	■		■ 2	■ ~6	■ 20%		■		3,981	1,034	$27,154 ($29,154)	$6,821 ($7,323)
3	Moderate	5		■	■	■ 2	■ ~3			■		8,534	5,587	$18,600 ($20,600)	$2,180 ($2,414)
4	Low	5	■ 20-30%			■ 2	■ ~8	■ 30- 80%		■		4,132	1,184	$18,531 ($20,531)	$4,485 ($4,969)
5	Very low	4			■	■ 2		■ 70%		■		7,816	4,869	$13,472 ($15,472)	$1,724 ($1,980)
6	Very low	6				■ 2	■ ~9	■ 80%	■	■		4,132	1,185	$17,726 ($19,726)	$4,290 ($4,774)
7	Very low	4			■	■ 2	■ ~6			■		9,009	6,062	$13,280 ($15,280)	$1,474 ($1,696)

TT – terminal tractor

5.1 Mitigation Alternative #1

Mitigation Alternative #1 (MA#1) incorporates the following tiered emission reduction strategies:

- Tier 0 – Use of VFEs on 80% of the project-related dredging equipment, support vessels, and dredged material transit vessels in 2004 and 2005
- Tier 0 – Electrification of the dredge equipment for Port Jersey
- Tier I – SCR installation and operation on the SIF fleet during the course of the project
- Tier II – KVK-5 tugboat repowering (of two tugboats) to yield reduction offsets to be used throughout the HDP duration
- Tier IV – Offset air credits used from 2002 through 2004 associated with the KVK-5 project

The total NOx emissions associated with the HDP Federal action over the 12-year project are 2,947 tons. MA#1 over the same period of time reduces a total of 7,930 tons NOx from project and non-project related marine emissions sources, producing a surplus of 4,983 tons NOx reduced over the life of the project. Of this, approximately 854 tons NOx per year are long-term, extending beyond completion of dredging. This alternative produces the second largest amount of surplus reductions and therefore one of the greatest overall benefits to the region's air quality; however, this is the most costly alternative, even though it does not yield the largest NOx reduction. Figure 5.1 presents the NOx emission reductions by tiered reduction strategy (bars) with the required reductions (red line) for the project by year, and the potential lower bound (detailed above in Section 3.2.2) of the SIF emission reductions (blue dashed line) that could occur when duty cycle and emission testing results are reviewed and approved by the RAT. The percent contribution to the total NOx reduction by strategy is presented in Figure 5.2. Table 5.2 presents the estimated emission reductions by strategy, for this alternative, for each year of the project, and the estimated costs associated with the implementation of the various strategies.

Figure 5.1: Mitigation Alternative #1 NOx Emission Reductions vs. Project Required Reductions (tons per year)

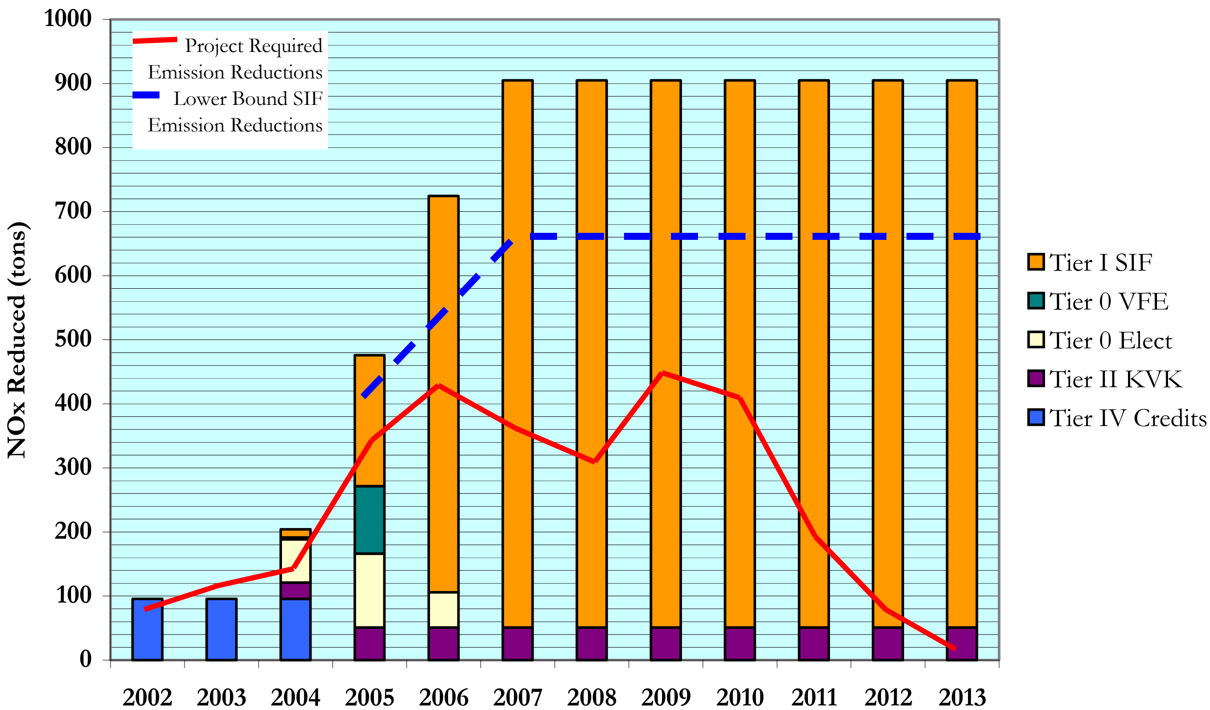

Figure 5.2: Mitigation Alternative #1 Percent Total NOx Reduction by Tiered Mitigation Strategy

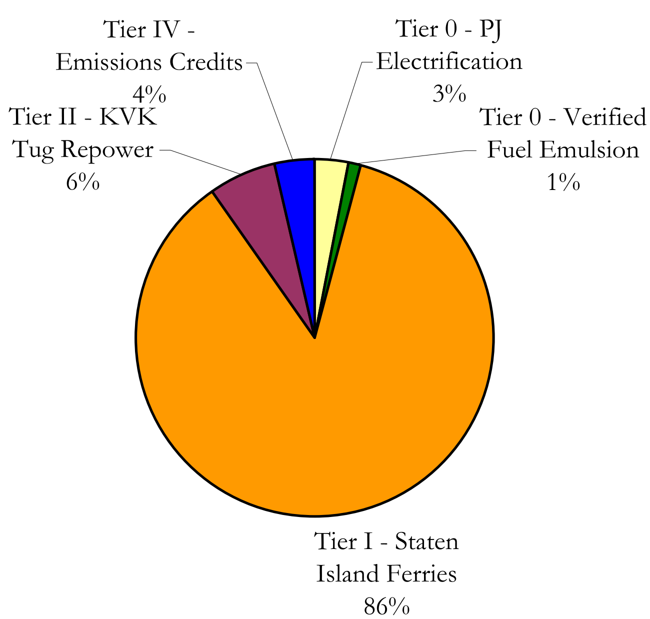

Table 5.2: Mitigation Alternative #1 Emission Reductions and Costs

Mitigation Strategy	Project Year 2002 (tons)	2003 (tons)	2004 (tons)	2005 (tons)	2006 (tons)	2007 (tons)	2008 (tons)	2009 (tons)	2010 (tons)	2011 (tons)	2012 (tons)	2013 (tons)
EMISSIONS												
Estimated Project NOx Emissions	81.80	121.11	145.26	339.17	429.21	366.47	321.95	440.33	409.64	202.00	74.62	15.66
Tier IV Offset Credits NOx Reduced	95.68	95.68	95.68									
Tier II KVK Tug Repowering NOx Reduced			25.43	50.86	50.86	50.86	50.86	50.86	50.86	50.86	50.86	50.86
Tier 0 PJ Dredge Electrification NOx Reduced			67.40	115.26	54.91							
Tier 0 - Verified Fuel Emulsion NOx Reduced			3.00	105.43								
Tier I - SIF			1A	1A, 2B	3C							
NOx Reduced			12.60	204.40	618.80	854.00	854.00	854.00	854.00	854.00	854.00	854.00
NOx Remaining	**(13.88)**	**25.43**	**(58.85)**	**(136.78)**	**(295.36)**	**(538.39)**	**(582.91)**	**(464.53)**	**(495.22)**	**(702.86)**	**(830.24)**	**(889.20)**

COSTS	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	**Total**
Emissions Credits	$113,065												**$113,065**
KVK Tug Repower		$613,130											**$613,130**
PJ Electrification			$6,400,000										**$6,400,000**
Tier 0 - Verified Fuel Emulsion			$34,433	$1,209,067									**$1,243,501**
Tier I - SIF		$200,000	$981,777	$2,898,883	$3,199,542	$444,871	$444,871	$444,871	$444,871	$444,871	$444,871	$444,871	**$10,394,298**
Total Expenditure	**$113,065**	**$813,130**	**$7,416,210**	**$4,107,950**	**$3,199,542**	**$444,871**	**$444,871**	**$444,871**	**$444,871**	**$444,871**	**$444,871**	**$444,871**	**$18,763,994**
Tier 0 Adjustment Factor			0.80	0.80									

Notes:

- Tier II KVK-5 Tugboat Repowering: 25.43 tons NOx decremented in 2004 for 2003 short fall
- Tier 0 – Verified Fuel Emulsion: Assumes 80% use on HDP equipment for years 2004 & 2005
- Tier I – SIF: Assumes 1 Austen Class generating offsets for second half of 2004; 1 Austen full time and 1 Austen and 2 Barberi Class ferries generating emission offsets second half 2005; all Austen and Barberi Class ferries generating offsets full time and three Centennial Class second half of 2006; all ferries generating emission offsets 2007 through 2013

Total NOx reduced, cost, and cost effectiveness for each of the tiered emission reduction strategies used in MA#1 are presented in Table 5.3 below.

Table 5.3: Mitigation Alternative #1 Total NOx Reduced, Cost, and Cost Effectiveness

Tiered Reduction Strategy	Total NOx Reduced (tons)	Total Cost	Total Cost Effectiveness ($/tons reduced)
Tier 0 - PJ Electrification	237.57	$6,400,000	$26,939
Tier 0 - Verified Fuel Emulsion	108.43	$1,243,501	$11,468
Tier I - Staten Island Ferries	6,813.80	$10,394,298	$1,525
Tier II - KVK Tug Repower	483.17	$613,130	$1,269
Tier IV - Emissions Credits	287.04	$113,065	$394
Totals	**7,930.01**	**$18,763,994**	**$2,366**

The total and project cost effectiveness, as described in Section 4.3, for MA#1 are:

- Total Cost Effectiveness = $18,763,994/7,930 tons NOx reduced
  = $2,366/tons NOx reduced

- Project Cost Effectiveness = $18,763,994//2,947 tons NOx reduced
  = $6,367/tons NOx reduced

The costs for each strategy were developed as follows:

- Tier 0 – VFEs. The incremental cost associated with VFEs was based on conversations with a VFE vendor and their local distributor. The incremental cost associated with a VFE vs. regular diesel is $0.26 per gallon over the available "rack price" for government purchase (no tax). Because the fuel emulsion has nearly 20% water, it requires approximately 17.6%[6] additional volume in use; therefore, the annual incremental cost for using a VFE is as follows:

  Annual Cost VFE = Annual Diesel Consumption (gallons) x 1.176 x $0.26/gallon

  The estimated emission reductions associated with this strategy are estimated using the following equations:

  Diesel engines > 300 hp:

  Emission Reductions NOx tons = Nonroad Source NOx Emissions tons[7] *x 0.202*

[6] Statement from the Lubrizol Corporation, 2003.

[7] *Marine and Land-Based Mobile Source Emission Estimates for the Consolidated Schedule for the Harbor Navigation Project*, Starcrest, October 2003.

Diesel engines 175 hp – 300 hp:

Emission Reductions NOx tons = Nonroad Source NOx Emissions tons × 0.188

Diesel engines 100 hp – 175 hp:

Emission Reductions NOx tons = Nonroad Source NOx Emissions tons × 0.170

Diesel engines <100 hp:

Emission Reductions NOx tons = Nonroad Source NOx Emissions tons × 0.193

For this MA, it is assumed that 80% of the HDP dredges, support vessels, and dredged material tugboats would operate using a VFE. This strategy is estimated at reducing a total of 108 tons NOx during 2004 and 2005.

- Tier 0 – PJ Electrification. The NJDOT/OMR electrification report estimates the cost of the project to be a total of $6.4 million. This includes $2.4 million to set up the shore-based power source.

  The total estimated emission reductions of 237 tons NOx is associated with the dredges from PJ being "zeroed out," leaving only the support vessels and the dredged material tugboats. See Appendix I for full emission estimate calculations.

- Tier I – Staten Island Ferry. The PANYNJ has estimated costs[8] for retrofitting the SIF fleet to be $6,140,000 in capital costs and $4,254,298 in O&M costs over the duration of the HDP. In addition, support for the development of monitoring protocols, project logistics, oversight of the SCR vendor, data collection, analysis of testing results, and other associated tasks as scoped by the PANYNJ, is estimated to cost $200,000/year for 2003, 2004, and 2005. The PANYNJ will have a full cost analysis and emission reduction report late summer 2004.

  The SIF fleet consumes approximately 3,000,000 gallons of diesel per year[9] and the regular diesel fuel it consumes would be replaced by ULSD. ULSD is necessary to enable SCR to function properly. Independent calls were made to a provider of ULSD and the incremental cost was found to be $0.1368 per gallon. For conservative cost analysis, it was assumed that the fleet would consume a total of 3.2 million gallons of ULSD per year and that the incremental costs were evenly divided by the number of ferries. This will be adjusted to reflect actual consumption rates by class when that information is received from the NYCDOT. The incremental annual cost of the fuel mixture per ferry per year was estimated to be $72,887. Urea is needed for the SCR operation and was independently priced at $0.06 per gallon. The total cost for retrofitting the entire SIF fleet was estimated to be approximately $9,794,298 with an additional $600,000 for monitoring and support services.

[8] Harbor Deepening Project, Summary of Estimated Costs, Jim Iacone, HDP Manager, PANYNJ, 26 August 2003.
[9] Telephone call with Lou Calcagno, NYCDOT, August 2003.

The estimated emission reductions were calculated using the CMVEI estimates and the following formula:

Emission Reductions tons = Estimated Propulsion Engine Emissions tons x 70% SCR Efficiency

This strategy yields a potential estimated total NOx reduction of 6,813 tons from 2004 through 2013.

- Tier II – KVK-5 Tugboat Repower. Based on the selected applications, the capital cost associated with the KVK-5 repower project is $588,130 plus $25,000 for services, or a total cost of $613,130.

  The estimated emission reductions, based on the applications received, are approximately 483 tons of NOx from 2004 through 2013.

- Tier IV – Emission Credits. The PANYNJ reported that the cost of the 95.68 tpy (287 total tons) of shutdown credits was $113,065. These emission credits would be applied in full during the KVK-5 construction phase (2002 – 2004). It will be determined by the agencies at a later date what they will allow, if anything, in further use of these credits. When that decision has been made, it will be incorporated into the HAMP.

Implementation of MA#1 would progress with the following steps:

- Tier 0 – VFEs. The NYD would need to have approved contract language by June 2004 to include in the initial and subsequent contracts. All HDP bid documents would be required to state that dredge equipment, support vessels, and dredged material transit vessels would need to be operated with PuriNOx (unless another fuel additive is certified by EPA during the course of the HDP). The winning dredge contractor would need to complete operability tests at the start of the project. Depending on the results of these tests, adjustments may need to be made to equipment in the event that it has any difficulty running on the VFE. This could affect the productivity of the dredge, at least initially, and the project schedule. The planned Corps operability tests using PuriNOx on one of its more representative vessels will address this risk by yielding actual results. This will help make estimates on dredge operations more dependable, but some specific operability tests on the dredges will still be necessary.

  Additional contract language would need to be added to the bid documents requiring the selected dredge contractor to maintain and provide records that include hours of engine operation (for each vessel), quantity of VFE burned, average load of engines, and any additional information to verify the use of the VFE or to estimate emissions. This information would need to be presented to the NYD every six months for the duration of each contract, and would be reported to the NJDEP, NYSDEC and EPA to verify that reductions were sufficient to meet the GC requirements.

NYD contract language will need to be developed six to eight months prior to the letting of the first bid package to ensure proper enforceability of the standard, in compliance with GC.

Fuel supply arrangements with the VFE vendor would need to be completed prior to the start of each contract to ensure a steady supply and no interruptions in the dredging schedule. The NYD would need to determine if they would buy the fuel or compensate the selected dredge contractors.

- Tier 0 – PJ Electrification. The NJDOT/OMR would need to implement their project plan such that emission reductions would occur in 2004. This would include installation of the base station facility and umbilical power cord to the dredge equipment, and retrofit of the contractor's dredge such that it could use shore power to operate. As it is unlikely that contractors will invest in modifications until they are selected for a contract, awards must be made in early 2004 in order to allow for modifications and to get the necessary shore-based power source operating in time for scheduled dredging.

- Tier I – Staten Island Ferry. The PANYNJ, in conjunction with the NYCDOT, would need to complete the Austen class demonstration project by mid-year 2004 (which is the current schedule), and then bring the following vessels online: the remaining Austen class ferry and both Barberi class ferries by mid-year 2005, and all three Centennial boats by mid-year 2006. There is flexibility in the schedule for the three Centennial class ferries, should delays occur. An analysis at that time could be made to determine when they would have to be online.

- Tier II – KVK-5 Tugboat Repower. The PANYNJ KVK-5 tugboat repower program is currently on schedule for implementation in December 2003. Data collection requirements will be refined by that time. Emission offsets from this strategy would end in 2013.

- Tier IV – Emission Credits. The PANYNJ has already procured shutdown credits totaling 95.68 tons NOx per year (2002 through 2004) and they are in place for the KVK-5 project.

Emission estimates and cost assumptions, in addition to example calculations, are presented in Appendix I.

MA#1 Advantages:

- 4% of the plan incorporates Tier 0 to reduce project emissions.
- Port Jersey electrification could provide other project related and non-project related emissions from use of the facilities in combination with a dredge that is capable of receiving shore power.
- Significantly reduces emissions within the nonattainment area beyond what is needed for the project. These surplus reductions provide a substantial "insurance" against future shortfalls and may even be creditable to other NYD/PANYNJ projects to meet GC requirements.
- Operational changes to the SIF fleet (i.e., reductions in use of ferries, or one going out for maintenance and repair) would have minimal impact, as the reductions achieved are enough to overcome this risk.
- Approximately 854 tons NOx per year continues to be reduced after project is completed, providing long-term benefits to regional air quality.

MA#1 Disadvantages:

- Relative risk: moderate.
- HDP schedule: moderate relative risk of negatively impacting the schedule if the dredge electrification, including on-shore power, is not completed prior to start of PJ.
- Expensive. Second highest cost alternative.
- There is the risk that the SIF fleet will not work well with the SCR due to temperature and/or duty cycle issues. However, even if the emission reduction efficiency were reduced by a third, GC requirements on NOx could be met.
- There is the risk that not all of the project equipment will be able to operate on a VFE, or that it will negatively affect operability and therefore productivity. However, this risk is minimally important because the ferry reductions are so significant.
- Electrification is not available and requires an onshore power source before conversion of any dredge, a process that is both lengthy and uncertain, especially as it must come online by 2004.

5.2 Mitigation Alternative #2

Mitigation Alternative #2 (MA#2) incorporates the following tiered emission reduction strategies:

- Tier 0 – Use of VFEs on 20% to 60% of the project-related dredging equipment, support vessels, and dredged material transit vessels from 2004 through 2011
- Tier 0 – Electrification of the dredge equipment for Port Jersey
- Tier II – KVK-5 tugboat repowering (of two tugboats) to yield reduction offsets to be used throughout the HDP duration
- Tier II – Repowering of a sufficient number of tugboats (which would be online by mid-2004) to yield a total of 150 tons of NOx per year emission reductions (only 75 tons for the first year). The reduction offsets would be used throughout the duration of the HDP
- Tier II – VFE conversion for 20% of the terminal tractor fleet identified in the cargo handling equipment (CHE) emissions inventory (EI)[10], from 2004 through 2006
- Tier IV - Offset air credits used from 2002 through 2004 associated with the KVK-5 project

The total NOx emissions associated with the HDP Federal action over the 12-year project are 2,947 tons. MA#2 over the same period of time reduces an estimated total of 3,981 tons NOx from project and non-project related marine and CHE emissions sources, producing a surplus of 1,034 tons of NOx over the life of the project. This alternative only provides for approximately 70 tons of NOx offsets for 2014 with no other long-term emission offsets that carry beyond the duration of the HDP. Because it relies on electrification and significant use of VFEs, MA#2 represents over a $8 million increase over MA#1 and generates less than half the NOx reductions. Figure 5.3 presents the NOx emission reductions by tiered reduction strategy (bars) with the required reductions (red line) for the project by year. The percent contribution to the total NOx reduction by strategy is presented in Figure 5.4. Table 5.4 presents the estimated emission reductions by strategy for each year of the project, and the estimated costs associated with the implementation of the various strategies.

If for any reason any of the tugboat repower projects adding up to the 150 tpy NOx reduction Tier II strategy end prior to the end of the project they would need to be replaced by a contingency measure such that GC requirements are met.

[10] *The Port of New York and New Jersey Emissions Inventory for Container Cargo Handling Equipment, Automarine Terminal Vehicles, and Associated Locomotive*, Starcrest, June 2003.

Figure 5.3: Mitigation Alternative #2 NOx Emission Reductions vs. Project Required Reductions (tons per year)

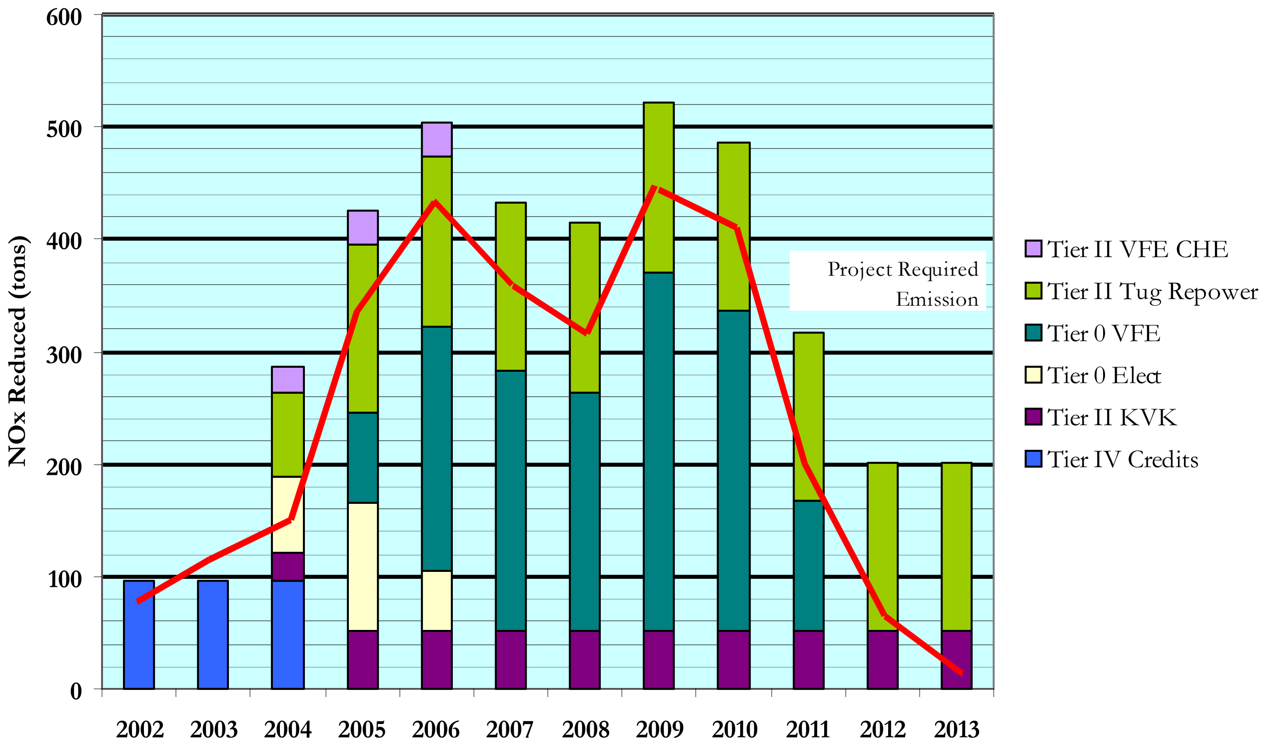

Figure 5.4: Mitigation Alternative #2 Percent Total NOx Reduction by Tiered Mitigation Strategy

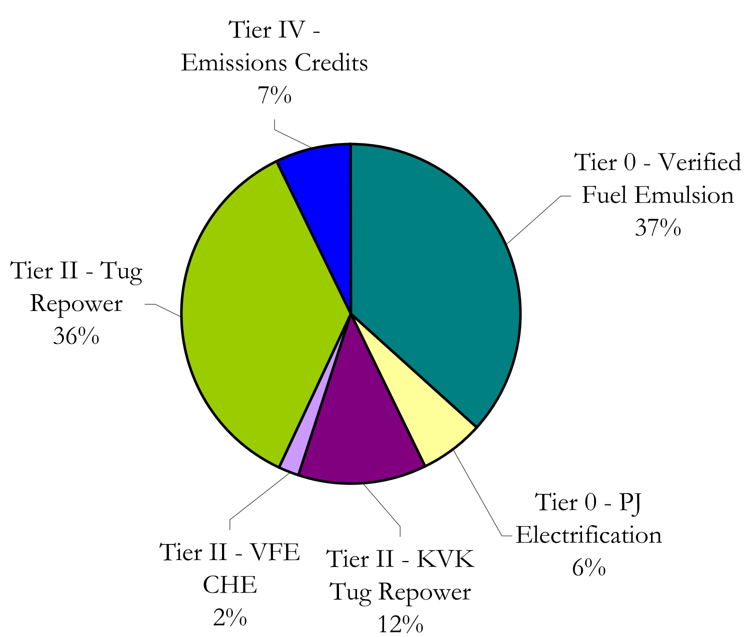

Table 5.4: Mitigation Alternative #2 Emission Reductions and Costs

Mitigation Strategy	2002 (tons)	2003 (tons)	2004 (tons)	2005 (tons)	2006 (tons)	2007 (tons)	2008 (tons)	2009 (tons)	2010 (tons)	2011 (tons)	2012 (tons)	2013 (tons)
EMISSIONS												
Estimated Project NOx Emissions	81.80	121.11	145.26	339.17	429.21	366.47	321.95	440.33	409.64	202.00	74.62	15.66
Tier IV Offset Credits NOx Reduced	95.68	95.68	95.68									
Tier II KVK Tug Repowering NOx Reduced			25.43	50.86	50.86	50.86	50.86	50.86	50.86	50.86	50.86	50.86
Tier 0 PJ Dredge Electrification NOx Reduced			67.40	115.26	54.91							
Tier 0 - Verified Fuel Emulsion NOx Reduced			0.75	79.07	217.34	231.81	213.12	320.07	285.21	116.27		
Tier II - VFE CHE NOx Reduced			20% TT 23.06	30.75	30.75							
Tier II - Tug Repower NOx Reduced			~6 Tugs 75	150	150	150	150	150	150	150	150	150
NOx Remaining	**(13.88)**	**25.43**	**(142.06)**	**(86.78)**	**(74.66)**	**(66.21)**	**(92.04)**	**(80.60)**	**(76.42)**	**(115.13)**	**(126.24)**	**(185.20)**

COSTS	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	Total
Emissions Credits	$113,065												**$113,065**
KVK Tug Repower		$613,130											**$613,130**
PJ Electrification			$6,400,000										**$6,400,000**
Tier 0 - Verified Fuel Emulsion			$8,608	$906,800	$2,492,453	$2,658,421	$2,444,074	$3,670,588	$3,270,731	$1,333,371			**$16,785,048**
Tier II - VFE CHE			$331,834	$375,779	$375,779								**$1,083,392**
Tier II - Tug Repower			$2,160,000										**$2,160,000**
Total Expenditure	**$113,065**	**$613,130**	**$8,900,443**	**$1,282,579**	**$2,868,232**	**$2,658,421**	**$2,444,074**	**$3,670,588**	**$3,270,731**	**$1,333,371**	**$0**	**$0**	**$27,154,635**
Tier 0 Adjustment Factor			0.20	0.60	0.60	0.60	0.60	0.40	0.30	0.20			

Notes:

- Tier II KVK-5 Tugboat Repowering: 25.43 tons NOx decremented in 2004 for 2003 short fall
- Tier 0 - Verified Fuel Emulsion: Tier 0 Adjustment Factor (% of fleet that is to use the VFE) x Fuel Consumption of HDP-related equipment per year. For example, in 2005, Tier 0 VFE assumes 60% of the HDP construction fleet (dredges, support vessels, and dredged material tugboats) will use VFEs.
- Tier II – VFE CHE: Assumes 20% of the terminal tractors (TT) identified in the PANYNJ CHE EI are converted to VFEs starting in April 2004 through 2006.
- Tier II – TERP: Assumes six tugs will be repowered by mid 2004 generating emission offsets for half the year; all six tugs are assumed to be generating emission offsets annually from 2005 through 2013

Total NOx reduced, cost, and cost effectiveness for each of the tiered emission reduction strategies used in MA#2 are presented in Table 5.5 below.

