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New York District

DRAFT

General Design Memorandum

Passaic River
Flood Damage Reduction Project

Appendix E - Geotechnical Design
Levees, Floodwalls and Miscellaneous

September 1995

Vol. III of III

APPENDIX E

GEOTECHNICAL DESIGN

LEVEES, FLOODWALLS AND MISCELLANEOUS

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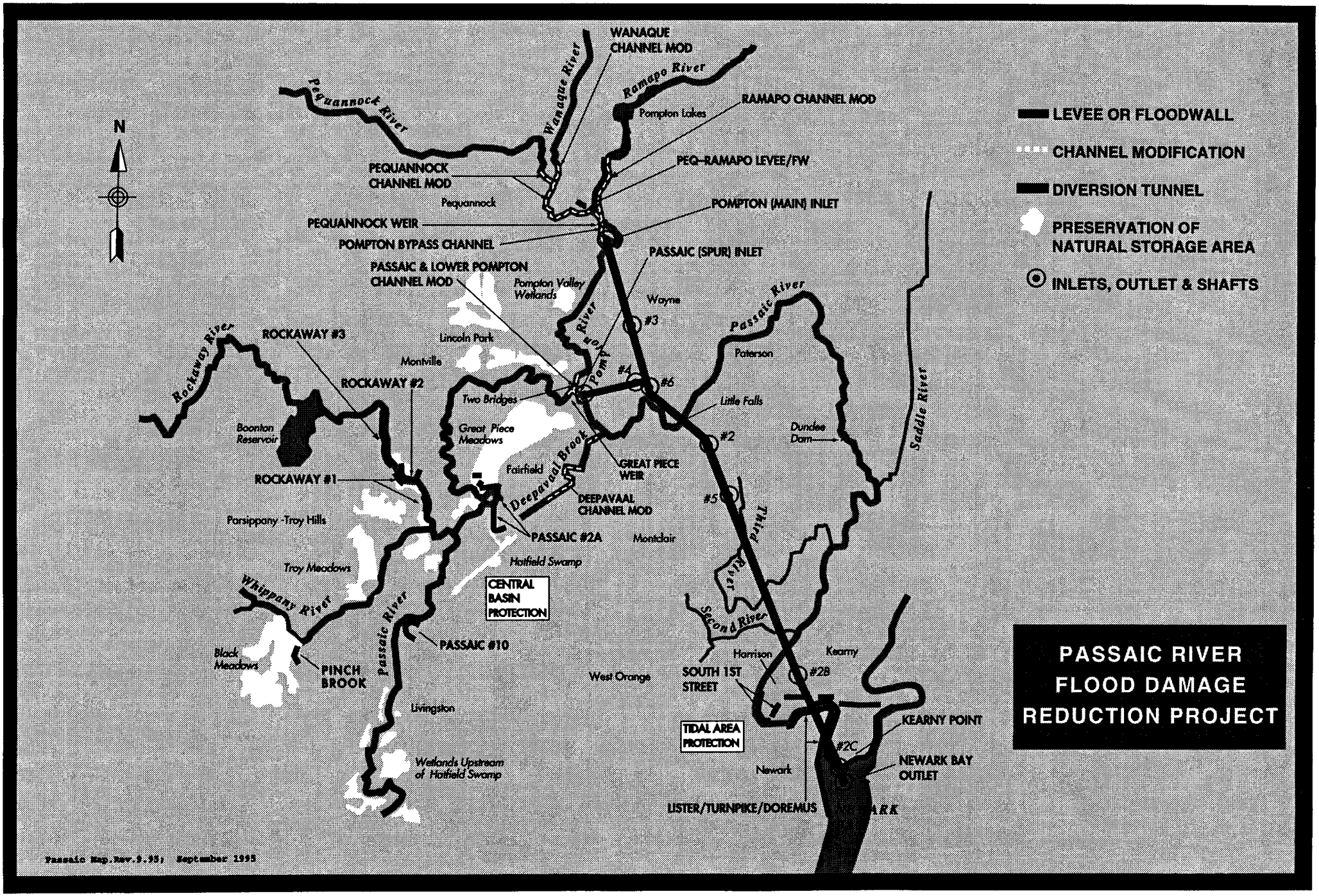
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SECTION 11

TIDAL AREA PROTECTION

11.1 SCOPE

The Tidal Area Protection system is designed to provide protection against the 100 year storm or flood event that would impact the residential, commercial and industrial properties located along the banks of the southern most reaches of the Passaic River and the western shore of the Hackensack River. The primary goal of this effort is to present a feasible design for the levee/floodwall systems from which a cost estimate may be developed. The municipalities affected include Harrison, Newark and the industrialized section of Kearny located on Kearny Point. The tidal area protection system for these areas has been divided into three sections for design and estimating purposes. The three sections are identified as the South First Street Levee/Floodwall System; the Lister/Turnpike/Doremus Levee/Floodwall System; and the Kearny Point Levee/Floodwall system. The geotechnical design features associated with each section are discussed separately below.