Table 5.5: Mitigation Alternative #2 Total NOx Reduced, Cost, and Cost Effectiveness

Tiered Reduction Strategy	Total NOx Reduced (tons)	Total Cost	Total Cost Effectiveness ($/tons reduced)
Tier 0 - Verified Fuel Emulsion	1463.64	$16,785,048	$11,468
Tier 0 - PJ Electrification	237.57	$6,400,000	$26,939
Tier II - KVK Tug Repower	483.17	$613,130	$1,269
Tier II - VFE CHE	84.57	$1,083,392	$12,811
Tier II - Tug Repower	1,425.00	$2,160,000	$1,516
Tier IV - Emissions Credits	287.04	$113,065	$394
Totals	**3,980.99**	**$27,154,635**	**$6,821**

The total and project cost effectiveness for MA#2 are:

- Total Cost Effectiveness = $27,154,635/3,981 tons NOx reduced
  = $6,821/tons NOx reduced

- Project Cost Effectiveness = $27,154,635/2,947 tons NOx reduced
  = $9,214/tons NOx reduced

The costs for each strategy were developed as follows:

- <u>Tier 0 – VFEs.</u> The incremental cost associated with VFEs was based on conversations with a VFE vendor and their local distributor. The incremental cost associated with a VFE vs. regular diesel is $0.26 per gallon over the available "rack price" for government purchase (no tax). Because the fuel emulsion has nearly 20% water, it requires approximately 17.6%[11] additional volume in use; therefore, the annual incremental cost for using a VFE is as follows:

  Annual Cost VFE = Annual Diesel Consumption (gallons) x 1.176 x $0.26/gallon

  The estimated emission reductions associated with this strategy are estimated using the following equations:

  Diesel engines > 300 hp:

  Emission Reductions NOx tons = Nonroad Source NOx Emissions tons[12] *x 0.202*

[11] Statement from the Lubrizol Corporation, 2003.
[12] *Marine and Land-Based Mobile Source Emission Estimates for the Consolidated Schedule for the Harbor Navigation Project*, Starcrest, October 2003.

Diesel engines 175 hp – 300 hp:

Emission Reductions NOx tons = Nonroad Source NOx Emissions tons × 0.188

Diesel engines 100 hp – 175 hp:

Emission Reductions NOx tons = Nonroad Source NOx Emissions tons × 0.170

Diesel engines <100 hp:

Emission Reductions NOx tons = Nonroad Source NOx Emissions tons × 0.193

For this alternative, if varying percentages (see Tier 0 Adjustment Factor, Table 5.4) of project-related equipment (dredges, support vessels, and dredged material transit tugboats) used a VFE while working on the HDP, it is estimated that a total NOx reduction of 1,463 tons would be achieved from 2004 through 2011.

- Tier 0 – PJ Electrification. The NJDOT/OMR electrification report estimates the cost of the project to be a total of $6.4 million. This includes $2.4 million to set up the shore-based power source.

  The total estimated emission reductions of 237 tons NOx is associated with the dredges from PJ being "zeroed out," leaving only the support vessels and the dredged material tugboats. See Appendix I for full emission estimate calculations.

- Tier II – KVK-5 Tugboat Repower. Based on the selected applications, the capital cost associated with the KVK-5 repower project is $588,130 plus $25,000 for services, or a total cost of $613,130.

  The estimated emission reductions, based on the applications received, are approximately 483 tons of NOx from 2004 through 2013.

- Tier II – TERP. A total annual emission reduction of 150 tpy NOx, or 1,425 tons NOx during the HDP, is estimated provided by repowering approximately eight additional tugboats. Using the framework of the KVK-5 project and implementing several of the recommendations in the final repower package, it is assumed (based on the KVK-5 repower results) that each tugboat could produce on average 25 tons of NOx reductions each year for the duration of the HDP, with each tugboat repower costing $360,000.

- Tier II – VFE in CHE. The incremental cost associated with VFEs is \$0.26 per gallon over the available "rack price" for government purchase and the increased volume for the VFE vs. diesel is an additional 17.6%. The CHE targeted by this strategy are terminal tractors, because they have been successfully converted to VFEs at other ports in the nation and can handle the associated power loss that results when changing fuels. From the 2000 baseline CHE EI, there were 411 terminal tractors (also known as yard hustlers) identified and their annual operating time totaled 945,040 hours. An average fuel consumption factor of 6.5 gallons diesel consumed per hour[13] was applied to the operational hours for an annual estimated fleet consumption of approximately 6,145,000 gallons diesel.

  For MA#2, it was assumed that 20% (83) of the terminal tractors would be converted to use a VFE, at an incremental cost of \$0.26 per gallon, from 2004 through 2010. The annual costs of this strategy were calculated using the following equation:

  $$\textit{Annual Costs} = 6{,}145{,}000 \textit{ gals} \times 1.176 \textit{ VFE consumption factor} \times 20\% \times \$0.26$$

  In addition, \$50,000 in 2004 was budgeted to include expenses associated with upgrading or creating storage facilities on the selected terminals and any costs associated with start-up and maintenance. Finally, for the VFE fueling cost in 2004, it was assumed that implementation of the strategy would not happen until April, and therefore the above equation was multiplied by 0.75 to correct for partial year use.

  The 441 identified terminal tractors produced an estimated 1,130 tons NOx in 2000. Their power range comprised two groups: 100 hp – 175 hp, with a verified NOx emission reduction of 17%; and 175 hp – 300 hp, with a verified NOx emission reduction of 18.8%. Not knowing exactly which terminals might participate and to what extent, it was assumed that the overall NOx emission reduction would conservatively be 17.2%, erring on the low side. It was also assumed that the entire fleet emitted 1,100 tons of NOx per year. The estimated emission reductions were calculated on an annual basis by using the following equation:

  $$\textit{Emission Reduction tons} = 1{,}110 \textit{ tons NOx} \times 20\% \times 17.2\%$$

  The result was then multiplied by 0.75 (only for 2004) to correct for partial year use.

  It was estimated that the total NOx emission reductions from this strategy could yield a total of 84.57 tons from April 2004 through 2006.

[13] Draft NONROAD Model, EPA, 1998; brake-specific fuel consumption, pounds/hour, converted to gallons/hour.

- Tier IV – Emission Credits. The PANYNJ reported that the cost of the 95.68 tpy (287 total tons) of shutdown credits was $113,065. These emission credits would be applied in full during the KVK-5 construction phase (2002 – 2004). It will be determined by the agencies at a later date what they will allow, if anything, in further use of these credits. When that decision has been made, it will be incorporated into the HAMP.

Implementation of MA#2 would progress with the following steps:

- Tier 0 – VFEs. The NYD would need to have approved contract language by June 2004 to include in the initial and subsequent contracts. All HDP bid documents would be required to state that all dredge equipment, support vessels, and dredged material transit vessels would need to be operated with PuriNOx (unless another fuel additive is certified by EPA during the course of the HDP). The winning dredge contractor would need to complete operability tests at the start of the project. Depending on the results of these tests, adjustments may need to be made to equipment in the event that it has any difficulty running on the VFE. This could affect the productivity of the dredge, at least initially, and the project schedule. The planned Corps operability tests using PuriNOx on one of its more representative vessels will address this risk by yielding actual results. This will help make estimates on dredge operations more dependable, but some specific operability tests on the dredges will still be necessary.

  Additional contract language would need to be added to the bid documents requiring the selected dredge contractor to maintain and provide records that include hours of engine operation (for each vessel), quantity of VFE burned, average load of engines, and any additional information to verify the use of the VFE or to estimate emissions. This information would need to be presented to the NYD every six months for the duration of each contract, and would be reported to the NJDEP, NYSDEC and EPA to verify that reductions were sufficient to meet the GC requirements.

  NYD contract language will need to be developed six to eight months prior to the letting of the first bid package to ensure proper enforceability of the standard, in compliance with GC.

  Fuel supply arrangements with the VFE vendor would need to be completed prior to the start of each contract to ensure a steady supply and no interruptions in the dredging schedule. The NYD would need to determine if they would buy the fuel or compensate the selected dredge contractors.

- Tier 0 – PJ Electrification. The NJDOT/OMR would need to implement their project plan such that emission reductions would occur in 2004. This would include installation of the base station facility and umbilical power cord to the dredge equipment, and retrofit of the contractor's dredge such that it could use shore power to operate. As it is unlikely that contractors will invest in modifications until they are selected for a contract, awards must be made in early 2004 in order to allow for modifications and to get the necessary shore-based power source operating in time for scheduled dredging.

- Tier II – KVK-5 Tugboat Repower. The PANYNJ KVK-5 tugboat repower program is currently on schedule for completion in December 2003. Data collection requirements will be refined by that time. Emission offsets from this strategy would end in 2013.

- Tier II – TERP. The PANYNJ would initiate an additional round of the tugboat repower program in 2004. The repower program would repower approximately six tugboats (enough to equal the desired emission reductions stated above) and emission reductions would start to be generated by mid 2004

- Tier II – VFE in CHE. The PANYNJ would initiate in November the selection of VFEs and their integration into the terminal tractors. Using the lead-time of six months from Section 3, emission reductions would start being generated in April 2004, with the full target at 20% of terminal tractors using VFE met by 2005. Given the relatively small portion of the fleet targeted for conversion, and the success of such a program elsewhere, this strategy has a reasonable likelihood of success, although the requirement for multiple operators to participate increases the complexity.

- Tier IV – Emission Credits. The PANYNJ has already procured shutdown credits totaling 95.68 tons NOx per year (2002 through 2004) and they are in place for the KVK-5 project.

Emission estimates and cost assumptions, in addition to example calculations, are presented in Appendix I.

MA#2 Advantages:

- 44% of the plan incorporates Tier 0 to reduce project emissions.
- Port Jersey electrification could provide other project related and non-project related emissions from use of the facilities in combination with a dredge that is capable of receiving shore power.
- The wide diversity of mitigation strategies reduces exposure to the relative risks associated with any one strategy.
- The use of shutdown credits has been minimized.

MA#2 Disadvantages:

- Relative risk: moderate.
- HDP schedule: moderate relative risk of negatively impacting the schedule if the dredge electrification, including on-shore power, is completed prior to start of PJ.
- Very expensive. By far the most expensive option.
- There are no addition NOx reductions beyond the duration of the HDP.
- Electrification not yet available.

- There is the risk that not all of the project equipment will be able to operate on a VFE, or that it will negatively affect operability and therefore productivity. However, this risk is minimally important because the ferry reductions are so significant.
- The low 20% target is more likely to be met than higher target levels, but the decrease in baseline emissions over time as the fleet is turned over with less polluting models still makes this a more risky option for the long term.
- Electrification is not available and requires an onshore power source before conversion of any dredge, a process that is both lengthy and uncertain, especially as it must come online by 2004.

5.3 Mitigation Alternative #3

Mitigation Alternative #3 (MA#3) incorporates the following tiered emission reduction strategies:

- Tier 0 – Electrification of the dredge equipment for Port Jersey
- Tier I – SCR installation and operation on the SIF fleet during the course of the project
- Tier II – KVK-5 tugboat repowering (of two tugboats) to yield reduction offsets to be used throughout the HDP duration
- Tier II – Repowering of a sufficient number of tugboats (which would be online by mid-2004) to yield a total of 75 tons of NOx per year emission reductions (only 37.5 tons for the first year). The reduction offsets would be used throughout the duration of the HDP
- Tier IV – Offset air credits used from 2002 through 2004 associated with the KVK-5 project

The total NOx emissions associated with the HDP Federal action over the 12-year project are 2,947 tons. MA#3 over the same period of time reduces an estimated total of 8,534 tons NOx from project and non-project related marine emissions sources, producing a surplus of 5,587 tons of NOx reduced over the life of the project. Of this, 854 tons NOx reduced are long-term, extending beyond the completion of the project. Figure 5.5 presents the NOx emission reductions by tiered reduction strategy (bars) with the required reductions (red line) for the project by year, and the potential lower bound (detailed above in Section 3.2.2) of the SIF emission reductions (blue dashed line) that could occur when duty cycle and emission testing results are reviewed and approved by the RAT. The percent contribution to the total NOx reduction by strategy is presented in Figure 5.6. Table 5.6 presents the estimated emission reductions by strategy for each year of the project, and the estimated costs associated with the implementation of the various strategies.

Figure 5.5: Mitigation Alternative #3 NOx Emission Reductions vs. Project Required Reductions (tons per year)

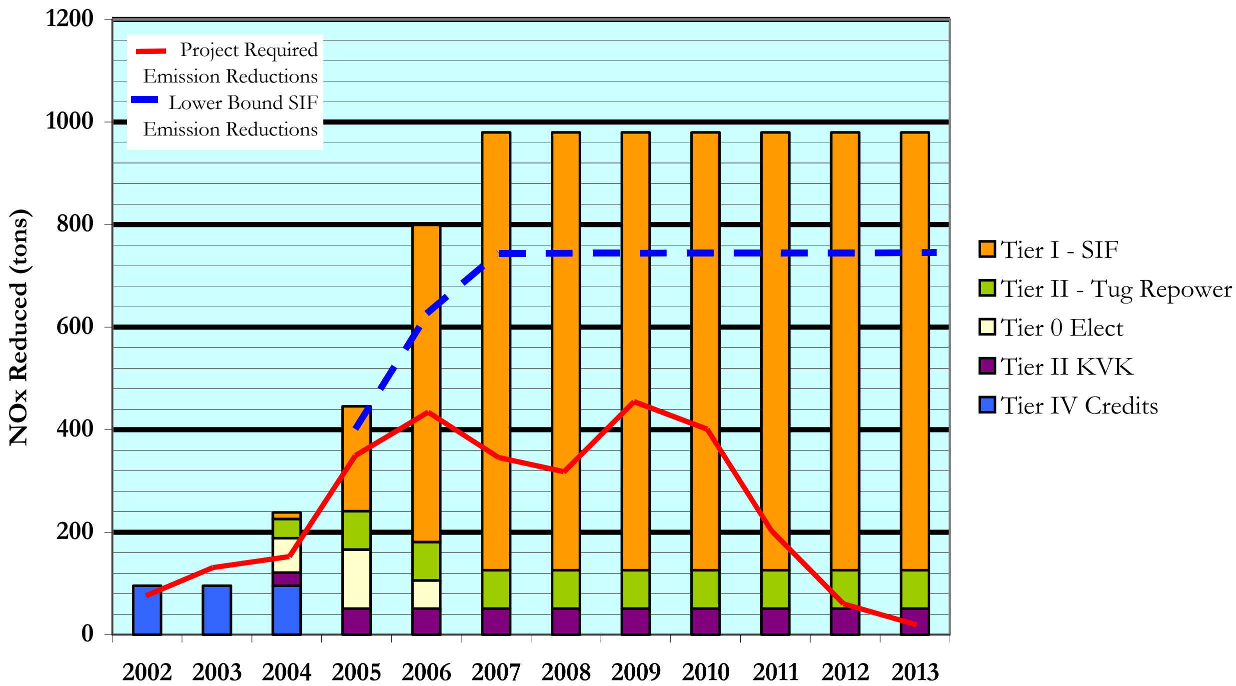

Figure 5.6: Mitigation Alternative #3 Percent Total NOx Reduction by Tiered Mitigation Strategy

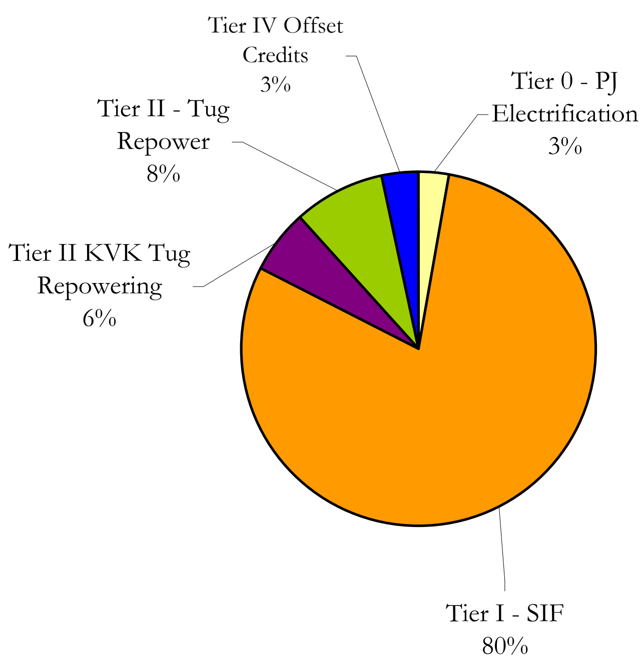

Table 5.6: Mitigation Alternative #3 Emission Reductions and Costs

Mitigation Strategy	2002 (tons)	2003 (tons)	2004 (tons)	2005 (tons)	2006 (tons)	2007 (tons)	2008 (tons)	2009 (tons)	2010 (tons)	2011 (tons)	2012 (tons)	2013 (tons)
EMISSIONS												
Estimated Project NOx Emissions	81.80	121.11	145.26	339.17	429.21	366.47	321.95	440.33	409.64	202.00	74.62	15.66
Tier IV Offset Credits												
NOx Reduced	95.68	95.68	95.68									
Tier II KVK Tug Repowering												
NOx Reduced			25.43	50.86	50.86	50.86	50.86	50.86	50.86	50.86	50.86	50.86
Tier 0 - PJ Electrification												
NOx Reduced			67.40	115.26	54.91							
Tier I - SIF			1A	1A, 2B	3C							
NOx Reduced			12.60	204.40	618.80	854.00	854.00	854.00	854.00	854.00	854.00	854.00
Tier II - Tug Repower			~3 Tugs									
NOx Reduced			37.50	75.00	75.00	75.00	75.00	75.00	75.00	75.00	75.00	75.00
NOx Remaining	**(13.88)**	**25.43**	**(93.35)**	**(106.35)**	**(370.36)**	**(613.39)**	**(657.91)**	**(539.53)**	**(570.22)**	**(777.86)**	**(905.24)**	**(964.20)**

COSTS	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	**Total**
Emissions Credits	$113,065												**$113,065**
KVK Tug Repower		$613,130											**$613,130**
PJ Dredge Electrication			$6,400,000										**$6,400,000**
Tier I - SIF		$200,000	$981,777	$2,898,883	$3,199,542	$444,871	$444,871	$444,871	$444,871	$444,871	$444,871	$444,871	**$10,394,298**
Tier II - Tug Repower			$1,080,000										**$1,080,000**
Total Expenditure	**$113,065**	**$813,130**	**$8,461,777**	**$2,898,883**	**$3,199,542**	**$444,871**	**$444,871**	**$444,871**	**$444,871**	**$444,871**	**$444,871**	**$444,871**	**$18,600,493**

Notes:

- Tier II KVK-5 Tugboat Repowering: 25.43 tons NOx decremented in 2004 for 2003 short fall
- Tier I – SIF: Assumes 1 Austen Class generating offsets for second half of 2004; 1 Austen full time and 1 Austen and 2 Barberi Class ferries generating emission offsets second half 2005; all Austen and Barberi Class ferries generating offsets full time and three Centennial Class second half of 2006; all ferries generating emission offsets 2007 through 2013
- Tier II – TERP: Assumes three tugboats will be repowered by mid 2004 generating emission offsets for half the year; all three tugboats are assumed to be generating emission offsets annually from 2005 through 2013

Total NOx reduced, cost, and cost effectiveness for each of the tiered emission reduction strategies used in MA#3 are presented in Table 5.7 below.

Table 5.7: Mitigation Alternative #3 Total NOx Reduced, Cost, and Cost Effectiveness

Tiered Reduction Strategy	Total NOx Reduced (tons)	Total Cost	Total Cost Effectiveness ($/tons reduced)
Tier 0 - PJ Electrification	237.57	$6,400,000	$26,939
Tier I - SIF	6,813.80	$10,394,298	$1,525
Tier II KVK Tug Repowering	483.17	$613,130	$1,269
Tier II - Tug Repower	712.50	$1,080,000	$1,516
Tier IV Offset Credits	287.04	$113,065	$394
Totals	**8,534.08**	**$18,600,493**	**$2,180**

The total and project cost effectiveness for MA#3 are:

- Total Cost Effectiveness = $18,600,493/8,534 tons NOx reduced
  = $2,180/tons NOx reduced

- Project Cost Effectiveness = $18,600,493/2,947 tons NOx reduced
  = $6,311/tons NOx reduced

The costs for each strategy were developed as follows:

- Tier 0 – PJ Electrification. The NJDOT/OMR electrification report estimates the cost of the project to be a total of $6.4 million. This includes $2.4 million to set up the shore-based power source.

  The estimated emission reductions of 237 tons NOx is associated with the dredges from PJ being "zeroed out", leaving only the support vessels and the dredged material tugboats. See Appendix I for full emission estimate calculations.

- Tier I – Staten Island Ferry. The PANYNJ has estimated costs[14] for retrofitting the SIF fleet to be $6,140,000 in capital costs and $4,254,298 in O&M costs over the duration of the HDP. In addition, support for the development of monitoring protocols, project logistics, oversight of the SCR vendor, data collection, analysis of testing results, and other associated tasks as scoped by the PANYNJ, is estimated to cost $200,000/year for 2003, 2004, and 2005. The PANYNJ will have a full cost analysis and emission reduction report late summer 2004.

[14] Harbor Deepening Project, Summary of Estimated Costs, PANYNJ, 26 August 2003.

The SIF fleet consumes approximately 3,000,000 gallons of diesel per year[15] and the regular diesel fuel it consumes would be replaced by ULSD. ULSD is necessary to enable SCR to function properly. Independent calls were made to a provider of ULSD and the incremental cost was found to be $0.1368 per gallon. For conservative cost analysis, it was assumed that the fleet would consume a total of 3.2 million gallons of ULSD per year and that the incremental costs were evenly divided by the number of ferries. This will be adjusted to reflect actual consumption rates by class when that information is received from the NYCDOT. The incremental annual cost of the fuel mixture per ferry per year was estimated to be $72,887. Urea is needed for the SCR operation and was independently priced at $0.06 per gallon. The total cost for retrofitting the entire SIF fleet was estimated to be approximately $9,794,298 with an additional $600,000 for monitoring and support services.

The estimated emission reductions were calculated using the CMVEI estimates and the following formula:

Emission Reductions tons = Estimated Propulsion Engine Emissions tons x 70% SCR Efficiency

This strategy yields a potential estimated total NOx reduction of 6,813 tons from 2004 through 2013.

- Tier II – KVK-5 Tugboat Repower. Based on the selected applications, the capital cost associated with the KVK-5 repower project is $588,130 plus $25,000 for services, or a total cost of $613,130.

  The estimated emission reductions, based on the applications received, are approximately 483 tons of NOx from 2004 through 2013.

- Tier II – TERP. A total annual emission reduction of 75 tpy NOx, or 712 tons NOx during the HDP, is estimated from repowering approximately eight additional tugboats. Using the framework of the KVK-5 project and implementing several of the recommendations in the final repower package, it is assumed (based on the KVK-5 repower results) that each tugboat could produce on average 25 tons of NOx reductions each year for the duration of the HDP, with each tugboat repower costing $360,000.

- Tier IV – Emission Credits. The PANYNJ reported that the cost of the 95.68 tpy (287 total tons) of shutdown credits was $113,065. These emission credits would be applied in full during the KVK-5 construction phase (2002 – 2004). It will be determined by the agencies at a later date what they will allow, if anything, in further use of these credits. When that decision has been made, it will be incorporated into the HAMP.

[15] Telephone call with Lou Calcagno, NYCDOT, August 2003.

Implementation of MA#3 would progress with the following steps:

- Tier 0 – PJ Electrification. The NJDOT/OMR would need to implement their project plan such that emission reductions would occur in 2004. This would include installation of the base station facility and umbilical power cord to the dredge equipment, and retrofit of the contractor's dredge such that it could use shore power to operate. As it is unlikely that contractors will invest in modifications until they are selected for a contract, awards must be made in early 2004 in order to allow for modifications and to get the necessary shore-based power source operating in time for scheduled dredging.

- Tier I – Staten Island Ferry. The PANYNJ, in conjunction with the NYCDOT, would need to complete the Austen class demonstration project by mid-year 2004 (which is the current schedule), and then bring the following vessels online: the remaining Austen class ferry and both Barberi class ferries by mid-year 2005, and all three Centennial classes by mid-year 2006. There is flexibility in the schedule for the three Centennial class ferries, should delays occur. An analysis at that time could be made to determine when they would have to be online.

- Tier II – KVK-5 Tugboat Repower. The PANYNJ KVK-5 tugboat repower program is currently on schedule for completion in December 2003. Data collection requirements will be refined by that time. Emission offsets from this strategy would end in 2013.

- Tier II – TERP. The PANYNJ would initiate an additional round of the tugboat repower program in 2004. The repower program would repower approximately three tugboats (enough to equal the desired emission reductions stated above) and emission reductions would start to be generated by mid 2004.

- Tier IV – Emission Credits. The PANYNJ has already procured shutdown credits totaling 95.68 tons NOx per year (2002 through 2004) and they are in place for the KVK-5 project.

Emission estimates and cost assumptions, in addition to example calculations, are presented in Appendix I.

MA#3 Advantages:

- 3% of the plan incorporates Tier 0 to reduce project emissions.
- Operational changes to the SIF fleet (i.e., reductions in use of ferries, or one going out for maintenance and repair) would have minimal impact, as the reductions achieved are significantly higher than the required reductions.
- Significantly reduces emissions within the nonattainment area beyond what is needed for the project. These surplus reductions provide a substantial "insurance" against future shortfalls and may even be creditable to other NYD/PANYNJ projects to meet GC requirements.

- Approximately 854 tons NOx per year continues to be reduced after project is completed, providing long-term benefits to regional air quality.

MA#3 Disadvantages:

- Relative risk: moderate.
- HDP schedule: moderate relative risk of negatively impacting the schedule if the dredge electrification, including on-shore power, is completed prior to start of PJ.
- Mid-scale total cost.
- HDP schedule: medium relative risk of negatively impacting the schedule due to the complexity of implementation and it is vital that electrification is working in 2004.
- The potential that the shutdown emission credits will not be approved for use in 2004.
- There is the risk that the SIF fleet will not work well with the SCR due to temperature and/or duty cycle issues. However, even if the emission reduction efficiency were reduced by a third, GC requirements on NOx could be met.
- Electrification is not available and requires an onshore power source before conversion of any dredge, a process that is both lengthy and uncertain, especially as it must come online by 2004.