11.2 FEATURE DESCRIPTION

11.2.1 South First Street Levee/Floodwall System The South First Street levee/floodwall system would be situated on the left bank of the Passaic River in the Town of Harrison. The proposed levee/floodwall system would provide protection from tidal floods from the South Fourth Street bridge up to the New Jersey Transit rail bridge just south of the Route 280 bridge. A total of approximately 1,750' of levee with an average height of approximately 6.5' and an average base width of approximately 50' and 5,700' of floodwall averaging approximately 6.2' high would be required. A continuous line of protection would be provided by gated structures across Passaic Avenue and adjacent to South Fourth Street. River access and access to property on the east side of South 4th Street would be provided through gated structures at several sites adjacent to the Passaic River and South 4th Street. A total of approximately 7,450 linear feet of levee and floodwall with eight closure structures will be required for this section. An additional section of floodwall to prevent flanking runs north from high ground adjacent to Cape May Avenue to the Conrail bridge embankment. This section of

floodwall is approximately 1425 feet in length and contains two gated closure structures. See the accompanying site plan for the overall view of floodwall alignment and the location of the closure structures.

11.2.2 Lister, Turnpike, Doremus Levee/Floodwall Systems

These systems would lie on the right bank of the Passaic River and consist of floodwalls, levees and associated closure structures and would generally protect the industrial areas bounded by the Passaic River, Ferry Street and Freeman Street in Newark; the N.J. Turnpike; Route 1 & 9 in Newark; and the Conrail yards adjacent to Port Newark. The total system consists of approximately 5,599' of levee averaging approximately 5.5' in height with a base width of approximately 44' and approximately 17,657' of floodwall (including gated structures) averaging approximately 8.1 feet in height. Access to existing and future dock facilities would be provided through gated closure structures. Runoff from interior sections would be collected by interior drainage systems and removed by pumping stations.

The floodwall and levee will begin approximately at the intersection of Raymond Boulevard and Oxford Street in the City of Newark and continue on the right bank of the Passaic River to the Conrail rail embankment approximately 1,300' north of NJ Turnpike extension Newark Bay Bridge for a total distance of approximately 23,300'. The closure structures will provide access for existing and future docking facilities as well as protection from flanking. See the accompanying plans for an overall view of the floodwall system.

Protection from flanking of the levee system will require additional measures within the interior of the protected area. The tie-in at the Conrail embankment will continue along the Conrail embankment to the New Jersey Turnpike embankment where a small levee will be required between the two embankments. Topographic information obtained show that Wilson Avenue is approximately at Elevation 12 under the N.J. Turnpike resulting in a 3' high by $\pm$ 45' wide closure at the Wilson Avenue overpass to prevent flanking. An unnamed overpass 700' north of Wilson Avenue is being eliminated and fill placed to bring the area up to existing NJ Turnpike road grade as part of their widening project. An additional small closure or track raising may be needed at the Conrail underpass at Route 1 and 9 to the N.J. Turnpike embankment to complete the line of protection for the Lister/Turnpike/Doremus floodwall system. The available topography shows the low point in this area ranging from 14.2 to 14.6. See the Overall Layout U.S.G.S. composite map at the end of this section for locations of these structures.

11.2.3 Kearny Point Levee/Floodwall System

The Kearny Point Levee/Floodwall system would consist of approximately 3,908' of earthen levee and approximately 33,771' of concrete floodwall protecting an industrial area from tidal flooding on the left bank of the Passaic River around Kearny Point and upstream along the right bank of the Hackensack River in Kearny. Also included in this system are floodwalls and closures to protect the PATH train line from tidal flooding that would occur from both the Hackensack and Passaic Rivers. The levees have an average approximate height of 5' and approximate base width of 40'. The average floodwall height is approximately 7'. A continuous line of protection will be provided by several gated structures and will require the raising of Fish House Road. Present and future access to the river will be maintained by gated structures. Runoff behind the system would be collected by an internal drainage system and discharged by one pumping station.

PATH Line protection would begin in Harrison and consist of a small floodwall to protect the north PATH tracks. Another segment would be required in Kearny to also protect the north track. Protection of south PATH track would begin approximately 2,200' west of the NJ Turnpike bridge and continue east to the Conrail embankment.

The Kearny Point segment would begin at the Conrail embankment approximately 500' east of the NJ Turnpike bridge, continue south along the left bank of the Passaic River, proceed around Kearny Point, north along the right bank of the Hackensack River, and tie into a containment berm on PSE&G property. The floodwall will begin again on the north side of the containment berm and continue east to the proposed raised Fish House Road. The floodwall will begin again on the north side of the raised road, cross the Transco Gas pipelines and proceed east. The floodwall will change direction to north, cross an existing roadway and tracks with gated structures and terminate in the Conrail embankment. The final segment of floodwall will proceed west for approximately 905' from high ground to high ground adjacent to the Conrail tracks. Embankment protection is proposed for the Conrail railroad embankment to insure that it is impervious to floodwater. See the accompanying plans for an overall view of the proposed layout.