5.4 Mitigation Alternative #4

Mitigation Alternative #4 (MA#4) incorporates the following tiered emission reduction strategies:

- Tier 0 – Use of VFEs on 20 to 30% of the project-related dredging equipment, support vessels, and dredged material transit vessels in 2006, 2007, 2009, and 2010
- Tier II – KVK-5 tugboat repowering (of two tugboats) to yield reduction offsets to be used throughout the HDP duration
- Tier II – Repowering of a sufficient number of tugboats (which would be online by mid-2004) to yield a total of 200 tons of NOx per year emission reductions (only 100 tons for the first year). The reduction offsets would be used throughout the duration of the HDP
- Tier II – VFE conversion for 80% (April 2004 through 2008) then 30% (2009 and 2010) of the terminal tractor fleet identified in the CHE EI
- Tier IV – Offset air credits used from 2002 through 2004 associated with the KVK-5 project

The total NOx emissions associated with the HDP Federal action over the 12-year project are 2,947 tons. MA#4 over the same period of time reduces an estimated total of 4,132 tons NOx from project and non-project related marine and CHE emissions sources, producing a surplus of 1,184 tons of NOx reduced. This alternative only provides for approximately 70 tons NOx offsets for 2014 with no other long-term emission offsets that carry beyond the duration of the HDP. Figure 5.7 presents the NOx emission reductions by tiered reduction strategy (bars) with the required reductions (red line) for the project by year. The percent contribution to the total NOx reduction by strategy is presented in Figure 5.8. Table 5.8 presents the estimated emission reductions by strategy for each year of the project, and the estimated costs associated with the implementation of the various strategies.

If for any reason any of the tugboat repower projects adding up to the 200 tpy NOx reduction Tier II strategy end prior to the end of the project they would need to be replaced by a contingency measure such that GC requirements are met.

Figure 5.7: Mitigation Alternative #4 NOx Emission Reductions vs. Project Required Reductions (tons per year)

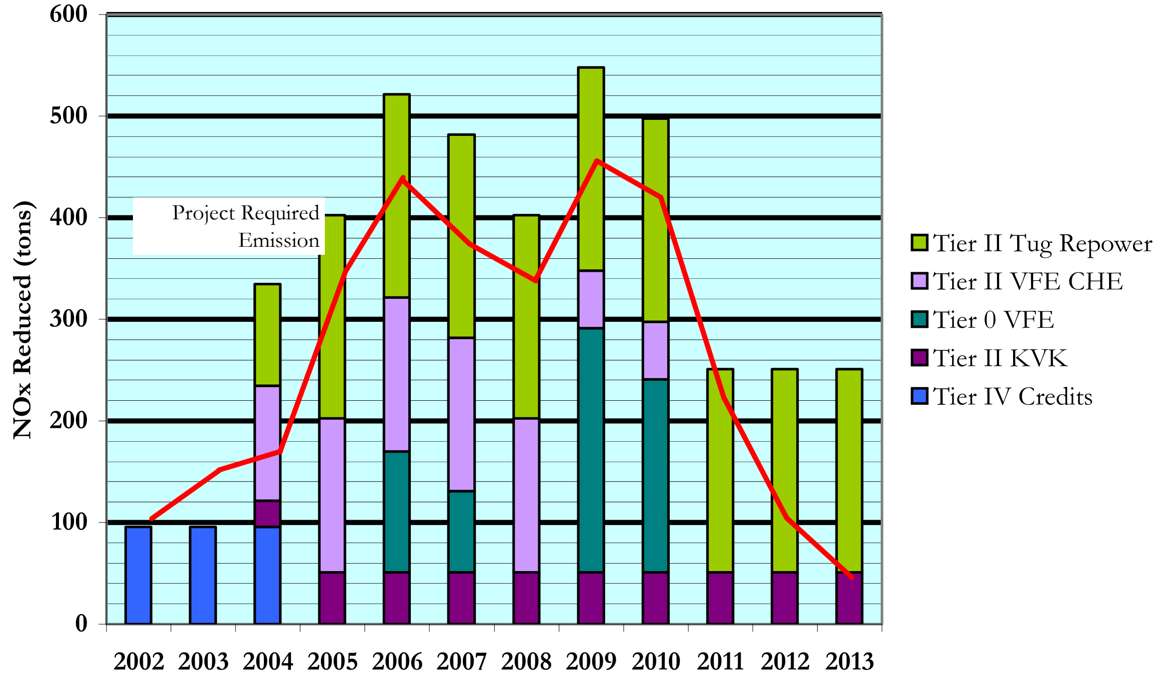

Figure 5.8: Mitigation Alternative #4 Percent Total NOx Reduction by Tiered Mitigation Strategy

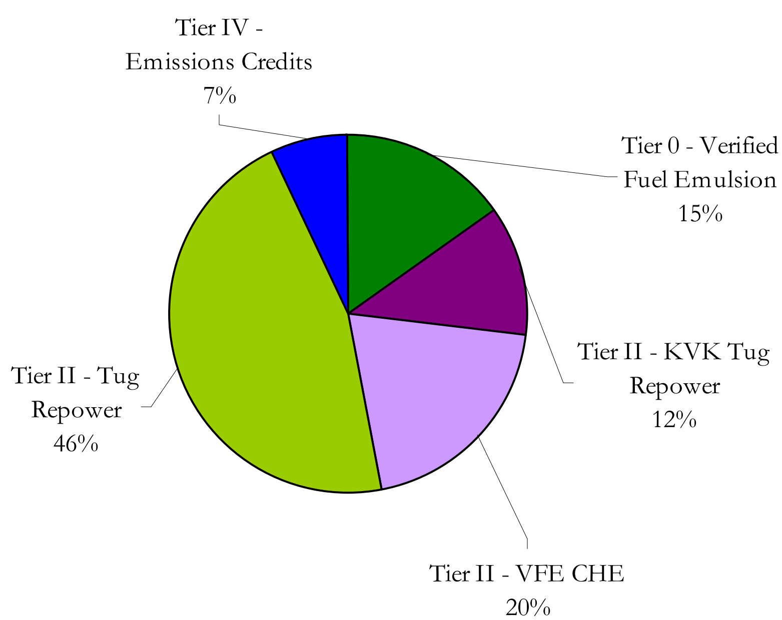

Table 5.8: Mitigation Alternative #4 Emission Reductions and Costs

Mitigation Strategy	2002 (tons)	2003 (tons)	2004 (tons)	2005 (tons)	2006 (tons)	2007 (tons)	2008 (tons)	2009 (tons)	2010 (tons)	2011 (tons)	2012 (tons)	2013 (tons)	Total
						Project Year							
EMISSIONS													
Estimated Project NOx Emissions	81.80	121.11	145.26	339.17	429.21	366.47	321.95	440.33	409.64	202.00	74.62	15.66	
Tier IV - Emissions Credits NOx Reduced	95.68	95.68	95.68										
Tier II - KVK Tug Repower NOx Reduced			25.43	50.86	50.86	50.86	50.86	50.86	50.86	50.86	50.86	50.86	
Tier 0 - Verified Fuel Emulsion NOx Reduced					118.94	79.82		240.05	190.14				
Tier II - VFE CHE			80% TT					30% TT					
NOx Reduced			113.52	151.36	151.36	151.36	151.36	56.76	56.76				
Tier II - Tug Repower			~8 Tugs										
NOx Reduced			100	200	200	200	200	200	200	200	200	200	
NOx Remaining	**(13.88)**	**25.43**	**(189.37)**	**(63.05)**	**(91.95)**	**(115.58)**	**(80.27)**	**(107.35)**	**(88.12)**	**(48.86)**	**(176.24)**	**(235.20)**	
COSTS													**Total**
Tier IV - Emissions Credits	$113,065												**$113,065**
Tier II - KVK Tug Repower		$613,130											**$613,130**
Tier 0 - Verified Fuel Emulsion					$1,453,430	$975,436		$2,933,461	$2,323,470				**$7,685,797**
Tier II - VFE CHE			$100,000	$1,503,116	$1,503,116	$1,503,116	$1,503,116	$563,669	$563,669				**$7,239,802**
Tier II - Tug Repower			$2,880,000										**$2,880,000**
Total Expenditure	**$113,065**	**$613,130**	**$2,980,000**	**$1,503,116**	**$2,956,546**	**$2,478,552**	**$1,503,116**	**$3,497,130**	**$2,887,139**	**$0**	**$0**	**$0**	**$18,531,794**
Tier 0 Adjustment					0.30	0.20		0.30	0.20				

Notes:

- Tier II KVK-5 Tugboat Repowering: 25.43 tons NOx decremented in 2004 for 2003 short fall
- Tier 0 - Verified Fuel Emulsion: Tier 0 Adjustment Factor (% of fleet that is to use the VFE) x Fuel Consumption of HDP-related equipment per year. For example, in 2006, Tier 0 VFE strategy assumes 30% of the HDP construction fleet (dredges, support vessels, and dredged material tugboats) will use VFEs.
- Tier II – VFE CHE: Assumes 80% of the terminal tractors (TT) identified in the PANYNJ CHE EI are converted to VFEs starting in April 2004 through 2008 and then reduced to 30% of the TT fleet beginning in 2009 through 2010
- Tier II – TERP: Assumes eight tugs will be repowered by mid 2004 generating emission offsets for half the year; all eight tugs are assumed to be generating emission offsets annually from 2005 through 2013

Total NOx reduced, cost, and cost effectiveness for each of the tiered emission reduction strategies used in MA#4 are presented in Table 5.9 below.

Table 5.9: Mitigation Alternative #4 Total NOx Reduced, Cost, and Cost Effectiveness

Tiered Reduction Strategy	Total NOx Reduced (tons)	Total Cost	Total Cost Effectiveness ($/tons reduced)
Tier 0 - Verified Fuel Emulsion	628.95	$113,065	$180
Tier II - KVK Tug Repower	483.17	$613,130	$1,269
Tier II - VFE CHE	832.48	$7,239,802	$8,697
Tier II - Tug Repower	1,900.00	$7,685,797	$4,045
Tier IV - Emissions Credits	287.04	$2,880,000	$10,033
Totals	**4,131.64**	**$18,531,794**	**$4,485**

The total and project cost effectiveness for MA#4 are:

- Total Cost Effectiveness = $18,531,794/4,132 tons NOx reduced
  = $4,485/tons NOx reduced

- Project Cost Effectiveness = $18,531,794/2,947 tons NOx reduced
  = $6,288/tons NOx reduced

The costs for each strategy were developed as follows:

- <u>Tier 0 – VFEs.</u> The incremental cost associated with VFEs was based on conversations with a VFE vendor and their local distributor. The incremental cost associated with a VFE vs. regular diesel is $0.26 per gallon over the available "rack price" for government purchase (no tax). Because the fuel emulsion has nearly 20% water, it requires approximately 17.6%[16] additional volume in use; therefore, the annual incremental cost for using a VFE is as follows:

  Annual Cost VFE = Annual Diesel Consumption (gallons) x 1.176 x $0.26/gallon

  The estimated emission reductions associated with this strategy are estimated using the following equation:

  Diesel engines > 300 hp:

  Emission Reductions NOx tons = Nonroad Source NOx Emissions tons[17] *x 0.202*

[16] Statement from the Lubrizol Corporation, 2003.
[17] *Marine and Land-Based Mobile Source Emission Estimates for the Consolidated Schedule for the Harbor Navigation Project*, Starcrest, October 2003.

Diesel engines 175 hp – 300 hp:

Emission Reductions NOx tons = Nonroad Source NOx Emissions tons x 0.188

Diesel engines 100 hp – 175 hp:

Emission Reductions NOx tons = Nonroad Source NOx Emissions tons x 0.170

Diesel engines <100 hp:

Emission Reductions NOx tons = Nonroad Source NOx Emissions tons x 0.193

For MA#4, it was assumed that VFEs would only be used at the following rates of, estimated total project fuel consumption (see Table 2.5), in project related-dredges, support vessels, and dredged material vessels:

2006 - 30% of HDP equipment
2007 - 20% of HDP equipment
2009 - 30% of HDP equipment
2010 - 20% of HDP equipment

For this MA, it is assumed that the varying equipment percentages listed above of the HDP dredges, support vessels, and dredged material tugboats would operate using a VFE. This strategy is estimated at reducing a total of 628 tons NOx during 2006 and 2010.

- Tier II – KVK-5 Tugboat Repower. Based on the selected applications, the capital cost associated with the KVK-5 repower project is $588,130 plus $25,000 for services, or a total cost of $613,130.

  The estimated emission reductions, based on the applications received, are approximately 483 tons of NOx from 2004 through 2013.

- Tier II – TERP. A total annual emission reduction of 200 tpy NOx, or 1,900 tons NOx during the HDP, is estimated from repowering approximately eight additional tugboats. Using the framework of the KVK-5 project and implementing several of the recommendations in the final repower package, it is assumed (based on the KVK-5 repower results) that each tugboat could produce on average 25 tons of NOx reductions each year for the duration of the HDP, with each tugboat repower costing $360,000.

- Tier II – VFE in CHE. The incremental cost associated with VFEs is $0.26 per gallon over the available "rack price" for government purchase and the increased volume for the VFE vs. diesel is an additional 17.6%. The CHE targeted by this strategy are terminal tractors, because they have been successfully converted to VFEs at other ports in the nation and can handle the associated power loss that results when changing fuels. From the 2000 baseline CHE EI, there were 411 terminal tractors (also known as yard hustlers) identified and their annual operating time totaled 945,040 hours. An average fuel consumption factor of 6.5 gallons diesel consumed per hour[18] was applied to the operational hours for an annual estimated fleet consumption of approximately 6,145,000 gallons diesel.

  For MA#4, it was assumed that 80% (approximately 329) of the terminal tractors would be converted to use a VFE at an incremental cost of $0.26 per gallon from 2004 through 2010. The annual costs of this strategy were calculated using the following equation:

  Annual Costs = 6,145,000 gals x 1.176 VFE consumption factor x 80% x $0.26

  In addition, $100,000 in 2004 was budgeted to include expenses associated with upgrading or creating storage facilities on the selected terminals and any costs associated with start- up and maintenance. Finally, for the VFE fueling cost in 2004, it was assumed that implementation of the strategy would not happen until April, and therefore the above equation was multiplied by 0.75 to correct for partial year use.

  The 441 identified terminal tractors produced an estimated 1,130 tons NOx in 2000. Their power range comprised two groups: 100 hp – 175 hp, with a verified NOx emission reduction of 17%; and 175 hp – 300 hp, with a verified NOx emission reduction of 18.8%. Not knowing exactly which terminals might participate and to what extent, it was assumed that the overall NOx emission reduction would conservatively be 17.2%, erring on the low side. It was also assumed that the entire fleet emitted 1,100 tons of NOx per year. The estimated emission reductions were calculated on an annual basis by using the following equation:

  Emission Reduction tons = 1,110 tons NOx x 80% (30% in 2009 & 2010) x 17.2%

  The result was then multiplied by 0.75 (only for 2004) to correct for partial year use.

  It was estimated that the total NOx emission reductions from this strategy could yield a total of 832 tons from April 2004 through 2010.

[18] Draft NONROAD Model, EPA, 1998; brake-specific fuel consumption, pounds/hour, converted to gallons/hour.

- Tier IV – Emission Credits. The PANYNJ reported that the cost of the 95.68 tpy (287 total tons) of shutdown credits was $113,065. These emission credits would be applied in full during the KVK-5 construction phase (2002 – 2004). It will be determined by the agencies at a later date what they will allow, if anything, in further use of these credits. When that decision has been made, it will be incorporated into the HAMP.

Implementation of MA#4 would progress with the following steps:

- Tier 0 – VFEs. The NYD would need to have approved contract language by June 2004 to include in the initial and subsequent contracts. All HDP bid documents would be required to state that all dredge equipment, support vessels, and dredged material transit vessels would need to be operated with PuriNOx (unless another fuel additive is certified by EPA during the course of the HDP). The winning dredge contractor would need to complete operability tests at the start of the project. Depending on the results of these tests, adjustments may need to be made to equipment in the event that it has any difficulty running on the VFE. This could affect the productivity of the dredge, at least initially, and the project schedule. The planned Corps operability tests using PuriNOx on one of its more representative vessels will address this risk by yielding actual results. This will help make estimates on dredge operations more dependable, but some specific operability tests on the dredges will still be necessary.

  Additional contract language would need to be added to the bid documents requiring the selected dredge contractor to maintain and provide records that include hours of engine operation (for each vessel), quantity of VFE burned, average load of engines, and any additional information to verify the use of the VFE or to estimate emissions. This information would need to be presented to the NYD every six months for the duration of each contract, and would be reported to the NJDEP, NYSDEC and EPA to verify that reductions were sufficient to meet the GC requirements.

  NYD contract language will need to be developed six to eight months prior to the letting of the first bid package to ensure proper enforceability of the standard, in compliance with GC.

  Fuel supply arrangements with the VFE vendor would need to be completed prior to the start of each contract to ensure a steady supply and no interruptions in the dredging schedule. The NYD would need to determine if they would buy the fuel or compensate the selected dredge contractors.

- Tier II – KVK-5 Tugboat Repower. The PANYNJ KVK-5 tugboat repower program is currently on schedule for completion in December 2003. Data collection requirements will be refined by that time. Emission offsets from this strategy would end in 2013. However, the ability to bring aboard enough operators to reach the 80% target for conversion by 2005 is ambitious over this time frame and would necessitate action as soon as possible.

- Tier II – VFE in CHE. The PANYNJ would initiate in November the selection of VFEs and their integration into the terminal tractors. Using the lead-time of six months from Section 3, emission reductions would start being generated in April 2004, with the full target at 80% (April 2004 through 2008) and 30% (2009 and 2010) of terminal tractors using VFE. Receiving the cooperation of enough operators to reach such a high target percentage and placing all of the necessary logistics and equipment in time to service them could be a serious challenge and a potential restraint on the reductions achieved. Routine turnover to less polluting models over time also necessitates careful tracking and a continuous effort to increase the percentage to meet reductions in baseline emissions and still reach the target NOx levels.

- Tier II – TERP. The PANYNJ would initiate an additional round of the tugboat repower program in 2004. The repower program would repower approximately eight tugboats (enough to equal the desired emission reductions stated above) and emission reductions would start to be generated by mid 2004.

  Tier IV – Emission Credits. The PANYNJ has already procured shutdown credits totaling 95.68 tons NOx per year (2002 through 2004) and they are in place for the KVK-5 project.

Emission estimates and cost assumptions, in addition to example calculations, are presented in Appendix I.

MA#4 Advantages:

- Relative risk: low.
- HDP schedule: low relative risk of negatively impacting the schedule due to the implementation of verified ERTs.
- Low-end total cost.
- 13% of the plan incorporates Tier 0 to reduce project emissions.
- The use of shutdown credits has been minimized.

MA#4 Disadvantages:

- There are no additional NOx reductions beyond the duration of the HDP.
- There is the risk that not all of the project equipment will be able to operate on a VFE, or that it will negatively affect operability and therefore productivity.
- Potential implementation issues associated with getting terminals onboard to participate in the CHE strategy are of special concern for a target of 80% conversion in two years. The anticipated reduction in baseline emission levels as less polluting models replace older ones makes the long term value less certain, however, the surpluses from the tugboats and low project levels provides good contingency.

5.5 Mitigation Alternative #5

Mitigation Alternative #5 (MA#5) incorporates the following tiered emission reduction strategies:

- Tier I – SCR installation and operation on the SIF fleet during the course of the project
- Tier II – KVK-5 tugboat repowering (of two tugboats) to yield reduction offsets to be used throughout the HDP duration
- Tier II – VFE conversion for 70% of the terminal tractor fleet identified in the CHE EI, for 2004 and 2005
- Tier IV – Offset air credits used from 2002 through 2004 associated with the KVK-5 project

The total NOx emissions that have to be mitigated for the HDP Federal action over the 12-year project are 2,947 tons. MA#5 over the same period of time reduces a total of 7,816 tons NOx from non-project related marine and CHE emissions sources, producing a surplus of 4,869 tons NOx over the life of the project, of which approximately 854 tons NOx per year are long-term, extending beyond completion of dredging. Figure 5.9 presents the NOx emission reductions by tiered reduction strategy (bars) with the required reductions (red line) for the project by year, and the potential lower bound (detailed above in Section 3.2.2) of the SIF emission reductions (blue dashed line) that could occur when duty cycle and emission testing results are reviewed and approved by the RAT. The percent contribution to the total NOx reduction by strategy is presented in Figure 5.10. Table 5.10 presents the estimated emission reductions by strategy for each year of the project, and the estimated costs associated with the implementation of the various strategies.

Figure 5.9: Mitigation Alternative #5 NOx Emission Reductions vs. Project Required Reductions (tons per year)

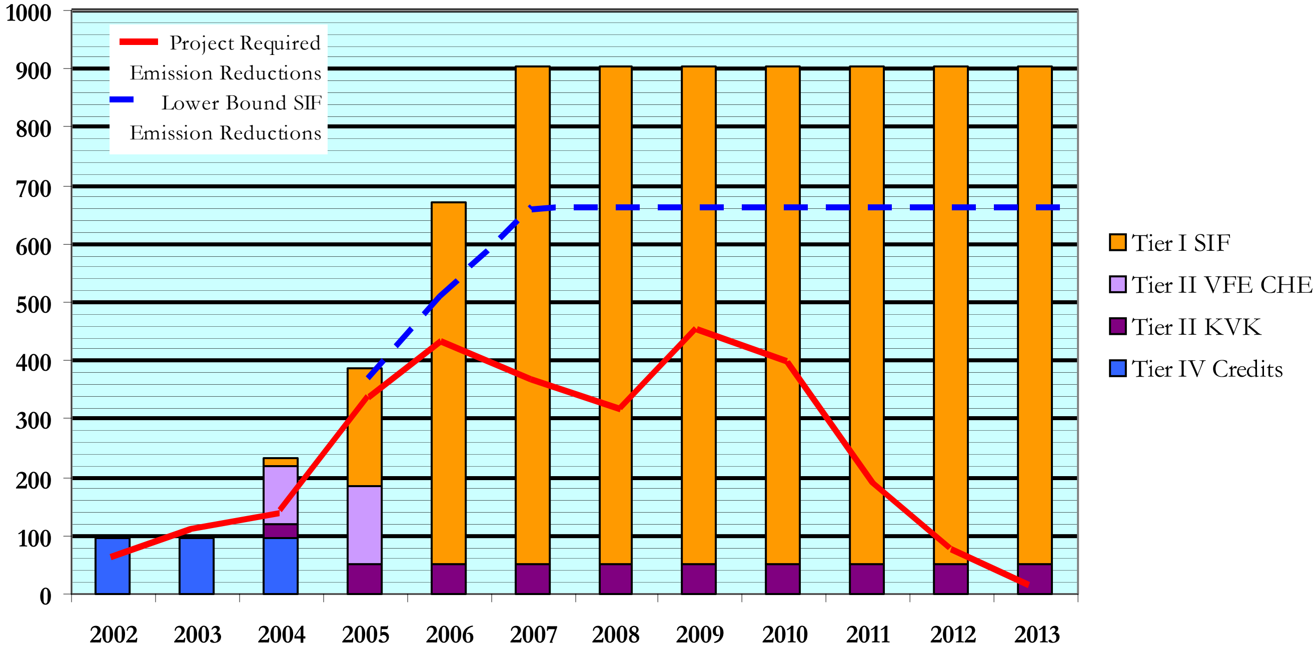

Figure 5.10: Mitigation Alternative #5 Percent Total NOx Reduction by Tiered Mitigation Strategy

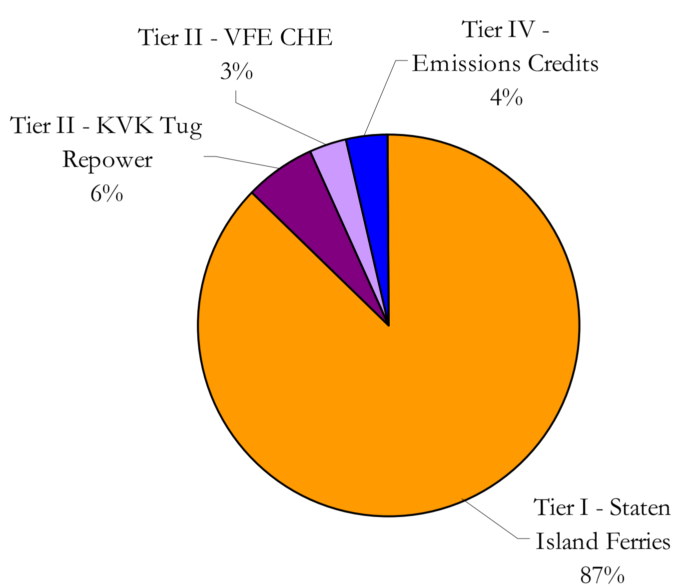

Table 5.10: Mitigation Alternative #5 Emission Reductions and Costs

Mitigation Strategy	2002 (tons)	2003 (tons)	2004 (tons)	2005 (tons)	2006 (tons)	2007 (tons)	2008 (tons)	2009 (tons)	2010 (tons)	2011 (tons)	2012 (tons)	2013 (tons)
EMISSIONS												
Estimated Project NOx Emissions	81.80	121.11	145.26	339.17	429.21	366.47	321.95	440.33	409.64	202.00	74.62	15.66
Tier IV Offset Credits NOx Reduced	95.68	95.68	95.68									
Tier II KVK Tug Repowering NOx Reduced			25.43	50.86	50.86	50.86	50.86	50.86	50.86	50.86	50.86	50.86
Tier I - SIF			1A	1A, 2B	3C							
NOx Reduced			12.60	204.40	618.80	854.00	854.00	854.00	854.00	854.00	854.00	854.00
Tier II - VFE CHE			70% TT									
NOx Reduced			99.33	132.44								
NOx Remaining	**(13.88)**	**25.43**	**(87.78)**	**(48.53)**	**(240.45)**	**(538.39)**	**(582.91)**	**(464.53)**	**(495.22)**	**(702.86)**	**(830.24)**	**(889.20)**

COSTS	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	Total
Emissions Credits	$113,065												**$113,065**
KVK Tug Repower		$613,130											**$613,130**
Tier I - SIF		$200,000	$981,777	$2,898,883	$3,199,542	$444,871	$444,871	$444,871	$444,871	$444,871	$444,871	$444,871	**$10,394,298**
Tier II - VFE CHE			$1,036,420	$1,315,227									**$2,351,647**
Total Expenditure	**$113,065**	**$813,130**	**$2,018,196**	**$4,214,109**	**$3,199,542**	**$444,871**	**$444,871**	**$444,871**	**$444,871**	**$444,871**	**$444,871**	**$444,871**	**$13,472,140**

Notes:

- Tier II KVK-5 Tugboat Repowering: 25.43 tons NOx decremented in 2004 for 2003 short fall
- Tier I – SIF: Assumes 1 Austen Class generating offsets for second half of 2004; 1 Austen full time and 1 Austen and 2 Barberi Class ferries generating emission offsets second half 2005; all Austen and Barberi Class ferries generating offsets full time and three Centennial Class second half of 2006; all ferries generating emission offsets 2007 through 2013
- Tier II – VFE CHE: Assumes 70% of the terminal tractors (TT) identified in the PANYNJ CHE EI are converted to VFEs starting in April 2004 through 2004 through 2005.

Total NOx reduced, cost, and cost effectiveness for each of the tiered emission reduction strategies used in MA#5 are presented in Table 5.11 below.

Table 5.11: Mitigation Alternative #5 Total NOx Reduced, Cost, and Cost Effectiveness

Tiered Reduction Strategy	Total NOx Reduced (tons)	Total Cost	Total Cost Effectiveness ($/tons reduced)
Tier I - Staten Island Ferries	6,813.80	$10,394,298	$1,525
Tier II - KVK Tug Repower	483.17	$613,130	$1,269
Tier II - VFE CHE	231.77	$2,351,647	$10,146
Tier IV - Emissions Credits	287.04	$113,065	$394
Totals	**7,815.78**	**$13,472,140**	**$1,724**

The total and project cost effectiveness for MA#5 are:

- Total Cost Effectiveness = $13,472,140/7,815 tons NOx reduced
  = $1,724/tons NOx reduced

- Project Cost Effectiveness = $13,472,140/2,947 tons NOx reduced
  = $4,571/tons NOx reduced

The costs for each strategy were developed as follows:

- <u>Tier I – Staten Island Ferry.</u> The PANYNJ has estimated costs[19] for retrofitting the SIF fleet to be $6,140,000 in capital costs and $4,254,298 in O&M costs over the duration of the HDP. In addition, support for the development of monitoring protocols, project logistics, oversight of the SCR vendor, data collection, analysis of testing results, and other associated tasks as scoped by the PANYNJ, is estimated to cost $200,000/year for 2003, 2004, and 2005. The PANYNJ will have a full cost analysis and emission reduction report late summer 2004.

  The SIF fleet consumes approximately 3,000,000 gallons of diesel per year[20] and the regular diesel fuel it consumes would be replaced by ULSD. ULSD is necessary to enable SCR to function properly. Independent calls were made to a provider of ULSD and the incremental cost was found to be $0.1368 per gallon. For conservative cost analysis, it was assumed that the fleet would consume a total of 3.2 million gallons of ULSD per year and that the incremental costs were evenly divided by the number of ferries. This will be adjusted to reflect actual consumption rates by class when that information is received from the NYCDOT. The incremental annual cost of the fuel mixture per ferry per year was estimated to be $72,887. Urea is needed for the SCR operation and was independently priced at $0.06 per gallon.

[19] Harbor Deepening Project, Summary of Estimated Costs, PANYNJ, 26 August 2003.
[20] Telephone call with Lou Calcagno, NYCDOT, August 2003.

The total cost for retrofitting the entire SIF fleet was estimated to be approximately $9,794,298 with an additional $600,000 for monitoring and support services.

The estimated emission reductions were calculated using the CMVEI estimates and the following formula:

Emission Reductions tons = Estimated Propulsion Engine Emissions tons x 70% SCR Efficiency

This strategy yields a potential estimated total NOx reduction of 6,813 tons from 2004 through 2013.

- Tier II – KVK-5 Tugboat Repower. Based on the selected applications, the capital cost associated with the KVK-5 repower project is $588,130 plus $25,000 for services, or a total cost of $613,130.

  The estimated emission reductions, based on the applications received, are approximately 483 tons of NOx from 2004 through 2013.

- Tier II – VFE in CHE. The incremental cost associated with VFEs is $0.26 per gallon over the available "rack price" for government purchase and the increased volume for the VFE vs. diesel is an additional 17.6%. The CHE targeted by this strategy are terminal tractors, because they have been successfully converted to VFEs at other ports in the nation and can handle the associated power loss that results when changing fuels. From the 2000 baseline CHE EI, there were 411 terminal tractors (also known as yard hustlers) identified and their annual operating time totaled 945,040 hours. An average fuel consumption factor of 6.5 gallons diesel consumed per hour[21] was applied to the operational hours for an annual estimated fleet consumption of approximately 6,145,000 gallons diesel.

  For MA#5, it was assumed that 55% (227) terminal tractors would be converted to use a VFE at an incremental cost of $0.26 per gallon for 2004 and 2005. The annual costs of this strategy were calculated using the following equation:

  Annual Costs = 6,145,000 gals x 1.176 VFE consumption factor x 55% x $0.26

  In addition, $50,000 in 2004 was budgeted to include expenses associated with upgrading or creating storage facilities on the selected terminals and any costs associated with start- up and maintenance. Finally, for the VFE fueling cost in 2004, it was assumed that implementation of the strategy would not happen until April, and therefore the above equation was multiplied by 0.75 to correct for partial year use.

[21] Draft NONROAD Model, EPA, 1998; brake-specific fuel consumption, pounds/hour, converted to gallons/hour.

The 441 identified terminal tractors produced an estimated 1,130 tons NOx in 2000. Their power range comprised two groups: 100 hp – 175 hp, with a verified NOx emission reduction of 17%; and 175 hp – 300 hp, with a verified NOx emission reduction of 18.8%. Not knowing exactly which terminals might participate and to what extent, it was assumed that the overall NOx emission reduction would conservatively be 17.2%, erring on the low side. It was also assumed that the entire fleet emitted 1,100 tons of NOx per year. The estimated emission reductions were calculated on an annual basis by using the following equation:

Emission Reduction tons = 1,110 tons NOx x 70% x 17.2%

The result was then multiplied by 0.75 (only for 2004) to correct for partial year use.

It was estimated that the total NOx emission reductions from this strategy could yield 231 tons from April 2004 through 2005.

- Tier IV – Emission Credits. The PANYNJ reported that the cost of the 95.68 tpy (287 total tons) of shutdown credits was $113,065. These emission credits would be applied in full during the KVK-5 construction phase (2002 – 2004). It will be determined by the agencies at a later date what they will allow, if anything, in further use of these credits. When that decision has been made, it will be incorporated into the HAMP.

Implementation of MA#5 would progress with the following steps:

- Tier I – Staten Island Ferry. The PANYNJ, in conjunction with the NYCDOT, would need to complete the Austen class demonstration project by mid-year 2004 (which is the current schedule), and then bring the following vessels online: the remaining Austen class ferry and both Barberi class ferries by mid-year 2005, and all three Centennial classes by mid-year 2006. There is flexibility in the schedule for the three Centennial class ferries, should delays occur. An analysis at that time could be made to determine when they would have to be online.

- Tier II – KVK-5 Tugboat Repower. The PANYNJ KVK-5 tugboat repower program is currently on schedule for implementation in December 2003. Data collection requirements will be refined by that time. Emission offsets from this strategy would end in 2013.

- Tier II – VFE in CHE. The PANYNJ would initiate in November the selection of VFEs and their integration into the terminal tractors. Using the lead-time of six months from Section 3, emission reductions would start being generated in April 2004, with the full annual target at 70% of terminal tractors using VFE in 2005. Since only about half of the terminal tractors have to be converted to meet the projected level of reduction, this strategy has a reasonable likelihood of success, although the requirement for multiple operators to participate increases the complexity, and necessitates acting on this very soon.

- Tier IV – Emission Credits. The PANYNJ has already procured shutdown credits totaling 95.68 tons NOx per year (2002 through 2004) and they are in place for the KVK-5 project.

Emission estimates and cost assumptions, in addition to example calculations, are presented in Appendix I.

MA#5 Advantages:

- Relative risk: very low.
- HDP schedule: very low relative risk of negatively impacting the schedule.
- Very low cost.
- Operational changes to the SIF fleet (i.e., reductions in use of ferries, or one going out for maintenance and repair) would have minimal impact, as the reductions achieved are significantly higher than the required reductions.
- Significantly reduces emissions within the nonattainment area beyond what is needed for the project. These surplus reductions provide a substantial "insurance" against future shortfalls and may even be creditable to other NYD/PANYNJ projects to meet GC requirements.
- Approximately 854 tons NOx per year continues to be reduced after project is completed, providing long-term benefits to regional air quality.
- The use of shutdown credits has been minimized.

MA#5 Disadvantages:

- Potential implementation issues associated with getting terminals onboard to participate in the CHE strategy.
- There is the risk that the SIF fleet will not work well with the SCR due to temperature and/or duty cycle issues. However, even if the emission reduction efficiency were reduced by a third, GC requirements on NOx could be met.

5.6 Mitigation Alternative #6

Mitigation Alternative #6 (MA#6) incorporates the following tiered emission reduction strategies:

- Tier II – KVK-5 tugboat repowering (of two tugboats) to yield reduction offsets to be used throughout the HDP duration
- Tier II – Repowering of a sufficient number of tugboats (which would be online by mid-2004) to yield a total of 225 tons of NOx per year emission reductions (only 112.5 tons for the first year). The reduction offsets would be used throughout the duration of the HDP
- Tier II – VFE conversion for 80% of the terminal tractor fleet identified in the CHE EI, from 2004 through 2010
- Tier III – SCR or similar reduction emission reduction technology installation on three hopper dredges operating in the Ambrose Channel during the HDP; one in 2004, one in 2006, and one in 2008
- Tier IV – Offset air credits used from 2002 through 2004 associated with the KVK-5 project

The total NOx emissions associated with the HDP Federal action over the 12-year project are 2,947 tons. MA#6 over the same period of time reduces an estimated total of 4,132 tons NOx from project and non-project related marine and CHE emissions sources, producing a surplus of 1,185 tons of NOx reduced. This alternative only provides for approximately 70 tons NOx offsets for 2014 with no other long-term emission offsets that carry beyond the duration of the HDP (unless any of the three retrofitted hopper dredges are used in the area on other projects). Figure 5.11 presents the NOx emission reductions by tiered reduction strategy (bars) with the required reductions (red line) for the project by year. The percent contribution to the total NOx reduction by strategy is presented in Figure 5.12. Table 5.12 presents the estimated emission reductions by strategy for each year of the project, and the estimated costs associated with the implementation of the various strategies.

If for any reason any of the tugboat repower projects adding up to the 225 tpy NOx reduction Tier II strategy end prior to the end of the project they would need to be replaced by a contingency measure such that GC requirements are met.

Figure 5.11: Mitigation Alternative #6 NOx Emission Reductions vs. Project Required Reductions (tons per year)

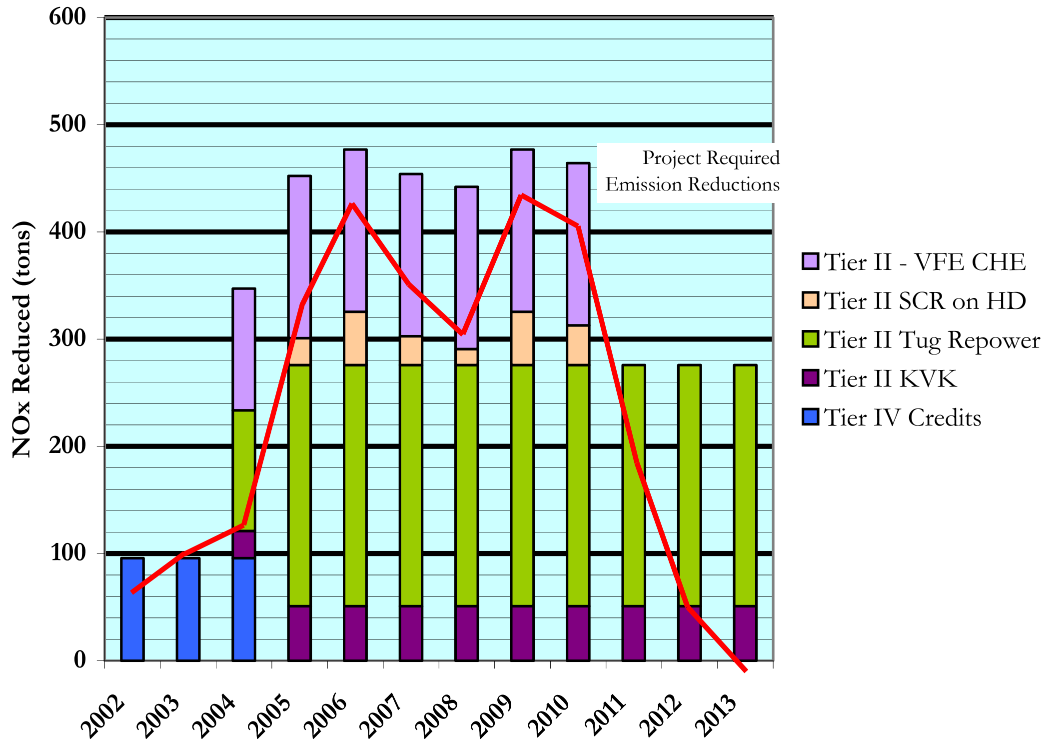

Figure 5.12: Mitigation Alternative #6 Percent Total NOx Reduction by Tiered Mitigation Strategy

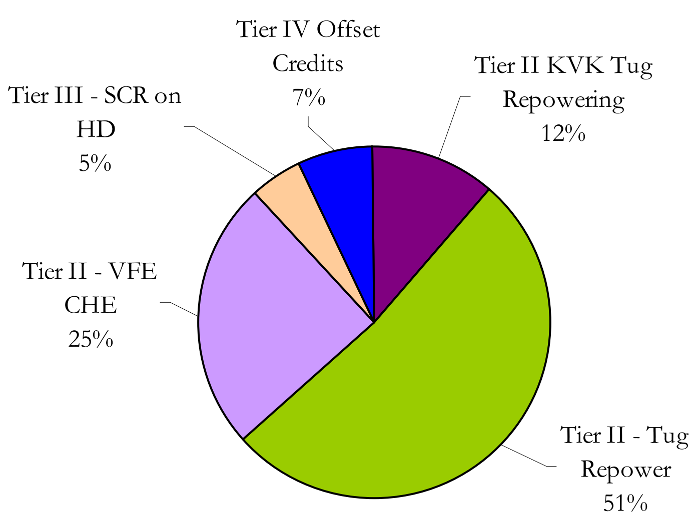

Table 5.12: Mitigation Alternative #6 Emission Reductions and Costs

Mitigation Strategy	2002 (tons)	2003 (tons)	2004 (tons)	2005 (tons)	2006 (tons)	2007 (tons)	2008 (tons)	2009 (tons)	2010 (tons)	2011 (tons)	2012 (tons)	2013 (tons)	Total
						Project Year							
EMISSIONS													
Estimated Project NOx Emissions	81.80	121.11	145.26	339.17	429.21	366.47	321.95	440.33	409.64	202.00	74.62	15.66	
Tier IV Offset Credits NOx Reduced	95.68	95.68	95.68										
Tier II KVK Tug Repowering NOx Reduced			25.43	50.86	50.86	50.86	50.86	50.86	50.86	50.86	50.86	50.86	
Tier III - SCR on HD			1 HD		1 HD		1 HD						
NOx Reduced				25.04	49.67	26.81	14.83	49.67	37.02				
Tier II - VFE CHE			80% TT										
NOx Reduced			113.52	151.36	151.36	151.36	151.36	151.36	151.36				
Tier II - Tug Repower			~9 tugs										
NOx Reduced			112.5	225	225	225	225	225	225	225	225	225	
NOx Remaining	**(13.88)**	**25.43**	**(201.87)**	**(113.09)**	**(47.69)**	**(87.56)**	**(120.11)**	**(36.57)**	**(54.60)**	**(73.86)**	**(201.24)**	**(260.20)**	
COSTS													**Total**
Tier IV Offset Credits	$113,065												**$113,065**
Tier II KVK Tug Repowering		$613,130											**$613,130**
Tier III - SCR on HD			$650,000	$192,824	$1,032,589	$206,448	$764,276	$382,589	$285,135				**$3,513,861**
Tier II - VFE CHE			$1,227,337	$1,503,116	$1,503,116	$1,503,116	$1,503,116	$1,503,116	$1,503,116				**$10,246,034**
Tier II - Tug Repower			$3,240,000										**$3,240,000**
Total Expenditure	**$113,065**	**$613,130**	**$5,117,337**	**$1,695,940**	**$2,535,705**	**$1,709,564**	**$2,267,392**	**$1,885,705**	**$1,788,251**	**$0**	**$0**	**$0**	**$17,726,090**

Notes:

- Tier II KVK-5 Tugboat Repowering: 25.43 tons NOx decremented in 2004 for 2003 short fall
- Tier III – SCR on HD: Assumes installation of SCR on 1 hopper dredge (HD) by end of 2004 with full emission reductions starting beginning of 2005; second HD retrofitted in 2006 with full emission reductions starting 2007; third HD retrofitted in 2008 with full emissions reductions starting 2009
- Tier II – VFE CHE: Assumes 80% of the terminal tractors (TT) identified in the PANYNJ CHE EI are converted to VFEs starting in April 2004 through 2010
- Tier II – TERP: Assumes nine tugs will be repowered by mid 2004 generating emission offsets for half the year; all nine tugs are assumed to be generating emission offsets annually from 2005 through 2013

Total NOx reduced, cost, and cost effectiveness for each of the tiered emission reduction strategies used in MA#6 are presented in Table 5.13 below.

Table 5.13: Mitigation Alternative #6 Total NOx Reduced, Cost, and Cost Effectiveness

Tiered Reduction Strategy	Total NOx Reduced (tons)	Total Cost	Total Cost Effectiveness ($/tons reduced)
Tier II KVK Tug Repowering	483.17	$613,130	$1,269
Tier II - Tug Repower	2,137.50	$3,240,000	$1,516
Tier II - VFE CHE	1021.68	$10,246,034	$10,029
Tier III - SCR on HD	203.05	$3,513,861	$17,306
Tier IV Offset Credits	287.04	$113,065	$394
Totals	**4,132.44**	**$17,726,090**	**$4,290**

The total and project cost effectiveness for MA#6 are:

- Total Cost Effectiveness = $17,726,090/4,132 tons NOx reduced
  = $4,290/tons NOx reduced

- Project Cost Effectiveness = $17,726,090/2,947 tons NOx reduced
  = $6,015/tons NOx reduced

The costs for each strategy were developed as follows:

- Tier II – KVK-5 Tugboat Repower. Based on the selected applications, the capital cost associated with the KVK-5 repower project is $588,130 plus $25,000 for services, or a total cost of $613,130.

  The estimated emission reductions, based on the applications received, are approximately 483 tons of NOx from 2004 through 2013.

- Tier II – TERP. A total annual emission reduction of 225 tpy NOx or 2,137 tons NOx during the HDP, is estimated provided by repowering approximately eight additional tugboats. Using the framework of the KVK-5 project and implementing several of the recommendations in the final repower package, it is assumed (based on the KVK-5 repower results) that each tugboat could produce on average 25 tons of NOx reductions each year for the duration of the HDP, with each tugboat repower costing $360,000.

- Tier II – VFE in CHE. The incremental cost associated with VFEs is $0.26 per gallon over the available "rack price" for government purchase and the increased volume for the VFE vs. diesel is an additional 17.6%. The CHE targeted by this strategy are terminal tractors, because they have been successfully converted to VFEs at other ports in the nation and can handle the associated power loss that results when changing fuels. From the 2000 baseline CHE EI, there were 411 terminal tractors (also known as yard hustlers) identified and their annual operating time totaled 945,040 hours. An average fuel consumption factor of 6.5 gallons diesel consumed per hour[22] was applied to the operational hours for an annual estimated fleet consumption of approximately 6,145,000 gallons diesel.

For MA#6, it was assumed that 80% (329) terminal tractors would be converted to use a VFE at an incremental cost of $0.26 per gallon from 2004 through 2010. The annual costs of this strategy were calculated using the following equation:

Annual Costs = 6,145,000 gals x 1.176 VFE consumption factor x 80% x $0.26

In addition, $100,000 in 2004 was budgeted to include expenses associated with upgrading or creating storage facilities on the selected terminals and any costs associated with start- up and maintenance. Finally, for the VFE fueling cost in 2004, it was assumed that implementation of the strategy would not happen until April, and therefore the above equation was multiplied by 0.75 to correct for partial year use.

The 441 identified terminal tractors produced an estimated 1,130 tons NOx in 2000. Their power range comprised two groups: 100 hp – 175 hp, with a verified NOx emission reduction of 17%; and 175 hp – 300 hp, with a verified NOx emission reduction of 18.8%. Not knowing exactly which terminals might participate and to what extent, it was assumed that the overall NOx emission reduction would conservatively be 17.2%, erring on the low side. It was also assumed that the entire fleet emitted 1,100 tons of NOx per year. The estimated emission reductions were calculated on an annual basis by using the following equation:

Emission Reduction tons = 1,110 tons NOx x 40% x 17.2%

The result was then multiplied by 0.75 (only for 2004) to correct for partial year use. It was estimated that the total NOx emission reductions from this strategy could yield a total of 1,021 tons from April 2004 through 2010.

- Tier III – SCR on Hopper Dredge. This strategy assumes that the three hopper dredges working on the Ambrose Channel for the HDP would be retrofitted with SCRs on the propulsion engines, estimated at a cost of $650,000.

  The estimated emission reductions were calculated using the HDP emission estimates for the hopper dredges and applied to the following formula:

  Emission Reductions tons = Estimated Propulsion Engine Emissions tons x 70% SCR Efficiency

  The potential NOx emission reductions from this strategy are estimated at 203 tons from 2005 through 2010.

[22] Draft NONROAD Model, EPA, 1998; brake-specific fuel consumption, pounds/hour, converted to gallons/hour.

- Tier IV – Emission Credits. The PANYNJ reported that the cost of the 95.68 tpy (287 total tons) of shutdown credits was $113,065. These emission credits would be applied in full during the KVK-5 construction phase (2002 – 2004). It will be determined by the agencies at a later date what they will allow, if anything, in further use of these credits. When that decision has been made, it will be incorporated into the HAMP.

Implementation of MA#6 would progress with the following steps:

- Tier II – KVK-5 Tugboat Repower. The PANYNJ KVK-5 tugboat repower program is currently on schedule for completion in December 2003. Data collection requirements will be refined by that time. Emission offsets from this strategy would end in 2013.

- Tier II – TERP. The PANYNJ would initiate two additional rounds of tugboat repower programs in 2004 and 2005. The first repower program (four tugboats) would need to be initiated in the fourth quarter of 2003 in order to start generating offsets by mid-2004. The second repower program (two tugboats) would need to be initiated in the second quarter of 2004 in order to start generating offsets by end of 2004.

- Tier II – VFE in CHE. The PANYNJ would initiate in November the selection of VFEs and their integration into the terminal tractors. Using the lead-time of six months from Section 3, emission reductions would start being generated in April 2004, with the full target at 80% of terminal tractors converted to VFE annually from 2005 through 2010. Receiving the cooperation of enough operators to reach such a high target percentage and placing all of the necessary logistics and equipment in time to service them could be a serious challenge and a potential restraint on the reductions achieved. Routine turnover to less polluting models over time also necessitates careful tracking and a continuous effort to increase the percentage to meet reductions in baseline emissions and still reach the target NOx levels.

- Tier III – SCR or Similar Reducing Tier III Technology on Hopper Dredges. The NYD would need to have contract language adjusted in the Ambrose Channel bid documents stating that all hopper dredge equipment would need to be operated with an ERT that reduces NOx by 70% or more. The winning dredge contractors would need to have the ERTs installed and operable prior to the start of work on their HDP contract. Verification of the Tier III technology would need to be coordinated with the RAT. The SCR would have to be functional January 2005.

  Additional contract language would need to be added to the bid documents requiring the selected dredge contractor to maintain and provide records that include hours of engine and SCR/Tier III ERT operation (for each vessel), quantity of urea burned, average load of engines, and any additional information that may be need to verify of the use of the Tier III ERT or to estimate emissions. This information would need to be presented to the NYD every six months for the duration of each contract, and to the two states and EPA to verify reductions in accordance with the enforceability requirements of GC.

NYD contract language will need to be developed in coordination with the RAT eight months prior to the letting of the first bid package.

Tier IV – Emission Credits. The PANYNJ has already procured shutdown credits totaling 95.68 tons NOx per year (2002 through 2004) and they are in place for the KVK-5 project.

Emission estimates and cost assumptions, in addition to example calculations, are presented in Appendix I.

MA#6 Advantages:

- Relative risk: very low.
- HDP schedule: very low relative risk of negatively impacting the schedule.
- Third to lowest cost.
- The wide diversity of mitigation strategies reduces exposure to the relative risks associated with any one strategy.
- 5% of the emission reductions come from HDP equipment.
- The use of shutdown credits has been minimized.

MA#6 Disadvantages:

- There are no additional NOx reductions beyond the duration of the HDP.
- Potential implementation issues associated with getting terminals onboard to participate in the CHE strategy. Reaching the 80% conversion target for terminal tractors to use VFE by 2005 is more of a risk than alternatives with lower targets, and this alternative has less surplus reductions to replace them if it is not met.
- Potential implementation issues associated with the retrofitting of the hopper dredges with SCRs, especially if different contractors (and vessels) are selected for contracts.
- Retrofitted hopper dredges would only work for a limited time (2005-2010) on the HDP and then could leave the nonattainment area and cease creating credits from the NYD investment.

5.7 Mitigation Alternative #7

Mitigation Alternative #7 (MA#7) incorporates the following tiered emission reduction strategies:

- Tier I – SCR installation and operation on the SIF fleet during the course of the project
- Tier II – KVK-5 tugboat repowering (of two tugboats) to yield reduction offsets to be used throughout the HDP duration
- Tier II – Repowering of a sufficient number of tugboats (which would be online by mid-2004) to yield a total of 150 tons of NOx per year emission reductions (only 75 tons for the first year). The reduction offsets would be used throughout the duration of the HDP
- Tier IV – Offset air credits used from 2002 through 2004 associated with the KVK-5 project

The total NOx emissions associated with the HDP Federal action over the 12-year project are 2,947 tons. MA#7 over the same period of time reduces a total of 9,009 tons NOx from non-project related marine sources, producing a surplus of 6,062 tons NOx reduced over the life of the project. Of this, approximately 854 tons NOx per year are long-term, extending beyond completion of dredging. This alternative represents a $192,000 savings over MA#5 and creates long-term emission reduction offsets beyond the duration of the HDP. Figure 5.13 presents the NOx emission reductions by tiered reduction strategy (bars) with the required reductions (red line) for the project by year, and the potential lower bound (detailed above in Section 3.2.2) of the SIF emission reductions (blue dashed line) that could occur when duty cycle and emission testing results are reviewed and approved by the RAT. The percent contribution to the total NOx reduction by strategy is presented in Figure 5.14. Table 5.14 presents the estimated emission reductions by strategy for each year of the project, and the estimated costs associated with the implementation of the various strategies.

If for any reason any of the tugboat repower projects adding up to the 150 tpy NOx reduction Tier II strategy end prior to the end of the project they would need to be replaced by a contingency measure such that GC requirements are met.

Figure 5.13: Mitigation Alternative #7 NOx Emission Reductions vs. Project Required Reductions (tons per year)

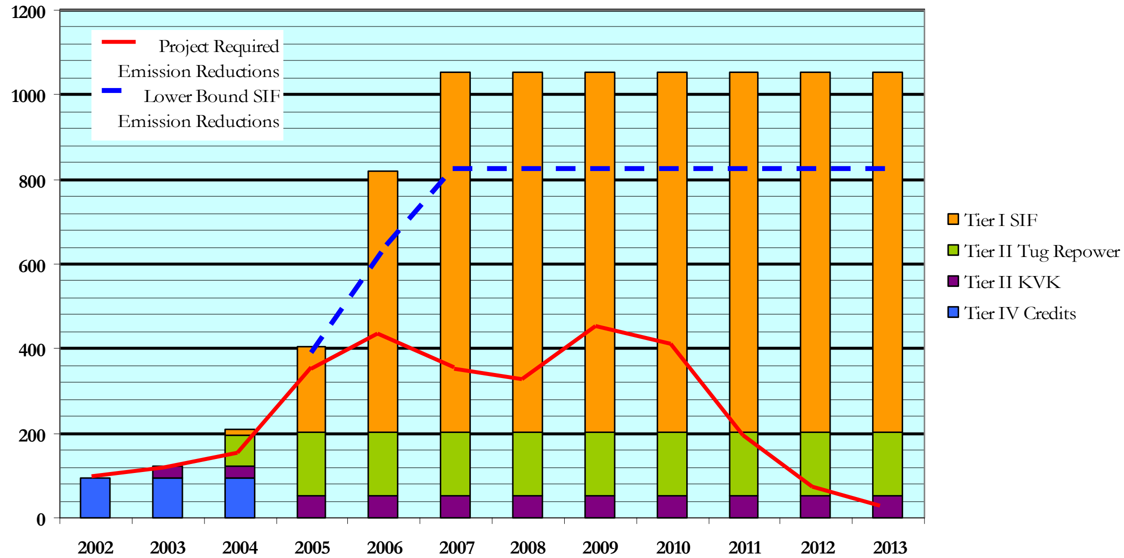

Figure 5.14: Mitigation Alternative #7 Percent Total NOx Reduction by Tiered Mitigation Strategy

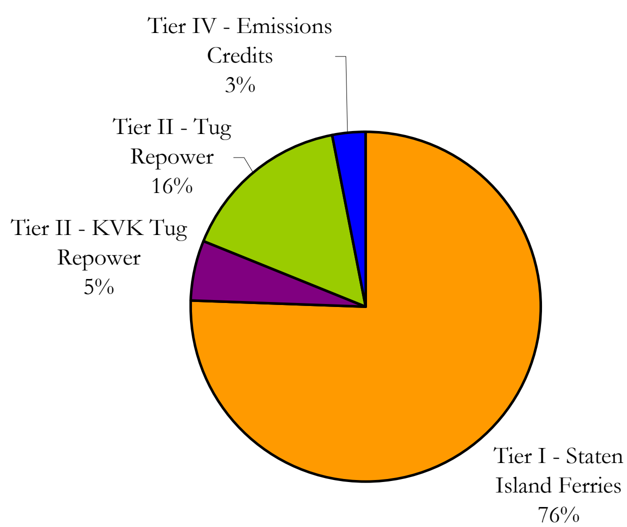

Table 5.14: Mitigation Alternative #7 Emission Reductions and Costs

Mitigation Strategy	2002 (tons)	2003 (tons)	2004 (tons)	2005 (tons)	2006 (tons)	Project Year 2007 (tons)	2008 (tons)	2009 (tons)	2010 (tons)	2011 (tons)	2012 (tons)	2013 (tons)
EMISSIONS												
Estimated Project NOx Emissions	81.80	121.11	145.26	339.17	429.21	366.47	321.95	440.33	409.64	202.00	74.62	15.66
Tier IV Offset Credits NOx Reduced	95.68	95.68	95.68									
Tier II KVK Tug Repowering NOx Reduced			25.43	50.86	50.86	50.86	50.86	50.86	50.86	50.86	50.86	50.86
Tier I - SIF			1A	1A, 2B	3C							
NOx Reduced			12.60	204.40	618.80	854.00	854.00	854.00	854.00	854.00	854.00	854.00
Tier II - Tug Repower			~6 Tugs									
NOx Reduced			75.00	150.00	150.00	150.00	150.00	150.00	150.00	150.00	150.00	150.00
NOx Remaining	**(13.88)**	**25.43**	**(63.45)**	**(66.09)**	**(390.45)**	**(688.39)**	**(732.91)**	**(614.53)**	**(645.22)**	**(852.86)**	**(980.24)**	**(1,039.20)**

COSTS	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	Total
Emissions Credits	$113,065												**$113,065**
KVK Tug Repower		$613,130											**$613,130**
Tier I - SIF		$200,000	$981,777	$2,898,883	$3,199,542	$444,871	$444,871	$444,871	$444,871	$444,871	$444,871	$444,871	**$10,394,298**
Tier II - Tug Repower			$2,160,000										**$2,160,000**
Total Expenditure	**$113,065**	**$813,130**	**$3,141,777**	**$2,898,883**	**$3,199,542**	**$444,871**	**$444,871**	**$444,871**	**$444,871**	**$444,871**	**$444,871**	**$444,871**	**$13,280,493**

Notes:

- Tier II KVK-5 Tugboat Repowering: 25.43 tons NOx decremented in 2004 for 2003 short fall
- Tier I – SIF: Assumes 1 Austen Class generating offsets for second half of 2004; 1 Austen full time and 1 Austen and 2 Barberi Class ferries generating emission offsets second half 2005; all Austen and Barberi Class ferries generating offsets full time and three Centennial Class second half of 2006; all ferries generating emission offsets 2007 through 2013
- Tier II – TERP: Assumes six tugs will be repowered by mid 2004 generating emission offsets for half the year; all six tugs are assumed to be generating emission offsets annually from 2005 through 2013

Total NOx reduced, cost, and cost effectiveness for each of the tiered emission reduction strategies used in MA#7 are presented in Table 5.15 below.

Table 5.15: Mitigation Alternative #7 Total NOx Reduced, Cost, and Cost Effectiveness

Tiered Reduction Strategy	Total NOx Reduced (tons)	Total Cost	Total Cost Effectiveness ($/tons reduced)
Tier I - Staten Island Ferries	6,813.80	$10,394,298	$1,525
Tier II - KVK Tug Repower	483.17	$613,130	$1,269
Tier II - Tug Repower	1,425.00	$2,160,000	$1,516
Tier IV - Emissions Credits	287.04	$113,065	$394
Totals	**9,009.01**	**$13,280,493**	**$1,474**

The total and project cost effectiveness for MA#7 are:

- Total Cost Effectiveness = $13,280,493/9,009 tons NOx reduced
  = $1,474/tons NOx reduced

- Project Cost Effectiveness = $13,280,493/2,947 tons NOx reduced
  = $4,506/tons NOx reduced

The costs for each strategy were developed as follows:

- Tier I – Staten Island Ferry. The PANYNJ has estimated costs[23] for retrofitting the SIF fleet to be $6,140,000 in capital costs and $4,254,298 in O&M costs over the duration of the HDP. In addition, support for the development of monitoring protocols, project logistics, oversight of the SCR vendor, data collection, analysis of testing results, and other associated tasks as scoped by the PANYNJ, is estimated to cost $200,000/year for 2003, 2004, and 2005. The PANYNJ will have a full cost analysis and emission reduction report late summer 2004.

  The SIF fleet consumes approximately 3,000,000 gallons of diesel per year[24] and the regular diesel fuel it consumes would be replaced by ULSD. ULSD is necessary to enable SCR to function properly. Independent calls were made to a provider of ULSD and the incremental cost was found to be $0.1368 per gallon. For conservative cost analysis, it was assumed that the fleet would consume a total of 3.2 million gallons of ULSD per year and that the incremental costs were evenly divided by the number of ferries. This will be adjusted to reflect actual consumption rates by class when that information is received from the NYCDOT. The incremental annual cost of the fuel mixture per ferry per year was estimated to be $72,887. Urea is needed for the SCR operation and was independently priced at $0.06 per gallon. The total cost for retrofitting the entire SIF fleet was estimated to be approximately $9,794,298 with an additional $600,000 for monitoring and support services.

[23] Harbor Deepening Project, Summary of Estimated Costs, PANYNJ, 26 August 2003.
[24] Telephone call with Lou Calcagno, NYCDOT, August 2003.

The estimated emission reductions were calculated using the CMVEI estimates and the following formula:

Emission Reductions tons = Estimated Propulsion Engine Emissions tons x 70% SCR Efficiency

This strategy yields a potential estimated total NOx reduction of 6,813 tons from 2004 through 2013.

- Tier II – KVK-5 Tugboat Repower. Based on the selected applications, the capital cost associated with the KVK-5 repower project is $588,130 plus $25,000 for services, or a total cost of $613,130.

  The estimated emission reductions, based on the applications received, are approximately 483 tons of NOx from 2004 through 2013.

- Tier II– TERP. A total annual emission reduction of 150 tpy NOx or 1,425 tons NOx during the HDP, is estimated to be provided by repowering approximately six additional tugboats. Using the framework of the KVK-5 project and implementing several of the recommendations in the final repower package, it is assumed (based on the KVK-5 repower results) that each tugboat could produce on average 25 tons of NOx reductions each year for the duration of the HDP, with each tugboat repower costing $360,000.

- Tier IV – Emission Credits. The PANYNJ reported that the cost of the 95.68 tpy (287 total tons) of shutdown credits was $113,065. These emission credits would be applied in full during the KVK-5 construction phase (2002 – 2004). It will be determined by the agencies at a later date what they will allow, if anything, in further use of these credits. When that decision has been made, it will be incorporated into the HAMP.

Implementation of MA#7 would progress with the following steps:

- Tier I – Staten Island Ferry. The PANYNJ, in conjunction with the NYCDOT, would need to complete the Austen class demonstration project by mid-year 2004 (which is the current schedule), and then bring the following vessels online: the remaining John Noble ferry and both Barberi class ferries by mid-year 2005, and all three Centennial boats during 2005 and 2006.

- Tier II – KVK-5 Tugboat Repower. The PANYNJ KVK-5 tugboat repower program is currently on schedule for completion in December 2003. Data collection requirements will be refined by that time. Emission offsets from this strategy would end in 2013.

- Tier II – TERP. The PANYNJ would initiate an additional round of the tugboat repower program in 2004. The repower program would repower approximately six tugboats (enough to equal the desired emission reductions stated above) and emission reductions would start to be generated by mid 2004.

- Tier IV – Emission Credits. The PANYNJ has already procured shutdown credits totaling 95.68 tons NOx per year (2002 through 2004) and they are in place for the KVK-5 project.

Emission estimates and cost assumptions, in addition to example calculations, are presented in Appendix I.

MA#7 Advantages:

- Relative risk: very low.
- HDP schedule: very low relative risk of negatively impacting the schedule.
- Lowest total cost and lowest cost per ton of NOx reduced.
- Very low implementation complexity.
- Operational changes to the SIF fleet (i.e., reductions in use of ferries, or one going out for maintenance and repair) would have minimal impact, as the reductions achieved are significantly higher than the required reductions.
- Significantly reduces emissions within the nonattainment area beyond what is needed for the project. These surplus reductions provide a substantial "insurance" against future shortfalls and may even be creditable to other NYD/PANYNJ projects to meet GC requirements.
- Approximately 854 tons NOx per year continues to be reduced after project is completed, providing long-term benefits to regional air quality.

MA#7 Disadvantages:

- There is the risk that the SIF fleet will not work well with the SCR due to temperature and/or duty cycle issues. However, even if the emission reduction efficiency were reduced by a third, GC requirements on NOx could be met.

SECTION 6 SELECTING THE PREFERRED PLAN

As described in Section 4, a number of factors are considered in determining which of the alternatives to recommend for implementation to bring the HDP into compliance with the GC rule. Cost effectiveness is obviously a factor and under the Corps' policy guidance, one that plays a major role in selecting alternatives to implement, all other things being equal. However, all other things are not equal, especially risk. Risk consists of two key components:

- The level of difficulty in implementing the various options of a given plan, and
- The susceptibility of the plan in not meeting GC if one or more of its options does not function as predicted.

The preferred mitigation alternative is MA#7. This is based on the fact that it has one of the lowest relative implementation complexities, sufficient emission reduction overages such that there is relatively very low risk to the HDP schedule, and it is very cost effective (having the lowest over all cost). MA#7 consists of:

- SCR installation in SIF fleet,
- Repowering of two tugboats under the KVK-5 permit,
- Repowering of approximately six additional project tugboats, and
- Use of purchased emission credits through 2004.

MA#7 is based only on the three proven tiers (Tier I, II, and IV): the SIF SCR installation, tugboat repowering, and emission credits, further ensuring that the HDP schedule is not affected by any realized risks. The remaining unused strategies become available as a contingency measure. Of these, work can progress by PANYNJ to initiate negotiations on a program to utilize VFE on a marine facility source (e.g., the port terminal tractors) and repowering of any remaining unmodernized container cranes. This approach would begin generating offset reductions in 2004 that could be applied to the project if needed, or used by the PANYNJ to offset other projects if not needed for HDP. In addition, the NYD could also continue developing contract specifications for use in requiring VFE on contract vessels. The specifications would be incorporated if additional reductions were needed without delaying the start of the bid process or construction.

Not only does MA#7 have the lowest overall cost, the installation of SCR on the SIF fleet represents a significant future environmental benefit of nearly 854 tons per year NOx reductions after the project is over. Further more, the SIF fleet represents a source that most closely resembles the continuous operational conditions of the HDP build out and are located within the HDP physical boundary. Table 6.1 illustrates how MA#7 achieves a broad spectrum of the evaluation criteria discussed in detail in Section 4.

Table 6.1: MA#7 vs. Evaluation Criteria

Evaluation Criteria	Consistent	MA#7 Comparison
Consistency with HQ Guidance	Yes	➢ Dredging schedule reduces peak year emissions ➢ Mitigation occurs within and extremely close to the impact area ➢ Main reductions coming from public ferries in preference to private facilities
Consistency with cSOC	Yes	Consistent with cSOC such that there is no net increase in emissions and new (non-verified) ERTs are being used in association with the ferries.
Cost Effectiveness	Yes	Least expensive mitigation alternative.
Maintaining Project Schedule	Yes	Sufficient array of contingency measures to best ensure no impact to HDP schedule.
Implementation Complexity	Yes	Consists of tugboat repowering and installation of SCR on the SIF fleet, both of which are currently underway.
Relative Risk	Yes	Very low because the selected strategies produce adequate surplus to meet unexpected increases in emissions and/or decreases in reduction and the remaining unimplemented strategies are contingencies for the project to use if one or more of the selected strategies is not available.
Consistency with Long-Term Environmental Benefits (air)	Yes	Provides the equipment to sustain nearly 854 tons NOx reduced per year for the SIF fleet, which is a significant favorable health impact to the ferry riders after construction of the project is completed.
Local Sponsor Concurrence	Yes	The PANYNJ is already repowering tugboats under the KVK-5 project and has started the SIF demonstration project. The alternative is consistent with the Port's long-term view on emission reductions in the harbor.

In order to obtain and demonstrate compliance, the implementation of the selected mitigation alternative will require:

- Contingency plans
- Monitoring, recordkeeping, and reporting
- Updating of the HAMP and Statement of Conformity
- An overall timeline/schedule

An overview of these four components is provided below. The HAMP is the NYD decision document, and as details are defined throughout the duration of the project, they will be added or referenced in HAMP updates.

Contingency Plans

As stated throughout the document, there are variables that are unknown (baseline emission assumptions, EERT effectiveness, hours of operations, downtime, etc.) and that have the potential (especially during the early part of the HAMP implementation) to jeopardize the HDP's compliance with the GC rule. As part of the SIP process, the states develop contingency plans should one of the emission reduction strategies or regulations not achieve the anticipated results, so too the HAMP should have a contingency plan to ensure compliance with the GC requirements.

To this end, the HAMP has both short-term and long-term contingency plans in place that will help in its successful implementation. The short-term contingencies are those discrete strategies developed in the tiered approach that are not employed by MA#7 as a primary strategy but that can be implemented should a primary strategy fail. The contingency options available for use include (but are not limited to):

- Use of VFEs on HDP construction equipment (four to six month lead time)
- Increase in number of tugboats repowered (six month lead time)
- Use of VFEs in terminal tractors (12 - 18 month lead time)
- Installation of SCR on project related hopper dredges (12-18 month lead time)
- Slowing down or halting project construction (as a contingency)

It was suggested by the RAT that consideration be given to fully developing one or more contingency measures (especially for the short term) such that during the initial years of the HDP there are contingency measures either already underway or able to be implemented in a minimum amount of time, so as not to impact the construction schedule. To this end the NYD is working with the VFE demonstration project and will further evaluate the short-term contingencies listed in the HAMP. The findings of the demonstration project and evaluations will be incorporated in the next HAMP revision.

Monitoring, Recordkeeping, and Reporting

To track the performance of the implemented measures associated with the HAMP and to demonstrate that it is successful, monitoring and recordkeeping of both HDP construction activities and mitigation strategies will need to be completed. HDP construction activities will be initially tracked internally on a quarterly basis such that the NYD can identify whether trends indicate that the emissions generated could potentially eclipse emission reductions generated in the same year (thus triggering the implementation of one of the contingency measures). As important, emission reductions from the primary mitigation strategies will be initially tracked internally on a periodic basis to be determined by the RAT. The NYD will advise the RAT formally of the review on a periodic basis, as yet to be determined. A statement that documents the progress of the year's implementation will be provided biannually. The details and findings of the monitoring and recordkeeping components will be developed and presented to the RAT for their concurrence, prior to the start of construction.

Updating the HAMP and Issuing Statements of Conformity

The HAMP is a living document that will be updated as better information becomes available. Updating the HAMP will consist of the following items:

- Update progress/status of Table 1.1, Status of Conditional Statement of Conformity Commitments.
- Update Table 6.1, HAMP Major Milestones.
- Update emission estimates for the SIF retrofit project when load factor data is collected, quality assured, and approved by the agencies.
- Update emission estimates for the SIF retrofit project when the baseline and post control emission testing has been completed, reviewed, and approved by the agencies.
- Review and update the HDP construction emissions (NOx, CO, VOC, PM) and actual dredged volumes initially on a quarterly basis to determine if the projected emission estimates in the HAMP are still valid. Also, the HDP plan would be evaluated for any impacts/changes of schedules that could impact the out years. An informal notice of the findings would be sent to the RAT.
- Review of mitigation strategies initially on a quarterly basis to determine the quantity of offsets that are being generated and to evaluate whether contingency measures need to be implemented. An informal notice of the findings would be sent to the RAT.
- Evaluate the progress of CO and determine if additional controls would be needed to prevent exceeding the GC trigger level of 100 tpy.
- Update Section 5.7 of the HAMP with above findings.
- Review and update the Findings Report on potential ERTs and EERTs on an annual basis to determine if they would be applicable for use as a contingency measure during the HDP.

- Roll-up of all key points for incorporation in a revised HAMP document on an annual basis. Update and incorporate/reference details that are developed with respect to mitigation strategies.

The major milestones that will be critical in the implementation of the HAMP MA#7 are presented in Figure 6.1.

Figure 6.1: HAMP Major Milestones

Date	Milestone	Lead
14 Nov 2003	HAMP Final Draft of 2003	USACE
18 Nov 2003	SIF Demo agreement executed	PANYNJ
8 Dec 2003	SIF Data loggers installed on Alice Austen	PANYNJ
15 Dec 2003	SIF SCR solicitation released to vendors	PANYNJ
22 Dec 2003	SIF Vessel information report released	PANYNJ
29 Dec 2003	SIF Data logger analysis (Alice Austen)	PANYNJ
14 Jan 2004	HAMP Issue revised estimates based on VIRR	USACE
23 Jan 2004	HAMP Issue revised report	USACE
30 Jan 2004	HAMP Review to determine if contingency plan implementation is needed	USACE
30 Jan 2004	SIF Remove data loggers (Alice Austen)	PANYNJ
13 Feb 2004	SIF SCR solicitation due	PANYNJ
1 Mar 2004	SIF Data loggers installed on Barberi Class	PANYNJ
1 Mar 2004	SIF Solicitation award date	PANYNJ
22 Mar 2004	SIF Contract execution date	PANYNJ
31 Mar 2004	HAMP Review to determine if contingency plan implementation is needed	USACE
31 Mar 2004	SOC First Construction Component	USACE
1 Jun 2004	SIF Barberi VIRR w/data logging	PANYNJ
30 Jun 2004	SIF SCR equipment installation (Alice Austen)	PANYNJ
30 Jun 2004	SIF Start SCR commissioning (Alice Austen)	PANYNJ
12 Jul 2004	SIF Finish SCR commissioning	PANYNJ
13 Jul 2004	SIF Start emissions testing (Alice Austen)	PANYNJ
16 Jul 2004	SIF Finish emissions testing	PANYNJ
4 Aug 2004	HAMP Issue revised estimates based on testing	USACE
13 Aug 2004	HAMP Issue revised report	USACE
20 Aug 2004	HAMP Review to determine if contingency plan implementation is needed	USACE
31 Aug 2004	SIF Demonstration project report	PANYNJ

The milestone schedule will be updated for additional specific NYD HAMP milestones such as the demonstration project, internal review dates, etc. These revisions will be made prior end of December 2003.

APPENDIX A CONDITIONAL STATEMENT OF CONFORMITY, 3 APRIL 2002

DEPARTMENT OF THE ARMY
NEW YORK DISTRICT, CORPS OF ENGINEERS
JACOB K. JAVITS FEDERAL BUILDING
NEW YORK, N.Y. 10278-0090

REPLY TO
ATTENTION OF

CLEAN AIR ACT
CONDITIONAL STATEMENT OF CONFORMITY
NEW YORK AND NEW JERSEY HARBOR NAVIGATION PROJECT

Based on the conformity analysis performed as an amendment to the subject report, I have determined that the New York and New Jersey Harbor Navigation Project (HNP) can meet General Conformity provided that the impacts generated as a result of dredging and dredged material management activities are reduced through a combination of measures outlined in this statement before or during construction of the project. The U.S. Army Corps of Engineers (USACE) in partnership with the non-Federal project sponsor, the Port Authority of New York and New Jersey (PANYNJ), performed an emissions analysis (summarized in Marine and Land Based Mobile Source Emission Estimates for the 50 foot Deepening Project, 10 September 2001, revised 3 January 2002) and determined that due to construction activities of the project, both CO and NOx emissions will be significantly above the de minimus levels for General Conformity in severe ozone and moderate carbon monoxide nonattainment areas (NOx at 25 tpy and CO at 100 tpy). Any significant change in conditions to the Federal action would trigger a new conformity determination for the project.

USACE is committed to pursuing real reductions of emissions generated as a result of construction of the project, as technologies are available. As one means of addressing project related air emissions, USACE will explore and analyze several methods to reduce emissions from the HNP. A preliminary feasibility analysis (Initial Findings Report Emission Reduction Strategies for the New York/New Jersey Harbor Navigation Project, January 2002) has identified potential technologies that may be appropriate for use in the project, and percentage emissions reductions that have been achieved by those technologies elsewhere. Some technologies for possible use in the harbor could include:

1. Electric dredges. Electric dredges have been used in other ports and with shore power, can reduce maritime emissions associated with dredging to almost zero, although emissions from associated tender activities would still exist as would emissions at the land based generating facility. While there are materials (e.g. bedrock) in the HNP that are not amenable to the use of electric dredges, and areas where access to shore-power would be impractical or impossible, it may be possible to use them for some portion of the project.

2. The use of low sulfur diesel fuel in dredges, tugs, and other diesel-powered equipment has achieved 5% to 10% of particulates (PM) and Sulfur (not NOx) emission reductions in other locations. There is a high likelihood of making low-sulfur fuels available to the HNP. While the use of low sulfur diesel fuel in and of itself may not create a substantial reduction in emissions, most emission control technologies require its use.

3. The use of fuel additives to create diesel emulsions may also be a possibility during the later stages of construction, once their use has been approved. These formulated fuels have yielded modest emission reductions in demonstration projects in California.

4. Engine retrofits and filters are also a possibility for the equipment that will be used. Reductions ranging from 20% to 90% may be achievable, for various pollutants.

a. Particulate filters have been used on diesel-powered equipment and have achieved reductions of up to 90%.

b. Oxidation catalyst and diesel particulate filter retrofits have been used at other ports and have resulted in reductions in NOx (up to 75%), CO (from 60-90%), hydrocarbons (HC) (from 60-90%) and PM (from 20-50%).

The analyses to date are preliminary so the commitment to using particular technologies cannot be made at this point, and dredging equipment availability is uncertain at this time. A detailed assessment of alternative technologies and fuels for the construction and dredged material management equipment will be undertaken to identify those reduction measures which are most appropriate for implementation in the HNP. A pilot/demonstration project will be considered, as appropriate, to further evaluate or refine the more promising control technologies. It is recognized that the alternatives that are most appropriate may change over time, given advances in technologies that are expected to occur over the duration of the construction of the project. Furthermore, USACE will revisit the use of alternative technologies and fuels to reduce the emissions from dredges and tugs every year during the construction project. In addition, USACE will solicit ideas to achieve compliance from the dredging industry and port facility operators, and will have the industries implement these measures, where practicable. The PANYNJ will also consider means of achieving emissions reductions for each pollutant of concern for port facility equipment, as may be necessary, to reduce project emissions. The PANYNJ will commit to preparing a report that will include an emissions inventory for port equipment, and existing technologies to potentially reduce those emissions in support of the NYNJ Harbor Navigation Project General Conformity Determination. This inventory will become the basis of a study to investigate a grant program to assist Port tenants to decrease emissions from port equipment. This study will also identify funding sources for such a grant program. USACE will evaluate options on reducing emissions at their facilities as another way of reducing project impacts and will also examine logistical alternatives such as revised schedules and other project constraints that may help reduce overall emissions.

As another means of addressing project related air emissions, the USACE-PANYNJ performed a review of methodologies used by the nonattainment area States in calculating the marine vessel emissions portion of their overall emission inventories (Analysis of Marine Emission Estimates in the New York and New Jersey State Implementation Plans (SIP), September 2001). This review determined that the States' nonattainment area SIP's may be able to accommodate project emissions within the existing emissions inventory. In order to verify this possibility, USACE-PANYNJ will provide an updated marine vessel emissions inventory of the New York/New Jersey Harbor before construction of the 50- foot project. The new inventory will update the emissions in the harbor and, if accepted by the nonattainment area States, may be used for comparison against the existing marine vessel inventories to determine what portion of the project emissions may be accommodated. It is anticipated that the updated inventory and analysis of the results can be completed in sufficient time for the nonattainment area states to include them in the next major scheduled revision (s), (e.g. MOBILE6 and/or Mid Course Correction). An air emissions consultation committee will be formed and chaired by USACE for the project that will be comprised of representatives from USEPA, PANYNJ and the states of New York and New Jersey. The PANYNJ has committed to providing the affected States with the tools necessary by which they can update their marine vessel emissions inventory during the construction of the project. A new marine vessel inventory will be provided to the States one year after the completion of the project.

Another option for mitigating air quality impacts is pursuing the availability of existing emission credits (a preliminary analysis in New York and New Jersey indicates the availability of approximately 5000 NOx Emission Reduction Credits (ERCs), combined). USACE-PANYNJ will purchase available credits, as necessary, to mitigate all remaining project emissions, including coverage of the de minimus amount, that could not be reduced by other measures, or accommodated by the States in their SIPs.

This Statement of Conformity is conditional, since it is not feasible at this time for USACE to reasonably define either the annual emissions or proposed offset measures' emissions reduction potential. As this is a lengthy project, more accurate data on actual emissions will be collected, existing technologies will be evaluated, and new technologies to reduce emissions will be assessed during the life of this project (i.e. construction duration). USACE will commit to reduce, to the extent possible, to attain conformity, using the best available information, all emissions possible (to be determined by advancements in and approval of technology and credit availability) prior to construction of any project element.

The USACE will not proceed to construction of the 50-foot deepening project until such time that the project can demonstrate conformity under the General Conformity Rule. To continue to update and distribute the information collected as part of this ongoing conformity determination effort, USACE will perform supplemental conformity determinations, with detailed compliance plans as necessary, for each element of construction of the 12 year project and release Public Notices to notify interested parties and regulatory agencies of any changes to this conditional proposal. The tentative schedule for each element of construction will occur on an annual basis, at a minimum, and covers the Rate of Progress Years of 2005 and 2007, until construction is completed in 2016.

In summary, the USACE will achieve conformity for NOx and CO through offsetting of the project's emissions. Compensation will occur through the use of emission reduction technologies, where practical, the purchase of credits, operational modifications to reduce emissions, and through possible accommodation by the States in their SIPs.

3 April 2002
Date

for D. W. [signature], LTC, EJ
John B. O'Dowd
Colonel, U.S. Army
District Engineer

APPENDIX B PANYNJ KVK-5 TUGBOAT REPOWER PROGRAM DOCUMENTATION

This appendix contains the document, *Marine and Land-Based Mobile Source Emission Estimates & Statement of General Conformity for Contract 5 Deepening Project* (Starcrest 2002). Differences between the NOx emission estimates contained in this appendix and those presented in Section 2 of this report will be resolved with the publication of the next revision of this document.

Marine and Land-Based Mobile Source Emission Estimates & Statement of General Conformity for Contract 5 Deepening Project

16 January 2002

Prepared for:

United States Army Corps of Engineers, New York District
The Port Authority of New York & New Jersey

Prepared by:

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**NOTICE OF
ASSUMPTIONS USED IN THIS DOCUMENT**

- All marine emissions do not take into account any fleet turnover, marine engine rule, or any other emission reductions in out years and therefore should be considered base-case.
- All nonroad land-based equipment associated with the upland facilities is assumed to meet Tier 1 EPA nonroad engine standards. The nonroad modeling in the out years assumes no turnover or newer standard engines such as Tier 2 or 3 nor any other emission reductions in out years and therefore should be considered base-case.
- Dredge volumes and schedule provided by the Port Authority of New York & New Jersey.
- Dredged material transit emissions leaving the harbor were estimated to a distance of 3-mile off shore.

SUMMARY EMISSION ESTIMATES

The emissions associated with the Contract 5 Deepening Project (C5DP) are related to the dredging of sediment from the existing depth to 50 feet, below mean sea level. These transient emissions are planned to occur in the years 2002, 2003, and 2004. There are three major emission source types for this project which are: dredged material transit, the dredge and its support vessels, and the land-based nonroad construction equipment associated with the disposal of non Historic Area Remediation Site (HARS) sediments. These categories represent the direct and indirect emissions associated with the project. The pollutants estimated are volatile organic compounds (VOCs), oxides of nitrogen (NOx), carbon monoxide (CO), and particulate matter less than 10 microns (PM10). The annual estimated emissions for the entire project and by state, for each of these source types, by pollutant are presented in the following table.

Emission Sources	Emissions 2002	2003	2004
VOC			
Dredge Material Marine Transit Vessels	0.24	0.36	0.12
Dredge & Support Vessels	1.56	2.32	0.77
Land-Based Equipment & Vehicles	1.26	1.64	0.39
Total (tons)	**3.06**	**4.32**	**1.28**
(tpd)	0.01	0.01	0.00
New York (tons)	***1.53***	***2.16***	***0.64***
New Jersey (tons)	***1.53***	***2.16***	***0.64***
NOx			
Dredge Material Marine Transit Vessels	11.24	16.71	5.70
Dredge & Support Vessels	68.85	102.51	33.66
Land-Based Equipment & Vehicles	1.71	1.89	0.18
Total (tons)	**81.80**	**121.11**	**39.54**
(tpd)	0.22	0.33	0.11
New York (tons)	***40.90***	***60.56***	***19.77***
New Jersey (tons)	***40.90***	***60.56***	***19.77***
CO			
Dredge Material Marine Transit Vessels	2.16	3.21	1.09
Dredge & Support Vessels	12.99	19.32	6.33
Land-Based Equipment & Vehicles	8.57	11.20	2.62
Total (tons)	**23.72**	**33.73**	**10.04**
(tpd)	0.06	0.09	0.03
New York (tons)	***11.86***	***16.86***	***5.02***
New Jersey (tons)	***11.86***	***16.86***	***5.02***
PM10			
Dredge Material Marine Transit Vessels	0.26	0.39	0.13
Dredge & Support Vessels	1.78	2.67	0.88
Land-Based Equipment & Vehicles	0.10	0.11	0.01
Total (tons)	**2.14**	**3.17**	**1.02**
(tpd)	0.01	0.01	0.00
New York (tons)	***1.07***	***1.58***	***0.51***
New Jersey (tons)	***1.07***	***1.58***	***0.51***

tpd - tons per day

STATEMENT OF GENERAL CONFORMITY

The 1990 Clean Air Act Amendments include the provision of Federal Conformity, which is a regulation that ensures that Federal Actions (funding, permit, easements, etc.) conform with a nonattainment area's State Implementation Plan (SIP) thus not adversely impacting the area's progress toward attaining the National Ambient Air Quality Standards (NAAQS). The Federal Action in the case of the C5DP project is the permit issued by the United States Corps of Engineers (USACE) for the deepening of the channel from its existing authorized depth to 50 feet below mean sea level. There are two types of Federal Conformity: 1) Transportation Conformity and 2) General Conformity (GC). Transportation Conformity does not apply to the C5DP project because it is not funded with Federal Highway Administration money and does not impact the onroad transportation system. However, the C5DP project does trigger a GC review because of the permit for new dredging (the Federal Action). This review consists of evaluating the nonattainment pollutant(s) emissions from the project with prescribed trigger levels, which are based on the severity of the nonattainment area.

The C5DP occurs in the New York and New Jersey (NYNJ) Harbor, in the Kill Van Kull Federal channel. This area is designated as severe nonattainment for ozone (VOC and NOx are the regulated precursors) and moderate nonattainment for CO. The general conformity trigger levels for nonattainment area (as stipulated in 40 CFR 93 subsection 153 of the federal regulation dealing with conformity) are:

- 25 tons per year ozone (NOx and VOC)
- 100 tons per year CO

The C5DP triggers a general conformity determination as its estimated NOx emissions exceed 25 tons per year. A general conformity determination has to be completed to evaluate if the emissions are sufficient to prevent the nonattainment area from reaching attainment by 2007 (the area attainment deadline) or impede any of the rate of progress (ROP) years for the SIP. It is important to note that the emissions from this project are one-time, construction rather than permanent, new sources.

The ROP years for the New Jersey and New York SIPs are 2002 and 2005, again with attainment being accomplished by 2007. If construction occurs in 2002 through 2004, as planned, it is clear that with respect of the total annual estimated emissions from the C5DP, this project will have no impact on either a ROP year or the attainment deadline of 2007. The estimated peak emissions for each state in 2003 are 61 tons of NOx, which are regionally insignificant, temporary construction emissions. The New Jersey Department of Environmental Protection (NJDEP) has set a 2007 air shed emission limit of nearly 100,000 tons NOx a year[1]. These emissions will not, in any way, prevent the area from reaching its SIP ROP year milestones, as construction does not fall on those years. The projects emissions will not have any impact on the area's ability to achieve the NAAQS standard in 2007. Therefore, the project meets the GC requirements.

[1] Proposed SIP revision for the attainment & maintenance of the ozone NAAQS, 31 December 2000. NJDEP

BACKGROUND

Starcrest Consulting Group, LLC (Starcrest), was subcontracted under Killam Associates, for the Port Authority of New York and New Jersey (PANYNJ) to develop estimated emissions associated with the potential dredging activities associated with the C5DP of the Kill Van Kull channel in the NYNJ Harbor. The purpose of this study is to develop potential project related uncontrolled direct and indirect emission estimates based on the best available planning information and emission factors/estimating procedures currently available. Uncontrolled means that the emissions are estimated using only those regulations that are currently promulgated and do not take into account any proposed regulation, emission technology, or change in operational activities.

The C5DP involves the dredging of over 2.3 million cubic yards (cuyds) of sediment and rock to deepen the channel from 40 to 50 feet below mean sea level. This will happen through two contracts: 40–45 feet will be under a USACE contract and 45–50 feet will be accomplished under a PANYNJ contract. Based on past projects in the Kill Van Kull, an excavator dredge would be used. Estimated emissions are calculated for the following pollutants: VOC, NOx, CO, and PM10.

MATERIAL TYPES

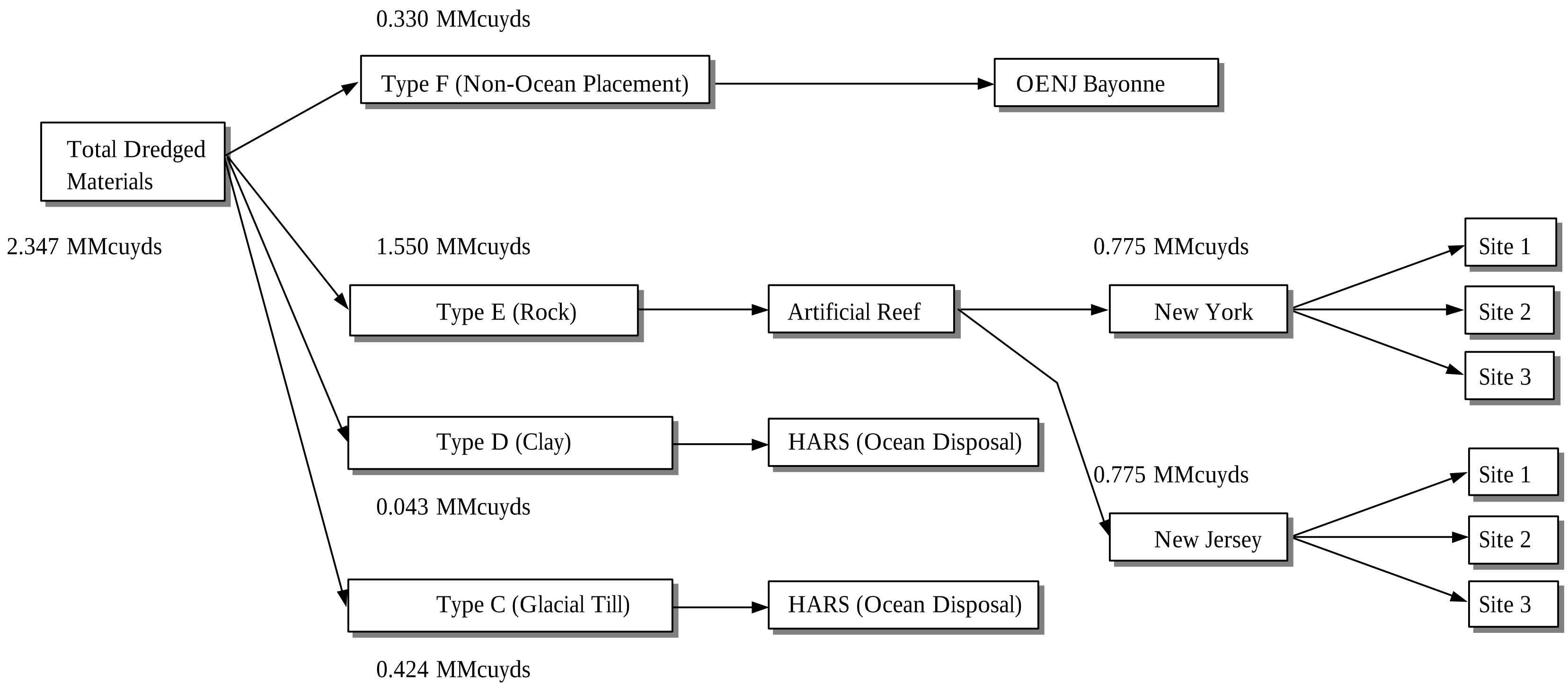
There are three types of materials that will be encountered during the dredging of C5DP which are described in the following table:

Material Type	Description
Type C	Glacial Till/Mixed HARS Suitable Material: Potentially suitable for HARS remediation or other beneficial uses.
Type D	Stiff Clay HARS Material: Potentially suitable for HARS, fill for habitat, restoration/creation, land remediation (e.g., landfill cover), etc.
Type E	Rock Material: Potentially suitable for fish reef creation or construction material.
Type F	Non-Ocean Placement Material: Potentially suitable for inshore placement in subaqueous pits, fill for habitat restoration/creation, land remediation or construction material.

DREDGED MATERIAL FLOW

The dredged material flow for the project was developed with the assistance of the PANYNJ and through conversations with those dredging companies most familiar with the dredging operations in the NYNJ Harbor.

The flow chart on the next page presents the dredged material flow and associated volumes for the project.


0.330 MMcuyds
Type F (Non-Ocean Placement)
OENJ Bayonne
Total Dredged Materials
2.347 MMcuyds
1.550 MMcuyds
Type E (Rock)
Artificial Reef
0.775 MMcuyds
New York
Site 1
Site 2
Site 3
Type D (Clay)
HARS (Ocean Disposal)
0.043 MMcuyds
0.775 MMcuyds
New Jersey
Site 1
Site 2
Site 3
Type C (Glacial Till)
HARS (Ocean Disposal)
0.424 MMcuyds

SOURCE TYPES

There are two categories of emission sources for the proposed project: marine and land-based sources.

The marine sources include:

- Dredges
- Tenders (Pushboats)
- Crewboats
- Dredged Material Transports (Towboats Moving Scows)

The land-based sources are broken into two categories, nonroad and onroad, and include:

Nonroad

- Excavators
- Material Transport Trucks/Haulers
- Loaders
- Compressors
- Material Handlers

Onroad:

- Employee Vehicles

Landside stationary sources associated with the OENJ Bayonne site are not included as they are presumed to be permitted under the appropriate State and Federal Clean Air Act regulations and thus already accounted for in the SIP.

MARINE SOURCES

The following sections detail how the potential marine emissions associated with the C5DP were estimated.

AVERAGE VESSEL PROFILE

In obtaining information for this study, emphasis was placed on conducting personal interviews with individuals having specific knowledge of the activities and/or equipment contributing to emissions associated with the proposed project. Dredge owners and operators from five dredging companies that are familiar with the NYNJ Harbor system were interviewed to determine the physical and operational characteristics of their dredging operations, such as operational schedules, support operations, engine and generator capacities, vessel speeds, and general dredging characteristics for a large-scale project. Information obtained from the dredging contractors was then averaged to determine representative values for each of the emission sources used in the calculations. A summary of the average vessel data is presented in the following table.

Type	Average Operational Engine Power						Average Operational Schedule		
	Auxiliary		Main Engine		Compressors		Auxiliary	Main Engine	Compressors
	hp	LF	hp	LF	hp	LF	hrs/day	hrs/day	hrs/day
Excavator D/H	350	0.40	3,000	0.50	N/A	N/A	24	18	N/A
Tender (Pushboat)	35	0.40	1,131	0.68	N/A	N/A	24	5	N/A
Crew Boat	N/A	N/A	425	0.50	N/A	N/A	24	9	N/A
Drill Barge	275	0.40	N/A	N/A	220	0.5	24	N/A	13
Upland Towboat	50	0.40	1,970	0.60	N/A	N/A	24	N/A	N/A
Ocean Towboat	50	0.40	3,500	0.60	N/A	N/A	24	N/A	N/A

Note: D/H – Diesel Hydraulic LF – Load Factor hp – horsepower hrs – hours N/A – Not Applicable
LF - average percentage of rated horsepower used during a source's operational profile.

Based on past dredging operations in the Kill Van Kull, it is reasonable to expect that the C5DP will utilize an excavator dredge. The average daily production rates for a typical NYNJ Harbor excavator dredge, from interviewing local dredge companies, are:

- Type C - 5,000 cuyds/day
- Type D - 5750 cuyds/day
- Type E - 5,000 cuyds/day
- Type F - 4,000 cuyds/day

The drill barge is used to drill to breakup rock in the channel so that the dredge can remove the rock. A drill barge's production rate in Type E is on average 2,500 cuyds/day.

Dredged material storage prior to transit from the dredge location is accomplished by the use of either an upland or ocean towboat towing/pushing a scow. There are two different types of scow, coastal (upland) and ocean; the difference being ocean scows have a greater material capacity.

Type	Material Capacity Cubic Yards	Average Speed (knots)
Hopper Dredge	3,500	10.5
Upland Scow	4,075	6.4
Ocean Scow	5,667	11.2

MARINE ENGINE EMISSION FACTORS

The emission factors for marine engines are provided below.

Pollutant	Engine Type	(g/kW-hr)	Emission Factors (lbs/hp-hr)	(tons/hp-hr)
VOC	Marine Propulsion	0.10	1.64E-04	8.22E-08
	Clamshell and Excavator Power	0.28	4.60E-04	2.30E-07
	Pushboat Propulsion, & Compressor	0.28	4.60E-04	2.30E-07
	Auxiliary	0.28	4.60E-04	2.30E-07
NOx	Marine Propulsion	13.36	0.022	1.10E-05
	Clamshell and Excavator Power	13.00	0.021	1.07E-05
	Pushboat Propulsion & Compressor	13.00	0.021	1.07E-05
	Auxiliary	10.00	0.016	8.22E-06
CO	Marine Propulsion	2.48	0.004	2.04E-06
	Clamshell and Excavator Power	2.50	0.004	2.06E-06
	Pushboat Propulsion & Compressor	2.50	0.004	2.06E-06
	Auxiliary	1.70	0.003	1.40E-06
PM10	Marine Propulsion	0.32	5.26E-04	2.63E-07
	Clamshell and Excavator Power	0.30	4.93E-04	2.47E-07
	Pushboat Propulsion & Compressor	0.30	4.93E-04	2.47E-07
	Auxiliary	0.40	6.58E-04	3.29E-07

Note: Pushboat Propulsion includes Dredge Tenders, Upland Towboats, & Open Towboats

Reference: EPA 199b, “Final Regulatory Impact Analysis: Control of Emissions from Compression Ignition Marine Engines” EPA420-R-99-026

ENGINE EMISSIONS

Engine emissions are calculated using the following equations:

Engine Emissions (Daily) = Engine Rating (hp) x LF x Average Daily Operation Hours x EF (tons/hp-hr)

Engine Emission (Hourly) = Engine Rating (hp) x LF x 1 hr x EF (tons/hp-hr)

DREDGING EMISSIONS BY MATERIAL TYPE

Dredge work group and support vessel configurations vary by material type. The following dredge vessel configurations were identified from interviews with dredging companies:

Material Type	Work Group Configurations
Type C, D, & F	Excavator, Tender (Pushboat), Crew Boat, Upland Towboat
Type E	Excavator, Tenders (Pushboats) (2), Crew Boat, Drill Boat (2), Ocean Towboat

The following equation are used to calculate daily emissions by material type:

Daily Emissions by Material Type (tons) = Sum of Vessel Engine Emissions by Work Group Configuration

The daily emissions calculations by dredge and material types are presented in the following tables (which includes two drill boats for Type E sediments):

Pollutant	Daily Emissions (tons) by Material Type			
	C	D	E	F
VOC	0.008	0.008	0.010	0.008
NOx	0.380	0.380	0.447	0.380
CO	0.072	0.072	0.084	0.072
PM10	0.009	0.009	0.011	0.009

Transit emission rates vary depending on material placement methods and locations. Hourly emission rates used in the calculations are presented in the following table.

Type	Hourly Emission Rate (tons)	
	Auxiliary	**Propulsion**
VOC		
Upland Towboat	4.568E-06	2.721E-04
Ocean Towboat	4.568E-06	4.833E-04
NOx		
Upland Towboat	1.631E-04	1.263E-02
Ocean Towboat	1.631E-04	2.244E-02
CO		
Upland Towboat	2.773E-05	2.429E-03
Ocean Towboat	2.773E-05	4.316E-03
PM10		
Upland Towboat	6.526E-06	2.915E-04
Ocean Towboat	6.526E-06	5.179E-04

DREDGING EMISSIONS

Dredging emissions are calculated using the following equations:

Average Dredge Daily Production Rate = Sum of (Daily Production Rates (by Dredge Type)) / Number of Dredges

Days Dredging = (Channel Volume x Percent Dredge Volume by Dredge Type) / Average Dredge Daily Production Rate

Daily Emissions by Dredge Type = Sum of Engine Emissions (Hourly)

Dredging Emissions = Days Dredging x Daily Emissions by Dredge Type

The following tables present the annual dredge volumes, by contract and total volume, associated with the C5DP.

Channel	Dredge Volumes 2002 cu yards	2003 cu yards	2004 cu yards	Total cu yards
USACE Contract (40' - 45')				
Kill Van Kull - Type C	212,000	212,000	0	424,000
Kill Van Kull - Type E	182,000	182,000	0	364,000
Kill Van Kull - Type F	29,500	29,500	0	59,000
PANYNJ Contract (45' - 50')				
Kill Van Kull - Type D	10,750	21,500	10,750	43,000
Kill Van Kull - Type E	296,500	593,000	296,500	1,186,000
Kill Van Kull - Type F	67,750	135,500	67,750	271,000
Project Total (40' - 50')				
Kill Van Kull - Type C	212,000	212,000	0	424,000
Kill Van Kull - Type D	10,750	21,500	10,750	43,000
Kill Van Kull - Type E	478,500	775,000	296,500	1,550,000
Kill Van Kull - Type F	97,250	165,000	67,750	330,000
Totals	**798,500**	**1,173,500**	**375,000**	**2,347,000**

DREDGED MATERIAL MARINE TRANSIT EMISSIONS

Potential transit emissions are estimated by first evaluating the annual material volumes that are provided by the PANYNJ. Based on these volumes, the number of material transits are estimated using transit vessel capacities, provided by the dredging contractors, and distances from the various channels to the appropriate remediation site.

Based on the number of transits, the annual mileage traveled is estimated. Mileage is based on the following factors: material type, remediation location of material type, and distance to dredged material placement location from the C5DP. The potential placement locations for each material type are assumed based on the information provided by the USACE and PANYNJ. The following table summarizes the potential dredged material placement locations assumed for each material type.

Material Type	Potential Dredged material Placement Location(s)
Type C	HARS (Ocean Remediation)
Type D	HARS (Ocean Remediation)
Type E	New York Artificial Reef New Jersey Artificial Reef
Type F	OENJ Bayonne

Once the dredged material transit mileage is calculated, the number of transit hours can be estimated based on an assumed average vessel speed, which was provided by the dredging contractors. Transit hours are subsequently converted to emissions estimates (tons).

Dredging material transit emissions are calculated using the following equations:

Dredged Material Trips = Channel Volume / Average Material Transport Capacity

Dredged Material Round Trip Mileage = Dredged Material Trips x (Middle Channel Distances to Placement Areas x 2)

Dredged Material Transit Hours = Dredged Material Transit Round Trip Mileage / Average Transit Speed (by Vessel Type)

Dredged Material Transit Emissions = Dredged Material Transit Hours x (Hourly Propulsion Emission Rate + Hourly Auxiliary Emission Rate)

Dredged Material Transit Trips, Dredged Material Round Trip Mileage, and Dredged Material Transit Hours by year for the C5DP is provided in Appendix A.

LAND-BASED EQUIPMENT

The following section discusses how emissions from land-based equipment associated with the C5DP have been estimated.

NONROAD ESTIMATION METHODOLOGY

Emissions from land-based nonroad equipment (does not include any stationary source onsite, as they are already permitted by the state) at the OENJ Bayonne remediation site were estimated using the same methodology and emission factor presented in the 50-foot Project. The nonroad emission factors are presented below.

Pollutant	Emissions tons/cuyd
VOC	1.658E-06
NOx	2.748E-05
CO	1.129E-05
PM10	1.584E-06

Reference: "Marine and Land-Based Mobile Source Emission Estimates for the 50-foot Deepening Project," 3 January 2002 Revised, Starcrest

The resulting nonroad emission estimates are presented in the following table.

Pollutant		Annual Nonroad Emissions Associated with Upland Remediation 2002	2003	2004
Type F	*(cuyds)*	*97,250*	*165,000*	*67,750*
VOC	(tons)	0.16	0.27	0.11
	(tpd)	0.00	0.00	0.00
NOx	(tons)	2.67	4.53	1.86
	(tpd)	0.01	0.01	0.01
CO	(tons)	1.10	1.86	0.76
	(tpd)	0.00	0.01	0.00
PM10	(tons)	0.15	0.26	0.11
	(tpd)	0.00	0.00	0.00

EMPLOYEE VEHICLES

Employee vehicles are considered an indirect emission source of the federal action. The emissions from the employee vehicles are considered insignificant (less than 1 ton of VOC, NOx, and PM), as the C5DP will have less than 40 people working at any one time associated with the dredging portion of the project. Therefore, the emissions associated with these vehicles have not been estimated. CO at intersections was found not to be an issue in the significantly larger 50-Foot Project, and therefore considered insignificant for the C5DP project as well.

APPENDIX A

Detailed Dredge Emission Estimates

The Port Authority of New York & New Jersey

Contract 5 - VOC Emission Estimates

(See Pages 9 & 11 for Equations)

	Days Dredging		
Channel/Sediment Type	**2002**	**2003**	**2004**
Kill Van Kull - Type C	42	42	0
Kill Van Kull - Type D	2	4	2
Kill Van Kull - Type E	96	155	59
Kill Van Kull - Type F	24	41	17

	VOC Emissions (tons) Excluding Dredged Material Transit Emissions		
Channel/Sediment Type	**2002**	**2003**	**2004**
Kill Van Kull - Type C	0.36	0.36	0.00
Kill Van Kull - Type D	0.02	0.03	0.02
Kill Van Kull - Type E	0.98	1.59	0.61
Kill Van Kull - Type F	0.20	0.35	0.14
VOC (tons)	***1.56***	***2.32***	***0.77***

	Dredged Material Transit Trips		
Channel/Sediment Type	**2002**	**2003**	**2004**
Kill Van Kull - Type C	37	37	0
Kill Van Kull - Type D	2	4	2
Kill Van Kull - Type E	117	190	73
Kill Van Kull - Type F	24	40	17

	Dredged Material Transit Round Trip Mileage		
Channel/Sediment Type	**2002**	**2003**	**2004**
Kill Van Kull - Type C	1,414	1,414	0
Kill Van Kull - Type D	72	143	72
Kill Van Kull - Type E	4,812	7,794	2,982
Kill Van Kull - Type F	86	146	184

	Dredged Material Transit Hours		
Channel/Sediment Type	**2002**	**2003**	**2004**
Kill Van Kull - Type C	110	110	0
Kill Van Kull - Type D	6	11	6
Kill Van Kull - Type E	375	607	232
Kill Van Kull - Type F	12	20	25

	VOC Emissions (tons)		
Channel/Sediment Type	**2002**	**2003**	**2004**
Kill Van Kull - Type C	0.05	0.05	0.00
Kill Van Kull - Type D	0.00	0.01	0.00
Kill Van Kull - Type E	0.18	0.30	0.11
Kill Van Kull - Type F	0.00	0.01	0.01

Total Transit VOC (tons)	**0.24**	**0.36**	**0.12**
Total Dredge VOC (tons)	**1.56**	**2.32**	**0.77**
Total VOC (tons)	**1.80**	**2.68**	**0.89**
(tpd)	**0.00**	**0.01**	**0.00**

The Port Authority of New York & New Jersey

Contract 5 - VOC Emission Estimates

Base Information for Dredging Emissions

Material Type

C - Glacial Till/Mixed HARS Suitable Material: Potentially suitable for HARS remediation or other beneficial uses.

D - Stiff Clay HARS Material: Potentially suitable for HARS, fill for habitat restoration/creation, land remediation (e.g., landfill cover), etc.

E - Rock Material: Potentially suitable for fish reef creation or construction material.

F - Non-Ocean Placement Material: Potentially suitable for inshore disposal in subaqueous pits, fill for habitat restoration/creation, land remediation or construction material.

Towboat/Pushboat Data

	Aux	Propulsion		Avg Scow Capacity
Area	tons/hr	tons/hr	mph	cuyds
Upland	4.568E-06	2.721E-04	7.3	4075
Ocean	4.568E-06	4.833E-04	12.8	5667

Dredge Working Group

Emissions			tons/day	
	C	D	E	F
Ex	0.01	0.01	0.010	0.01
Production			cuyds/day	
	C	D	E	F
Ex	5,000	5750	5,000	4,000

Ex - Excavator Dredge

The Port Authority of New York & New Jersey

Contract 5 - NOx Emission Estimates

(See Pages 9 & 11 for Equations)

Channel/Sediment Type	Days Dredging 2002	2003	2004
Kill Van Kull - Type C	42	42	0
Kill Van Kull - Type D	2	4	2
Kill Van Kull - Type E	96	155	59
Kill Van Kull - Type F	24	41	17

Channel/Sediment Type	NOx Emissions (tons) Excluding Dredged Material Transit Emissions		
	2002	2003	2004
Kill Van Kull - Type C	16.12	16.12	0.00
Kill Van Kull - Type D	0.71	1.42	0.71
Kill Van Kull - Type E	42.78	69.29	26.51
Kill Van Kull - Type F	9.24	15.68	6.44
NOx (tons)	***68.85***	***102.51***	***33.66***

Channel/Sediment Type	Dredged Material Transit Trips 2002	2003	2004
Kill Van Kull - Type C	37	37	0
Kill Van Kull - Type D	2	4	2
Kill Van Kull - Type E	117	190	73
Kill Van Kull - Type F	24	40	17

Channel/Sediment Type	Dredged Material Transit Round Trip Mileage 2002	2003	2004
Kill Van Kull - Type C	1,414	1,414	0
Kill Van Kull - Type D	72	143	72
Kill Van Kull - Type E	4,812	7,794	2,982
Kill Van Kull - Type F	86	146	184

Channel/Sediment Type	Dredged Material Transit Hours 2002	2003	2004
Kill Van Kull - Type C	110	110	0
Kill Van Kull - Type D	6	11	6
Kill Van Kull - Type E	375	607	232
Kill Van Kull - Type F	12	20	25

Channel/Sediment Type	NOx Emissions (tons) 2002	2003	2004
Kill Van Kull - Type C	2.49	2.49	0.00
Kill Van Kull - Type D	0.13	0.25	0.13
Kill Van Kull - Type E	8.47	13.72	5.25
Kill Van Kull - Type F	0.15	0.25	0.32

	2002	2003	2004
Total Transit NOx (tons)	**11.24**	**16.71**	**5.70**
Total Dredge NOx (tons)	**68.85**	**102.51**	**33.66**
Total NOx (tons)	**80.08**	**119.22**	**39.35**
(tpd)	**0.22**	**0.33**	**0.11**

The Port Authority of New York & New Jersey

Contract 5 - NOx Emission Estimates

Base Information for Dredging Emissions

Material Type

C - Glacial Till/Mixed HARS Suitable Material: Potentially suitable for HARS remediation or other beneficial uses.

D - Stiff Clay HARS Material: Potentially suitable for HARS, fill for habitat restoration/creation, land remediation (e.g., landfill cover), etc.

E - Rock Material: Potentially suitable for fish reef creation or construction material.

F - Non-Ocean Placement Material: Potentially suitable for inshore disposal in subaqueous pits, fill for habitat restoration/creation, land remediation or construction material.

Towboat/Pushboat Data

	Aux	Propulsion		Avg Scow Capacity
Area	tons/hr	tons/hr	mph	cuyds
Upland	1.631E-04	1.263E-02	7.3	4075
Ocean	1.631E-04	2.244E-02	12.8	5667

Dredge Working Group

Emissions			tons/day	
	C	D	E	F
Ex	0.38	0.38	0.447	0.38
Production			cuyds/day	
	C	D	E	F
Ex	5,000	5750	5,000	4,000

Ex - Excavator Dredge

The Port Authority of New York & New Jersey

Contract 5 - CO Emission Estimates

(See Pages 9 & 11 for Equations)

Channel/Sediment Type	Days Dredging 2002	2003	2004
Kill Van Kull - Type C	42	42	0
Kill Van Kull - Type D	2	4	2
Kill Van Kull - Type E	96	155	59
Kill Van Kull - Type F	24	41	17

Channel/Sediment Type	CO Emissions (tons) Excluding Dredged Material Transit Emissions 2002	2003	2004
Kill Van Kull - Type C	3.07	3.07	0.00
Kill Van Kull - Type D	0.14	0.27	0.14
Kill Van Kull - Type E	8.02	12.99	4.97
Kill Van Kull - Type F	1.76	2.99	1.23
CO (tons)	***12.99***	***19.32***	***6.33***

Channel/Sediment Type	Dredged Material Transit Trips 2002	2003	2004
Kill Van Kull - Type C	37	37	0
Kill Van Kull - Type D	2	4	2
Kill Van Kull - Type E	117	190	73
Kill Van Kull - Type F	24	40	17

Channel/Sediment Type	Dredged Material Transit Round Trip Mileage 2002	2003	2004
Kill Van Kull - Type C	1,414	1,414	0
Kill Van Kull - Type D	72	143	72
Kill Van Kull - Type E	4,812	7,794	2,982
Kill Van Kull - Type F	86	146	184

Channel/Sediment Type	Dredged Material Transit Hours 2002	2003	2004
Kill Van Kull - Type C	110	110	0
Kill Van Kull - Type D	6	11	6
Kill Van Kull - Type E	375	607	232
Kill Van Kull - Type F	12	20	25

Channel/Sediment Type	CO Emissions (tons) 2002	2003	2004
Kill Van Kull - Type C	0.48	0.48	0.00
Kill Van Kull - Type D	0.02	0.05	0.02
Kill Van Kull - Type E	1.63	2.64	1.01
Kill Van Kull - Type F	0.03	0.05	0.06

	2002	2003	2004
Total Transit CO (tons)	**2.16**	**3.21**	**1.09**
Total Dredge CO (tons)	**12.99**	**19.32**	**6.33**
Total CO (tons)	**15.15**	**22.53**	**7.43**
(tpd)	**0.04**	**0.06**	**0.02**

The Port Authority of New York & New Jersey

Contract 5 - CO Emission Estimates
Base Information for Dredging Emissions

Material Type

C - Glacial Till/Mixed HARS Suitable Material: Potentially suitable for HARS remediation or other beneficial uses.
D - Stiff Clay HARS Material: Potentially suitable for HARS, fill for habitat restoration/creation, land remediation (e.g., landfill cover), etc.
E - Rock Material: Potentially suitable for fish reef creation or construction material.
F - Non-Ocean Placement Material: Potentially suitable for inshore disposal in subaqueous pits, fill for habitat restoration/creation, land remediation or construction material.

Towboat/Pushboat Data

	Aux	Propulsion		Avg Scow Capacity
Area	tons/hr	tons/hr	mph	cuyds
Upland	2.773E-05	2.429E-03	7.3	4075
Ocean	2.773E-05	4.316E-03	12.8	5667

Dredge Working Group

Emissions			tons/day	
	C	D	E	F
Ex	0.07	0.07	0.084	0.07
Production			cuyds/day	
	C	D	E	F
Ex	5,000	5750	5,000	4,000

Ex - Excavator Dredge

The Port Authority of New York & New Jersey

Contract 5 - PM Emission Estimates

(See Pages 9 & 11 for Equations)

Channel/Sediment Type	Days Dredging 2002	2003	2004
Kill Van Kull - Type C	42	42	0
Kill Van Kull - Type D	2	4	2
Kill Van Kull - Type E	96	155	59
Kill Van Kull - Type F	24	41	17

Channel/Sediment Type	PM Emissions (tons) Excluding Dredged Material Transit Emissions 2002	2003	2004
Kill Van Kull - Type C	0.39	0.39	0.00
Kill Van Kull - Type D	0.02	0.03	0.02
Kill Van Kull - Type E	1.14	1.85	0.71
Kill Van Kull - Type F	0.23	0.38	0.16
PM (tons)	***1.78***	***2.67***	***0.88***

Channel/Sediment Type	Dredged Material Transit Trips 2002	2003	2004
Kill Van Kull - Type C	37	37	0
Kill Van Kull - Type D	2	4	2
Kill Van Kull - Type E	117	190	73
Kill Van Kull - Type F	24	40	17

Channel/Sediment Type	Dredged Material Transit Round Trip Mileage 2002	2003	2004
Kill Van Kull - Type C	1,414	1,414	0
Kill Van Kull - Type D	72	143	72
Kill Van Kull - Type E	4,812	7,794	2,982
Kill Van Kull - Type F	86	146	184

Channel/Sediment Type	Dredged Material Transit Hours 2002	2003	2004
Kill Van Kull - Type C	110	110	0
Kill Van Kull - Type D	6	11	6
Kill Van Kull - Type E	375	607	232
Kill Van Kull - Type F	12	20	25

Channel/Sediment Type	PM Emissions (tons) 2002	2003	2004
Kill Van Kull - Type C	0.06	0.06	0.00
Kill Van Kull - Type D	0.00	0.01	0.00
Kill Van Kull - Type E	0.20	0.32	0.12
Kill Van Kull - Type F	0.00	0.01	0.01
Total Transit PM (tons)	**0.26**	**0.39**	**0.13**
Total Dredge PM (tons)	**1.78**	**2.67**	**0.88**
Total PM (tons)	**2.04**	**3.05**	**1.02**
(tpd)	**0.01**	**0.01**	**0.00**

The Port Authority of New York & New Jersey

Contract 5 - PM Emission Estimates

Base Information for Dredging Emissions

Material Type

C - Glacial Till/Mixed HARS Suitable Material: Potentially suitable for HARS remediation or other beneficial uses.

D - Stiff Clay HARS Material: Potentially suitable for HARS, fill for habitat restoration/creation, land remediation (e.g., landfill cover), etc.

E - Rock Material: Potentially suitable for fish reef creation or construction material.

F - Non-Ocean Placement Material: Potentially suitable for inshore disposal in subaqueous pits, fill for habitat restoration/creation, land remediation or construction material.

Towboat/Pushboat Data

	Aux	Propulsion		Avg Scow Capacity
Area	tons/hr	tons/hr	mph	cuyds
Upland	6.526E-06	2.915E-04	7.3	4075
Ocean	6.526E-06	5.179E-04	12.8	5667

Dredge Working Group

Emissions			tons/day	
	C	D	E	F
Ex	0.01	0.01	0.012	0.01
Productior			cuyds/day	
	C	D	E	F
Ex	5,000	5750	5,000	4,000

Ex - Excavator Dredge

APPENDIX C MEETING NOTES FROM NYD DREDGE COMPANY PARTICIPATION MEETINGS

[Pending receipt of documentation from USACE]

APPENDIX D PANYNJ FACILITY EMISSION REDUCTIONS APPLICATION TO THE HDP

Port Facility Emission Reductions
PORT USER/TENANT ENCOURAGEMENT PROGRAM

Contingent on need, the Port Authority (PANYNJ) would develop a Port Facility Emission Reductions – Port User/Tenant Encouragement (PUTE) Program. This program would be an adjunct to the PANYNJ GreenPorts program. Baseline information from the cargo handling equipment emissions inventory that was completed as part of the cSOC could be used to provide the information identifying equipment providing the greatest emission offsets. The PANYNJ would work with tenants and Port users towards retrofitting, repowering and/or considering alternative fuels for facility equipment as appropriate.

Should any PANYNJ funding be involved it would be subject to Port Authority Board of Commissioners approval.

[PANYNJ is waiting for language approval from the Aviation Department.]

APPENDIX E PURINOX FACT SHEET

This document contains information obtained through phone interviews during the summer of 2003 with persons knowledgeable about the VFE PuriNOx, manufactured by Lubrizol Corporation, in terms of:

- Demonstrations conducted
- Delivery and schedule
- Pricing

Golden Gate Demonstration
(Contact: Mary Culnane, Water Transit Authority)

A Golden Gate Ferry PuriNOx demonstration was conducted for the San Francisco Bay Area Water Transit Authority: *Measurement of Air Pollutant Emissions from In-Service Passenger Ferries – Emissions Data Report* (Engine, Fuel and Emissions Engineering, Inc., August 2002). A copy of the report is available at:

http://www.watertransit.org/publications/technical_studies/EF&EE_Emission_Data_Report.pdf

A summary of the emission reductions achieved are shown below.

Golden Gate Ferry PuriNOx Project:
Percent Reduction in Emissions (%)

Operating Conditions	PM	NOx	CO	CO_2
High Speed Cruise	-64	-21	-68	-21
Idle Ahead in Gear	+90	-16	No change	-21
Idle Neutral	+40	-64	+42	-23
Stop and Go (transition)	-75	-23	-56	-20

There was an increase in PM at idle conditions; however, Lubrizol believes that increasing the engine revolutions per minute (rpm) at idle can eliminate this increase.

The Water Transit Authority contact that managed the demonstration is:

Mary Culnane
Manager, Marine Engineering
Water Transit Authority
120 Broadway
San Francisco, CA 94111
415.291.3377 x 3193
mailto:culnane@watertransit.org

Delivery/Schedule

Lubrizol has two sizes for tanks: 5 million gallon and 25 million gallon. The larger tank, if warranted, may be installed at the Newark, New Jersey base.

PuriNOx is currently manufactured at Lubrizol's Painesville Ohio plant and as such Sunoco/Lubrizol could deliver three to four million gallons immediately. It would take three to six months to permit and install the 25 million gallon tank. In the absence of a large volume order Sunoco is not yet willing to invest the $1.0 million necessary to install a blender at their Newark terminal.

Pricing
(contact: Bill Coughlin, Sunoco)

Pricing information was obtained as follows:

- <100,000 gallons per year: (80% of current low sulfur diesel [LSD] #2) + $1.12 per gallon, delivered to the New York City (NYC) harbor area, in tank truck quantities.
- >100,000 gallons per year: (80% of current LSD #2) + $0.72 per gallon, delivered to the NYC harbor area, in rail car quantities, delivered to a storage facility of customer's choice.

Low Sulfur Diesel #2 Pricing History

Month and Year	Price*
June 2003	$0.7555
May 2003	$0.7815
April 2003	$0.7945
March 2003	$1.07
February 2003	$1.23

**Does not include freight or tax*

- 5-10 million gallons/year (with blender): $0.50 per gallon (note that this is not the price above rack, but just a straight cost per gallon). This cost estimate is a prediction. The incremental cost ranges from $0.244 to $0.26 above rack depending on the annual volume delivered.

APPENDIX F PORT JERSEY STRATEGY REPORT

[Pending publication of the report from NJDOTOMR/PANYNJ]

APPENDIX G NYD GUIDANCE MEMORANDUM, 4 DECEMBER 2002

DEPARTMENT OF THE ARMY
NEW YORK DISTRICT, CORPS OF ENGINEERS
JACOB K. JAVITS FEDERAL BUILDING
NEW YORK, N.Y. 10278-0090

DEC 6 REC'D

REPLY TO ATTENTION OF

CENAN-PL-E

4 December 2002

MEMORANDUM FOR Commander, North Atlantic Division, ATTN: CENAD-CM-PL, Building 301, Fort Hamilton, Brooklyn, New York 11252

SUBJECT: Request for Air Quality Conformity Policy Guidance

1. We are pleased to outline New York District's (NYD) strategy to bring the New York & New Jersey Harbor Navigation Project (HNP) into compliance with the General Conformity Rule (GCR) of the Clean Air Act (CAA, attch.1). We request your concurrence of our use of the traditional Corps mitigation policy to achieve this goal.

2. The HNP is in a "severe non-attainment" region (attch. 2) for ozone precursor emissions. This means that project emissions, which average 305 tons/year, exceed the allowable limit of 25 tons per year. Since the State Implementation Plans (SIPs) of New York and New Jersey do not include the HNP in their baseline condition, New York District committed, in its Conditional Statement of Conformity (cSOC, April 2002), to bring the project into compliance and meet the limits set by the CAA by providing:

-Real emission reductions from project-related equipment and vessels, where feasible,
-Purchasing emission reduction credits (ERCs) and, if unable to achieve conformity,
-Request revising the SIPs to accommodate the HNP.

3. In order to accomplish CAA conformity, we propose to first seek to reduce project related emissions from the dredges, vessels and support equipment used during construction, using available technology where applicable. If unable to reduce real air emission to the required levels, we will then seek to purchase credits (as economically justified), as available and allowable under the CAA. As these measures are directly related to the project and are needed to be in compliance with a Federal act to reach construction, they will be cost-shared with the non-Federal partner.

4. Emissions that are not covered by the above actions will then be offset, as needed, to meet the CAA standards. Offsets are measures taken to reduce the level of NOx within the airshed to "mitigate" or offset emissions caused by the project. These offsets would also be necessary for compliance with the CAA and project construction and, therefore, cost-shared in the same manner as the project related direct emission reduction measures described above. The selected offsets would actually consist of a combination of measures based on cost-efficiency versus pollutant levels mitigated. They could include technical corrections to the SIPs based on data collected from a detailed Marine Inventory Study. The actions considered for selecting offsets would parallel the process used for traditional mitigation, which first tries to mitigate on

or near the impact site but allows for "offsite" mitigation within the watershed. In this case, the airshed will be substituted for the watershed, outlined as follows:

a. Offsets will first be sought for public facilities adjacent to the project area, beginning with those of our partner.

b. If unable to meet the necessary emissions levels from offsets adjacent to the project area, they will be sought within the larger airshed. These efforts will focus on public facilities within the harbor, but may look beyond its boundaries to encompass all of the airshed, as necessary, to meet conformity requirements of the CAA.

5. Those actions that the Corps would not have the means to directly implement would be undertaken by the partner with a credit being issued toward their share of the project cost. Any partner-related emission reduction activities that help bring the HNP into conformity will be cost shared, subject to the same cost-sharing formula used for the project as a whole.

6. Since USACE and DA guidance (attch.2) is facility-focused and not applicable to large civil works projects, we have developed the process outlined above to apply traditional mitigation strategies toward reducing and compensating for project impacts to addressing air impacts from the HNP. We believe this is an appropriate application of Corps policy and seek your concurrence and/or further guidance.

7. My POC is Mr. Mark Lulka, Project Biologist. He can be reached at (212) 264-5818.

L. Houston

for Frank Santomauro, P.E.
Chief, Planning Division

Attachments

APPENDIX H HQ APPROVAL, 23 DECEMBER 2002

DEPARTMENT OF THE ARMY
U.S. Army Corps of Engineers
WASHINGTON, D.C. 20314-1000

REPLY TO
ATTENTION OF:

DEC 23 2002

CECW-PD

MEMORANDUM FOR COMMANDER, NORTH ATLANTIC DIVISION

SUBJECT: Request for Air Quality Conformity Policy Guidance

We concur with CENAN-PL's approach to compliance with the General Conformity rule of the Clean Air Act. It is consistent with existing guidance in ER 1105-2-100, paragraph C-2. (c) and paragraph C-7.

FOR THE COMMANDER:

Encl

JAMES F. JOHNSON
Chief, Planning and Policy Division
Directorate of Civil Works

APPENDIX I MITIGATION ALTERNATIVE ASSUMPTIONS AND EXAMPLE CALCULATIONS

MITIGATION ALTERNATIVE #1

Mitigation Strategy	2002 (tons)	2003 (tons)	2004 (tons)	2005 (tons)	2006 (tons)	2007 (tons)	2008 (tons)	2009 (tons)	2010 (tons)	2011 (tons)	2012 (tons)	2013 (tons)
						Project Year						
EMISSIONS												
Estimated Project NOx Emissions	81.80	121.11	145.26	339.17	429.21	366.47	321.95	440.33	409.64	202.00	74.62	15.66
Tier IV Offset Credits NOx Reduced	95.68	95.68	95.68									
Tier II KVK Tug Repowering NOx Reduced			25.43	50.86	50.86	50.86	50.86	50.86	50.86	50.86	50.86	50.86
Tier 0 PJ Dredge Electrification NOx Reduced			67.40	115.26	54.91							
Tier 0 - Verified Fuel Emulsion NOx Reduced			3.00	105.43								
Tier I - SIF			1A	1A, 2B	3C							
NOx Reduced			12.60	204.40	618.80	854.00	854.00	854.00	854.00	854.00	854.00	854.00
NOx Remaining	**(13.88)**	**25.43**	**(58.85)**	**(136.78)**	**(295.36)**	**(538.39)**	**(582.91)**	**(464.53)**	**(495.22)**	**(702.86)**	**(830.24)**	**(889.20)**

COSTS	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	**Total**
Emissions Credits	$113,065												**$113,065**
KVK Tug Repower		$613,130											**$613,130**
PJ Electrification			$6,400,000										**$6,400,000**
Tier 0 - Verified Fuel Emulsion			$34,433	$1,209,067									**$1,243,501**
Tier I - SIF		$200,000	$981,777	$2,898,883	$3,199,542	$444,871	$444,871	$444,871	$444,871	$444,871	$444,871	$444,871	**$10,394,298**
Total Expenditure	**$113,065**	**$813,130**	**$7,416,210**	**$4,107,950**	**$3,199,542**	**$444,871**	**$444,871**	**$444,871**	**$444,871**	**$444,871**	**$444,871**	**$444,871**	**$18,763,994**
Tier 0 Adjustment Factor			0.80	0.80									

Notes:

- Tier II KVK-5 Tug Repowering: 25.43 tons NOx decremented in 2004 for 2003 short fall; 50.86 tons NOx per year is from the agreed projected emission reductions of the two tugboats selected for the KVK-5 repower project
- Tier 0 – Verified Fuel Emulsion: Assumes 80% use on HDP equipment for years 2004 & 2005
- Tier I – SIF: Assumes 1 Austen Class generating offsets for second half of 2004; 1 Austen full time and 1 Austen and 2 Barberi Class ferries generating emission offsets second half 2005; all Austen and Barberi Class ferries generating offsets full time and three Centennial Class second half of 2006; all ferries generating emission offsets 2007 through 2013

USACE NYD

HAMP MA#1 - Reduction Strategy & Costs Timelines

DRAFT

TOTAL COST EFFECTIVENESS ($/ton)

Tier IV - Emissions Credits	$394
Tier II - KVK Tug Repower	$1,269
Tier 0 - PJ Electrification	$26,939
Tier 0 - Verified Fuel Emulsion	$11,468
Tier I - Staten Island Ferries	$1,525

	Total	Project	
Total Cost	**$18,763,994**	**$18,763,994**	
Total Tons Reduced	**7,930**	**2,947**	**4,983**
Overall Cost Effectiveness	**$2,366**	**$6,367**	**per ton**

Tier I - SIF Fuel/Urea Assumptions

3,200,000	gallons SIF Fleet/year
457,143	diesel per boat/year
$0.06	per gal urea
$1,016	urea/ferry/year
$0.1368	ULSD[1]
1.00	% ULSD
$62,537	ULSD/boat/year

1 - Cost differential of ULSD vs nonroad diesel.
Cost provided by Bill Coglin, Sunoco

Tier I SIF - Baseline Emission & Cost Assumptions

Austen Class (A)		
Baseline Emissions	36	tons/year propulsion engines
SCR	70%	NOx reduction
Capital cost	$750,000	/ferry
O/M - Urea	$1,016	/year/ferry
O/M - Fuel	$62,537	/year/ferry
Barberi Class (B)		
Baseline Emissions	238	tons/year propulsion engines
SCR	70%	NOx reduction
Capital cost	$895,000	/ferry
O/M - Urea	$1,016	/year/ferry
O/M - Fuel	$62,537	/year/ferry
Centennial Class (C)		
Baseline Emissions	224	tons/year propulsion engines
SCR	70%	NOx reduction
Capital cost	$950,000	/ferry
O/M - Urea	$1,016	/year/ferry
O/M - Fuel	$62,537	/year/ferry
MJB Consulting	$200,000	per year (2003 - 5)

Example Calculations:

Total Cost Effectiveness (TCE)

TCE (Staten Island Ferries) = [ΣCapital Costs ($) + ΣO&M Costs ($)] / ΣTotal tons NOx Reduced
= [$6,140,000 + $4,254,298] / 6,813 total tons NOx reduced
= $1,525 / ton NOx reduced

Project Cost Effectiveness (PCE)

PCE (MA#1) = [ΣCapital Costs ($) + ΣO&M Costs ($)] / ΣProject tons NOx Reduced
= [$18,763,994] / 2,947 tons NOx reduced
= $6,367 / ton NOx reduced

Example Calculations (cont'd):

Tier 0 Verified Fuel Emulsion Emission Reductions (2005; assumes that PJ portion of HDP will not use VFEs)

NOx Emission Reductions (tons) = Tier 0 Adjustment Factor x [Estimated HDP Diesel Consumption (gallons) x VFE Fuel Consumption Factor] / 47,000 gals PuriNOx / ton NOx reduced]
= 0.80 x [5,267,000 gallons x 1.176] / 47,000 gals PuriNOx / ton NOx reduced]
= 105.43 tons NOx reduced

Tier 0 Verified Fuel Emulsion Costs (2005)

Costs = [Tier 0 Adjustment Factor x Estimated HDP Diesel Consumption (gallons) x VFE Fuel Consumption Increase Factor] x Incremental Cost/gallon PuriNOx
= [0.80 x 5,267,000 gallons x 1.176] x $0.244
= $1,209,067

Example Calculations (cont'd):

Tier I SIF Emission Reductions (2005)

NOx Emission Reductions (tons) = [1 ferry x Annual NOx emission reductions Austen Class x SCR efficiency] +
[1 ferry x Annual Adj (6/12) x Annual NOx emission reductions Austen Class x SCR efficiency] +
[2 ferries x Annual Adj (6/12) x Annual NOx emissions reductions Barberi Class x SCR efficiency]

where,

Annual NOx Emission Reductions Austen Class = Propulsion Engine Baseline Emissions from CMVEI = 36 tons NOx/year/ferry
Annual NOx Emission Reductions Barberi Class = Propulsion Engine Baseline Emissions from CMVEI = 238 tons NOx/year/ferry

= [36 tpy NOx x 0.70] + [0.5 x 36 tpy NOx x 0.70] + [2 x 238 tpy NOx x 0.70]
= 25.2 tpy NOx + 12.6 tpy NOx + 166.6 tpy NOx
= 204.4 tpy NOx reduced

Costs = [ΣCapital Costs ($) + ΣO&M Costs ($)] + $200,000 (PANYNJ contractor)

where,

ΣCapital Costs = Retrofit Costs for 1 Austen Class + Retrofit Costs for 2 Barberi = $750,000 + 2 x $895,000
= $2,540,000

ΣO&M Costs = [1.5 x (O/M fuel + O/M urea)] + [2 x Annual Adj x (O/M fuel + O/M urea)]

O/M Fuel = [Total SIF Fleet Fuel (gallons) / 7 ferries] x Incremental Cost of ULSD
= [3,200,000 / 7] x $0.1368/gallon
= $62,537 per ferry/year

O/M Urea = [Total SIF Fleet Fuel (gallons) / 7 ferries] x Urea Consumption Factor x Cost of Urea
= [3,200,000 / 7] x 0.04 x $0.06/gallon
= $1,016 per ferry/year

ΣO&M Costs = [1.5 x ($62,537 + $1,016)] + [2 x (6/12) x ($62,537 + $1,016)]
= $158,882

= [$2,540,000 + $158,882] + $200,000
= $2,898,883

MITIGATION ALTERNATIVE #2

Mitigation Strategy	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	Total
						Project Year							
	(tons)	(tons)	(tons)	(tons)	(tons)	(tons)	(tons)	(tons)	(tons)	(tons)	(tons)	(tons)	
EMISSIONS													
Estimated Project NOx Emissions	81.80	121.11	145.26	339.17	429.21	366.47	321.95	440.33	409.64	202.00	74.62	15.66	
Tier IV Offset Credits NOx Reduced	95.68	95.68	95.68										
Tier II KVK Tug Repowering NOx Reduced			25.43	50.86	50.86	50.86	50.86	50.86	50.86	50.86	50.86	50.86	
Tier 0 PJ Dredge Electrification NOx Reduced			67.40	115.26	54.91								
Tier 0 - Verified Fuel Emulsion NOx Reduced			0.75	79.07	217.34	231.81	213.12	320.07	285.21	116.27			
Tier II - VFE CHE NOx Reduced			20% TT 23.06	30.75	30.75								
Tier II - Tug Repower NOx Reduced			6 Tugs 75	150	150	150	150	150	150	150	150	150	
NOx Remaining	**(13.88)**	**25.43**	**(142.06)**	**(86.78)**	**(74.66)**	**(66.21)**	**(92.04)**	**(80.60)**	**(76.42)**	**(115.13)**	**(126.24)**	**(185.20)**	
COSTS													**Total**
Emissions Credits	$113,065												**$113,065**
KVK Tug Repower		$613,130											**$613,130**
PJ Electrification			$6,400,000										**$6,400,000**
Tier 0 - Verified Fuel Emulsion			$8,608	$906,800	$2,492,453	$2,658,421	$2,444,074	$3,670,588	$3,270,731	$1,333,371			**$16,785,048**
Tier II - VFE CHE			$331,834	$375,779	$375,779								**$1,083,392**
Tier II - Tug Repower			$2,160,000										**$2,160,000**
Total Expenditure	**$113,065**	**$613,130**	**$8,900,443**	**$1,282,579**	**$2,868,232**	**$2,658,421**	**$2,444,074**	**$3,670,588**	**$3,270,731**	**$1,333,371**	**$0**	**$0**	**$27,154,635**
Tier 0 Adjustment Factor			0.20	0.60	0.60	0.60	0.60	0.40	0.30	0.20			

Notes:

- Tier II KVK-5 Tug Repowering: 25.43 tons NOx decremented in 2004 for 2003 short fall; 50.86 tons NOx per year is from the agreed projected emission reductions of the two tugboats selected for the KVK-5 repower project
- Tier 0 - Verified Fuel Emulsion: Tier 0 Adjustment Factor (% of fleet that is to use the VFE) x Fuel Consumption of HDP project-related equipment per year. For example, in 2005, Tier 0 VFE assumes 60% of the HDP construction fleet (dredges, support vessels, and dredged material tugboats) will use VFEs.
- Tier II – VFE CHE: Assumes 20% of the terminal tractors (TT) identified in the PANYNJ CHE EI are converted to VFEs starting in April 2004 through 2006.
- Tier II – Tug Repower: Assumes six tugs will be repowered by mid 2004 generating emission offsets for half the year; all six tugs are assumed to be generating emission offsets annually from 2005 through 2013

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HAMP MA#2 - Reduction Strategy & Costs Timelines

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COST EFFECTIVENESS ($/ton)

Tier IV - Emissions Credits	$591
Tier II - KVK Tug Repower	$1,269
Tier 0 - PJ Electrification	$26,939
Tier 0 - Verified Fuel Emulsion	$11,468
Tier II - VFE CHE	$12,811
Tier II - Tug Repower	$1,516

	Total	Project	
Total Cost	**$27,154,635**	**$27,154,635**	
Total Tons Reduced	**3,981**	**2,947**	**1,034**
Overall Cost Effectiveness	**$6,821**	**$9,214**	**per ton**

Tier II Tug Repower Assumptions

Average reduction	25	tons NOx/towboat
Average repowering cost	$360,000	per towboat

Tier II VFE CHE Assumptions

Total TT Fuel Consump	6,145,000	gallons/year
Implementation Costs	$50,000	one time up front

Example Calculations:

Total Cost Effectiveness (TCE) - See Mitigation Alternative 1 for example calculation
Project Cost Effectiveness (PCE) - See Mitigation Alternative 1 for example calculation
Tier 0 Verified Fuel Emulsion Emission Reductions - See Mitigation Alternative 1 for example calculation
Tier 0 Verified Fuel Emulsion Costs - See Mitigation Alternative 1 for example calculation

Tier II VFE CHE Emission Reductions (2006)

NOx Emission Reductions = % TT Fleet to Use VFE x Total TT Fuel Consumption (gallons) x VFE Fuel Consumption Factor / 47,000 gallons/ton NOx reduced (PuriNOx)
= 20% x 6,145,000 gallons/year x 1.176 x 47,000 gallons/ton NOx reduced (PuriNOx)
= 30.75 tons NOx

Costs = [% TT Fleet to Use VFE x Total TT Fuel Consumption (gallon) x VFE Fuel Consumption Factor x Incremental Cost of VFE]
= [20% x 6,145,000 x 1.176 x $0.26]
= $375,779

Example Calculations (cont'd):

Tier II Tug Repower Emission Reductions (2004)

NOx Emission Reductions (tons) = # tugboats x Annual Adj. x Average Tug Reduction (tons NOx reduced/tugboat)
= 6 tugboats x (6/12) x 25 tons NOx/tugboat
= 75 tpy NOx reduced

Costs = # tugboats x average repowering costs/tug (from KVK-5 repower project)
= 6 x $360,000
= $2,160,000

MITIGATION ALTERNATIVE #3

						Project Year						
Mitigation Strategy	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
	(tons)	(tons)	(tons)	(tons)	(tons)	(tons)	(tons)	(tons)	(tons)	(tons)	(tons)	(tons)
EMISSIONS												
Estimated Project												
NOx Emissions	81.80	121.11	145.26	339.17	429.21	366.47	321.95	440.33	409.64	202.00	74.62	15.66
Tier IV Offset Credits												
NOx Reduced	95.68	95.68	95.68									
Tier II KVK Tug Repowering												
NOx Reduced			25.43	50.86	50.86	50.86	50.86	50.86	50.86	50.86	50.86	50.86
Tier 0 - PJ Electrification												
NOx Reduced			67.40	115.26	54.91							
Tier I - SIF			1A	1A, 2B	3C							
NOx Reduced			12.60	204.40	618.80	854.00	854.00	854.00	854.00	854.00	854.00	854.00
Tier II - Tug Repower			3 Tugs									
NOx Reduced			37.50	75.00	75.00	75.00	75.00	75.00	75.00	75.00	75.00	75.00
NOx Remaining	**(13.88)**	**25.43**	**(93.35)**	**(106.35)**	**(370.36)**	**(613.39)**	**(657.91)**	**(539.53)**	**(570.22)**	**(777.86)**	**(905.24)**	**(964.20)**

COSTS													**Total**
Emissions Credits	$113,065												**$113,065**
KVK Tug Repower		$613,130											**$613,130**
PJ Dredge Electrication			$6,400,000										**$6,400,000**
Tier I - SIF		$200,000	$981,777	$2,898,883	$3,199,542	$444,871	$444,871	$444,871	$444,871	$444,871	$444,871	$444,871	**$10,394,298**
Tier II - Tug Repower			$1,080,000										**$1,080,000**
Total Expenditure	**$113,065**	**$813,130**	**$8,461,777**	**$2,898,883**	**$3,199,542**	**$444,871**	**$444,871**	**$444,871**	**$444,871**	**$444,871**	**$444,871**	**$444,871**	**$18,600,493**

Notes:

- Tier II KVK-5 Tug Repowering: 25.43 tons NOx decremented in 2004 for 2003 short fall; 50.86 tons NOx per year is from the agreed projected emission reductions of the two tugboats selected for the KVK-5 repower project
- Tier I – SIF: Assumes 1 Austen Class generating offsets for second half of 2004; 1 Austen full time and 1 Austen and 2 Barberi Class ferries generating emission offsets second half 2005; all Austen and Barberi Class ferries generating offsets full time and three Centennial Class second half of 2006; all ferries generating emission offsets 2007 through 2013
- Tier II – Tug Repower: Assumes three tugs will be repowered by mid 2004 generating emission offsets for half the year; all three tugs are assumed to be generating emission offsets annually from 2005 through 2013

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HAMP MA#3 - Reduction Strategy & Costs Timelines

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COST EFFECTIVENESS ($/ton)	
Emissions Credits	$394
KVK Tug Repower	$1,269
Tier I - Staten Island Ferries	$1,525
Tier II - Tug Repower	$1,516
Tier 0 - PJ Electrification	$26,939

	Total	**Project**	
Total Cost	**$18,600,493**	**$18,600,493**	
Total Tons Reduced	**8,534**	**2,947**	**5,587**
Overall Cost Effectiveness	**$2,180**	**$6,311**	**per ton**

Tier I - SIF Fuel/Urea Assumptions

3,200,000	gallons SIF Fleet/year
457,143	diesel per boat/year
$0.06	per gal urea
$1,016	urea/ferry/year
$0.1368	ULSD[1]
1.00	% ULSD
$62,537	ULSD/boat/year

1 - Cost differential of ULSD vs nonroad diesel.
Cost provided by Bill Coglin, Sunoco

Tier I SIF - Baseline Emission & Cost Assumptions

Austen Class (A)		
Baseline Emissions	36	tons/year propulsion engines
SCR	70%	NOx reduction
Capital cost	$750,000	/ferry
O/M - Urea	$1,016	/year/ferry
O/M - Fuel	$62,537	/year/ferry
Barberi Class (B)		
Baseline Emissions	238	tons/year propulsion engines
SCR	70%	NOx reduction
Capital cost	$895,000	/ferry
O/M - Urea	$1,016	/year/ferry
O/M - Fuel	$62,537	/year/ferry
Centennial Class (C)		
Baseline Emissions	224	tons/year propulsion engines
SCR	70%	NOx reduction
Capital cost	$950,000	/ferry
O/M - Urea	$1,016	/year/ferry
O/M - Fuel	$62,537	/year/ferry
MJB Consulting	$200,000	per year (2003 - 5)

Tier II Tug Repower Assumptions

Average reduction	25	tons NOx/towboat
Average repowering cost	$360,000	per towboat

Example Calculations:

Total Cost Effectiveness (TCE) - See Mitigation Alternative 1 for example calculation
Project Cost Effectiveness (PCE) - See Mitigation Alternative 1 for example calculation
Tier I SIF Emission Reductions - See Mitigation Alternative 1 for example calculation
Tier I SIF Costs - See Mitigation Alternative 1 for example calculation
Tier II Tug Repower Emission Reductions - See Mitigation Alternative 2 for example calculation
Tier II Tug Repower Costs - See Mitigation Alternative 2 for example calculation

MITIGATION ALTERNATIVE #4

Mitigation Strategy	2002 (tons)	2003 (tons)	2004 (tons)	2005 (tons)	2006 (tons)	2007 (tons)	2008 (tons)	2009 (tons)	2010 (tons)	2011 (tons)	2012 (tons)	2013 (tons)	
						Project Year							
EMISSIONS													
Estimated Project NOx Emissions	81.80	121.11	145.26	339.17	429.21	366.47	321.95	440.33	409.64	202.00	74.62	15.66	
Tier IV - Emissions Credits NOx Reduced	95.68	95.68	95.68										
Tier II - KVK Tug Repower NOx Reduced			25.43	50.86	50.86	50.86	50.86	50.86	50.86	50.86	50.86	50.86	
Tier 0 - Verified Fuel Emulsion NOx Reduced					118.94	79.82		240.05	190.14				
Tier II - VFE CHE NOx Reduced			80% TT 113.52	151.36	151.36	151.36	151.36	30% TT 56.76	56.76				
Tier II - Tug Repower NOx Reduced			8 Tugs 100	200	200	200	200	200	200	200	200	200	
NOx Remaining	**(13.88)**	**25.43**	**(189.37)**	**(63.05)**	**(91.95)**	**(115.58)**	**(80.27)**	**(107.35)**	**(88.12)**	**(48.86)**	**(176.24)**	**(235.20)**	
COSTS													**Total**
Tier IV - Emissions Credits	$113,065												**$113,065**
Tier II - KVK Tug Repower		$613,130											**$613,130**
Tier 0 - Verified Fuel Emulsion					$1,453,430	$975,436		$2,933,461	$2,323,470				**$7,685,797**
Tier II - VFE CHE			$100,000	$1,503,116	$1,503,116	$1,503,116	$1,503,116	$563,669	$563,669				**$7,239,802**
Tier II - Tug Repower			$2,880,000										**$2,880,000**
Total Expenditure	**$113,065**	**$613,130**	**$2,980,000**	**$1,503,116**	**$2,956,546**	**$2,478,552**	**$1,503,116**	**$3,497,130**	**$2,887,139**	**$0**	**$0**	**$0**	**$18,531,794**
Tier 0 Adjustment					0.30	0.20		0.30	0.20				

Notes:

- Tier II KVK-5 Tug Repowering: 25.43 tons NOx decremented in 2004 for 2003 short fall; 50.86 tons NOx per year is from the agreed projected emission reductions of the two tugboats selected for the KVK-5 repower project
- Tier 0 - Verified Fuel Emulsion: Tier 0 Adjustment Factor (% of fleet that is to use the VFE) x Fuel Consumption of HDP project-related equipment per year. For example, in 2006, Tier 0 VFE strategy assumes 30% of the HDP construction fleet (dredges, support vessels, and dredged material tugboats) will use VFEs.
- Tier II – VFE CHE: Assumes 80% of the terminal tractors (TT) identified in the PANYNJ CHE EI are converted to VFEs starting in April 2004 through 2008 and then reduced to 30% of the TT fleet beginning in 2009 through 2010
- Tier II – Tug Repower: Assumes eight tugs will be repowered by mid 2004 generating emission offsets for half the year; all eight tugs are assumed to be generating emission offsets annually from 2005 through 2013

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HAMP MA#4 - Reduction Strategy & Costs Timelines

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COST EFFECTIVENESS ($/ton)

Tier IV - Emissions Credits	$394
Tier II - KVK Tug Repower	$1,269
Tier 0 - Verified Fuel Emulsion	$12,220
Tier II - VFE CHE	$8,697
Tier II - Tug Repower	$1,516

	Total	Project	
Total Cost	**$18,531,794**	**$18,531,794**	
Total Tons Reduced	**4,132**	**2,947**	**1,184**
Overall Cost Effectiveness	**$4,485**	**$6,288**	**per ton**

Tier II Tug Repower Assumptions

Average reduction	25	tons NOx/towboat
Average repowering cost	$360,000	per towboat

Tier II VFE CHE Assumptions

Total TT Fuel Consump	6,145,000	gallons/year
Implementation Costs	$100,000	on time up front

Example Calculations:

Total Cost Effectiveness (TCE) - See Mitigation Alternative 1 for example calculation
Project Cost Effectiveness (PCE) - See Mitigation Alternative 1 for example calculation
Tier 0 Verified Fuel Emulsion Emission Reductions - See Mitigation Alternative 1 for example calculation
Tier 0 Verified Fuel Emulsion Costs - See Mitigation Alternative 1 for example calculation
Tier II VFE CHE Emission Reductions - See Mitigation Alternative 2 for example calculation
Tier II VFE CHE Costs - See Mitigation Alternative 2 for example calculation
Tier II Tug Repower Emission Reductions - See Mitigation Alternative 2 for example calculation
Tier II Tug Repower Costs - See Mitigation Alternative 2 for example calculation

MITIGATION ALTERNATIVE #5

Mitigation Strategy	2002 (tons)	2003 (tons)	2004 (tons)	2005 (tons)	2006 (tons)	Project Year 2007 (tons)	2008 (tons)	2009 (tons)	2010 (tons)	2011 (tons)	2012 (tons)	2013 (tons)	Total
EMISSIONS													
Estimated Project NOx Emissions	81.80	121.11	145.26	339.17	429.21	366.47	321.95	440.33	409.64	202.00	74.62	15.66	
Tier IV Offset Credits NOx Reduced	95.68	95.68	95.68										
Tier II KVK Tug Repowering NOx Reduced			25.43	50.86	50.86	50.86	50.86	50.86	50.86	50.86	50.86	50.86	
Tier I - SIF			1A	1A, 2B	3C								
NOx Reduced			12.60	204.40	618.80	854.00	854.00	854.00	854.00	854.00	854.00	854.00	
Tier II - VFE CHE			70% TT										
NOx Reduced			99.33	132.44									
NOx Remaining	**(13.88)**	**25.43**	**(87.78)**	**(48.53)**	**(240.45)**	**(538.39)**	**(582.91)**	**(464.53)**	**(495.22)**	**(702.86)**	**(830.24)**	**(889.20)**	
COSTS													**Total**
Emissions Credits	$113,065												**$113,065**
KVK Tug Repower		$613,130											**$613,130**
Tier I - SIF		$200,000	$981,777	$2,898,883	$3,199,542	$444,871	$444,871	$444,871	$444,871	$444,871	$444,871	$444,871	**$10,394,298**
Tier II - VFE CHE			$1,036,420	$1,315,227									**$2,351,647**
Total Expenditure	**$113,065**	**$813,130**	**$2,018,196**	**$4,214,109**	**$3,199,542**	**$444,871**	**$444,871**	**$444,871**	**$444,871**	**$444,871**	**$444,871**	**$444,871**	**$13,472,140**

Notes:

- Tier II KVK-5 Tug Repowering: 25.43 tons NOx decremented in 2004 for 2003 short fall; 50.86 tons NOx per year is from the agreed projected emission reductions of the two tugboats selected for the KVK-5 repower project
- Tier I – SIF: Assumes 1 Austen Class generating offsets for second half of 2004; 1 Austen full time and 1 Austen and 2 Barberi Class ferries generating emission offsets second half 2005; all Austen and Barberi Class ferries generating offsets full time and three Centennial Class second half of 2006; all ferries generating emission offsets 2007 through 2013
- Tier II – VFE CHE: Assumes 70% of the terminal tractors (TT) identified in the PANYNJ CHE EI are converted to VFEs starting in April 2004 through 2004 through 2005.

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HAMP MA#5 - Reduction Strategy & Costs Timelines

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COST EFFECTIVENESS ($/ton)	
Tier IV - Emissions Credits	$394
Tier II - KVK Tug Repower	$1,269
Tier II - VFE CHE	$10,146
Tier I - Staten Island Ferries	$1,525

	Total	Project	
Total Cost	**$13,472,140**	**$13,472,140**	
Total Tons Reduced	**7,816**	**2,947**	**4,869**
Overall Cost Effectiveness	**$1,724**	**$4,571**	**per ton**

Tier I - SIF Fuel/Urea Assumptions	
3,200,000	gallons SIF Fleet/year
457,143	diesel per boat/year
$0.06	per gal urea
$1,016	urea/ferry/year
$0.1368	ULSD[1]
1.00	% ULSD
$62,537	ULSD/boat/year

1 - Cost differential of ULSD vs nonroad diesel.
Cost provided by Bill Coglin, Sunoco

Tier I SIF - Baseline Emission & Cost Assumptions		
Austen Class (A)		
Baseline Emissions	36	tons/year propulsion engines
SCR	70%	NOx reduction
Capital cost	$750,000	/ferry
O/M - Urea	$1,016	/year/ferry
O/M - Fuel	$62,537	/year/ferry
Barberi Class (B)		
Baseline Emissions	238	tons/year propulsion engines
SCR	70%	NOx reduction
Capital cost	$895,000	/ferry
O/M - Urea	$1,016	/year/ferry
O/M - Fuel	$62,537	/year/ferry
Centennial Class (C)		
Baseline Emissions	224	tons/year propulsion engines
SCR	70%	NOx reduction
Capital cost	$950,000	/ferry
O/M - Urea	$1,016	/year/ferry
O/M - Fuel	$62,537	/year/ferry
MJB Consulting	$200,000	per year (2003 - 5)

Tier II VFE CHE Assumptions		
Total TT Fuel Consump	6,145,000	gallons/year
Implementation Costs	$50,000	on time up front

Example Calculations:

Total Cost Effectiveness (TCE) - See Mitigation Alternative 1 for example calculation
Project Cost Effectiveness (PCE) - See Mitigation Alternative 1 for example calculation
Tier I SIF Emission Reductions - See Mitigation Alternative 1 for example calculation
Tier I SIF Costs - See Mitigation Alternative 1 for example calculation
Tier II VFE CHE Emission Reductions - See Mitigation Alternative 2 for example calculation
Tier II VFE CHE Costs - See Mitigation Alternative 2 for example calculation

MITIGATION ALTERNATIVE #6

Mitigation Strategy	2002 (tons)	2003 (tons)	2004 (tons)	2005 (tons)	2006 (tons)	2007 (tons)	2008 (tons)	2009 (tons)	2010 (tons)	2011 (tons)	2012 (tons)	2013 (tons)
						Project Year						
EMISSIONS												
Estimated Project NOx Emissions	81.80	121.11	145.26	339.17	429.21	366.47	321.95	440.33	409.64	202.00	74.62	15.66
Tier IV Offset Credits												
NOx Reduced	95.68	95.68	95.68									
Tier II KVK Tug Repowering												
NOx Reduced			25.43	50.86	50.86	50.86	50.86	50.86	50.86	50.86	50.86	50.86
Tier III - SCR on HD			1 HD		1 HD		1 HD					
NOx Reduced				25.04	49.67	26.81	14.83	49.67	37.02			
Tier II - VFE CHE			80% TT									
NOx Reduced			113.52	151.36	151.36	151.36	151.36	151.36	151.36			
Tier II - Tug Repower			9 Tug									
NOx Reduced			112.5	225	225	225	225	225	225	225	225	225
NOx Remaining	**(13.88)**	**25.43**	**(201.87)**	**(113.09)**	**(47.69)**	**(87.56)**	**(120.11)**	**(36.57)**	**(54.60)**	**(73.86)**	**(201.24)**	**(260.20)**

COSTS	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	**Total**
Tier IV Offset Credits	$113,065												**$113,065**
Tier II KVK Tug Repowering		$613,130											**$613,130**
Tier III - SCR on HD			$650,000	$192,824	$1,032,589	$206,448	$764,276	$382,589	$285,135				**$3,513,861**
Tier II - VFE CHE			$1,227,337	$1,503,116	$1,503,116	$1,503,116	$1,503,116	$1,503,116	$1,503,116				**$10,246,034**
Tier II - Tug Repower			$3,240,000										**$3,240,000**
Total Expenditure	**$113,065**	**$613,130**	**$5,117,337**	**$1,695,940**	**$2,535,705**	**$1,709,564**	**$2,267,392**	**$1,885,705**	**$1,788,251**	**$0**	**$0**	**$0**	**$17,726,090**

Notes:

- Tier II KVK-5 Tug Repowering: 25.43 tons NOx decremented in 2004 for 2003 short fall; 50.86 tons NOx per year is from the agreed projected emission reductions of the two tugboats selected for the KVK-5 repower project
-
- Tier III – SCR on HD: Assumes installation of SCR on 1 hopper dredge (HD) by end of 2004 with full emission reductions starting beginning of 2005; second HD retrofitted in 2006 with full emission reductions starting 2007; third HD retrofitted in 2008 with full emissions reductions starting 2009
- Tier II – VFE CHE: Assumes 80% of the terminal tractors (TT) identified in the PANYNJ CHE EI are converted to VFEs starting in April 2004 through 2010
- Tier II – Tug Repower: Assumes nine tugs will be repowered by mid 2004 generating emission offsets for half the year; all nine tugs are assumed to be generating emission offsets annually from 2005 through 2013

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HAMP MA#6 - Reduction Strategy & Costs Timelines

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COST EFFECTIVENESS ($/ton)

Emissions Credits	$394
KVK Tug Repower	$1,269
Tier 0 (III) - SCR on HD	$17,306
Tier II - VFE CHE	$10,029
Tier II - Tug Repower	$1,516

	Total	Project	
Total Cost	**$17,726,090**	**$17,726,090**	
Total Tons Reduced	**4,132**	**2,947**	
Overall Cost Effectiveness	**$4,290**	**$6,015**	**1,185 per ton**

Tier III - HD SCR Fuel/Urea Assumptions

$0.06	per gal urea
0.04	% urea to fuel
$0.1368	ULSD[1]
1.00	% ULSD

1 - Cost differential of ULSD vs nonroad diesel.
Cost provided by Bill Coglin, Sunoco

Tier II Emerging Technology (SCR on HDs) Assumptions

HD SCR		
Propulsion Engine	75%	of total HD NOx Emissions
SCR Efficiency	70%	NOx reduction
Capital cost	$650,000	/HD
O/M - Urea	=	0.04 x HD annual fuel consumption x $0.06
O/M - Fuel	=	HD annual fuel consumption x $0.1368

Tier II Tug Repower Assumptions

Average reduction	25	tons NOx/towboat
Average repowering cost	$360,000	per towboat

Tier II VFE CHE Assumptions

Total TT Fuel Consump	6,145,000	gallons/year
Implementation Costs	$100,000	on time up front

Example Calculations:

Total Cost Effectiveness (TCE) - See Mitigation Alternative 1 for example calculation
Project Cost Effectiveness (PCE) - See Mitigation Alternative 1 for example calculation
Tier I HD SCR Emission Reductions - See SIF example Mitigation Alternative 1 for example calculation
Tier I HD SCR Costs - See SIF example Mitigation Alternative 1 for example calculation
Tier II VFE CHE Emission Reductions - See Mitigation Alternative 2 for example calculation
Tier II VFE CHE Costs - See Mitigation Alternative 2 for example calculation
Tier II Tug Repower Emission Reductions - See Mitigation Alternative 2 for example calculation
Tier II Tug Repower Costs - See Mitigation Alternative 2 for example calculation

MITIGATION ALTERNATIVE #7

	Project Year											
Mitigation Strategy	**2002** (tons)	**2003** (tons)	**2004** (tons)	**2005** (tons)	**2006** (tons)	**2007** (tons)	**2008** (tons)	**2009** (tons)	**2010** (tons)	**2011** (tons)	**2012** (tons)	**2013** (tons)
EMISSIONS												
Estimated Project												
NOx Emissions	81.80	121.11	145.26	339.17	429.21	366.47	321.95	440.33	409.64	202.00	74.62	15.66
Tier IV Offset Credits												
NOx Reduced	95.68	95.68	95.68									
Tier II KVK Tug Repowering												
NOx Reduced			25.43	50.86	50.86	50.86	50.86	50.86	50.86	50.86	50.86	50.86
Tier I - SIF			1A	1A, 2B	3C							
NOx Reduced			12.60	204.40	618.80	854.00	854.00	854.00	854.00	854.00	854.00	854.00
Tier II - Tug Repower			6 Tugs									
NOx Reduced			75.00	150.00	150.00	150.00	150.00	150.00	150.00	150.00	150.00	150.00
NOx Remaining	**(13.88)**	**25.43**	**(63.45)**	**(66.09)**	**(390.45)**	**(688.39)**	**(732.91)**	**(614.53)**	**(645.22)**	**(852.86)**	**(980.24)**	**(1,039.20)**

COSTS													**Total**
Emissions Credits	$113,065												**$113,065**
KVK Tug Repower		$613,130											**$613,130**
Tier I - SIF		$200,000	$981,777	$2,898,883	$3,199,542	$444,871	$444,871	$444,871	$444,871	$444,871	$444,871	$444,871	**$10,394,298**
Tier II - Tug Repower			$2,160,000										**$2,160,000**
Total Expenditure	**$113,065**	**$813,130**	**$3,141,777**	**$2,898,883**	**$3,199,542**	**$444,871**	**$444,871**	**$444,871**	**$444,871**	**$444,871**	**$444,871**	**$444,871**	**$13,280,493**

Notes:

- Tier II KVK-5 Tug Repowering: 25.43 tons NOx decremented in 2004 for 2003 short fall
- Tier I – SIF: Assumes 1 Austen Class generating offsets for second half of 2004; 1 Austen full time and 1 Austen and 2 Barberi Class ferries generating emission offsets second half 2005; all Austen and Barberi Class ferries generating offsets full time and three Centennial Class second half of 2006; all ferries generating emission offsets 2007 through 2013
- Tier II – Tug Repower: Assumes six tugs will be repowered by mid 2004 generating emission offsets for half the year; all six tugs are assumed to be generating emission offsets annually from 2005 through 2013

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HAMP MA#7 - Reduction Strategy & Costs Timelines

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COST EFFECTIVENESS ($/ton)

Tier IV - Emissions Credits	$394
Tier II - KVK Tug Repower	$1,269
Tier II Tug Repower	$1,516
Tier I - Staten Island Ferries	$1,525

	Total	Project	
Total Cost	**$13,280,493**	**$13,280,493**	
Total Tons Reduced	**9,009**	**2,947**	**6,062**
Overall Cost Effectiveness	**$1,474**	**$4,506**	**per ton**

Tier I - SIF Fuel/Urea Assumptions

3,200,000	gallons SIF Fleet/year
457,143	diesel per boat/year
$0.06	per gal urea
$1,016	urea/ferry/year
$0.1368	ULSD[1]
1.00	% ULSD
$62,537	ULSD/boat/year

1 - Cost differential of ULSD vs nonroad diesel.
Cost provided by Bill Coglin, Sunoco

Tier I SIF - Baseline Emission & Cost Assumptions

Austen Class (A)		
Baseline Emissions	36	tons/year propulsion engines
SCR	70%	NOx reduction
Capital cost	$750,000	/SCR/ferry
O/M - Urea	$1,016	/year/ferry
O/M - Fuel	$62,537	/year/ferry
Barberi Class (B)		
Baseline Emissions	238	tons/year propulsion engines
SCR	70%	NOx reduction
Capital cost	$895,000	/SCR/ferry
O/M - Urea	$1,016	/year/ferry
O/M - Fuel	$62,537	/year/ferry
Constellation Class (C)		
Baseline Emissions	224	tons/year propulsion engines
SCR	70%	NOx reduction
Capital cost	$950,000	/SCR/ferry
O/M - Urea	$1,016	/year/ferry
O/M - Fuel	$62,537	/year/ferry
MJB Consulting	$200,000	per year (2003 - 5)

Tier II Tug Repower Assumptions

Average reduction	25	tons NOx/towboat
Average repowering cost	$360,000	per towboat

Example Calculations:

Total Cost Effectiveness (TCE) - See Mitigation Alternative 1 for example calculation
Project Cost Effectiveness (PCE) - See Mitigation Alternative 1 for example calculation
Tier I SIF Emission Reductions - See Mitigation Alternative 1 for example calculation
Tier I SIF Costs - See Mitigation Alternative 1 for example calculation
Tier II Tug Repower Emission Reductions - See Mitigation Alternative 2 for example calculation
Tier II Tug Repower Costs - See Mitigation Alternative 2 for example calculation

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