11.3 SUBSURFACE INVESTIGATION

Test borings were performed for each of the three levee/floodwall systems. Boring HLS-1 was drilled for the South First Street system; borings HLL-1, HLD-1 and HLD-2 were drilled

for the Lister/Turnpike/Doremus system; and HLK-1 through HLK-5 were drilled for the Kearny Point system. Additional subsurface data from test borings previously performed for the USACE within the immediate vicinity of the proposed levee/floodwall systems was also utilized in developing generalized site soil stratigraphy. This data includes borings DC-5 and C-146. Representative soil samples were obtained from the test borings drilled for the current investigation in accordance with the procedures of the standard penetration test. Undisturbed tube samples of sensitive soils were also obtained from boring HLK-1 for subsequent laboratory testing. Borings HLS-1, HLK-1 and HLK-3 were advanced to the top of rock and drilling terminated; borings HLL-1, HLK-4, DC-5 and C-146 were also core drilled into rock for sampling related to the flood tunnel design and construction. All other borings were advanced and drilling terminated within the overburden soils. The borings were generally located within the immediate vicinity of the proposed levee/floodwall alignment or as close as site constraints and access would permit. Refer to project site plans for the approximate boring locations, Plates 11.1 thru 11.13 Individual boring logs are included at the end of this section.

A much more extensive subsurface investigation program will be required during FDM studies. Roughly 100 to 200 additional borings will be required along the nearly 13 miles of floodwall/levee.

11.4 SITE GEOLOGY

The general area surrounding the alignment of the levee/floodwall systems formerly existed as tidal mud flats and marsh lands bordering the Passaic and Hackensack Rivers and the northern reach of Newark Bay. Subsequent industrial development along the waterfront has resulted in substantial fill placement throughout these areas to accommodate construction. Consequently, the natural soils throughout the alignment of the proposed levee/floodwall system are overlain by a layer of highly variable fill materials typically on the order of 10 to 20 feet in thickness. Based on the results of the subsurface investigation the underlying natural soil stratigraphy can be summarized as recent deposits of organic silts, clays and occasional peat layers underlain in descending order by alluvial silts and silty sands, glacial laucustrine silts and clays, and dense granular glacial till extending to rock. The underlying bedrock is identified as the Brunswick Formation and generally consists of bedded shales, siltstones and sandstones. The

general composition of each stratum encountered in the test borings is described below in descending order. A subsurface profile of the soil stratigraphy is presented on Plates 11.14 through 11.15.

(1) Fill:

Predominantly granular soils variably intermixed with silt, clay, decaying organic matter, and miscellaneous debris including wood, metal and general building demolition rubble. Because of their uncontrolled placement, these material varied from loose to dense in their degree of relative density.

(2) Organic Silt, Clay and Peat:

Soft recent estuarine deposits of organic silts and clays that have accumulated in old river channels and on fluvial sands and varved silts and clays. This stratum was noted to range from approximately 5 to 18 feet in thickness though thicker deposits are likely. Isolated layers of peat were also noted within this stratum.

(3) Alluvial Silts and Silty Sands:

Medium dense silts and silty sands, with traces of gravel deposited as alluvial sediments on top of the laucustrine silts and clays. These materials were encountered in borings HLL-1, HLS-1, HLD-1, HLK-1 and HLK-4 and typically ranged from about 4 to 15 feet in thickness. In boring HLS-1 and HLK-4, this stratum consisted primarily of dense sand.

(4) Glacial Laucustrine Silts and Clays:

Generally medium to stiff varved deposits consisting of alternating layers of silt, clay, and occasionally very fine sand. In some areas (borings HLK-3, 4 and 5) the upper 10 to 20 feet of this stratum has been desiccated forming a very stiff crust, in other areas (HLK-1) the crust has been eroded. In borings HLS-1 and HLL-1, the laucustrine deposits were not encountered.

(5) Glacial Till:

The glacial till consists of ground moraine deposits of dense sand, gravel, silts and clay with variable amounts of cobbles and boulders. The glacial till was encountered in all borings and typically extended to rock. In borings HLL-1 and

HLS-1, the upper portions of the glacial soils consisted of fluvially deposited silts and poorly graded fine sands grading to coarser grained till materials with depth.

11.5 LABORATORY SOIL TESTING

Three undisturbed tube samples were obtained from boring HLK-1 within the alluvial silty sands (sample #1) and the laucustrine silts and clays (samples #2 and 3). The standard penetration test data from this boring indicated these materials were generally looser/softer than other areas investigated and were selected for testing assuming they represented the poorest soil conditions. All laboratory test results are included at the end of Section 11; the design soil strength parameters are discussed in the next section.

11.5.1 Triaxial Shear Test Each of the undisturbed samples were subjected to unconsolidated undrained triaxial shear testing for determination of the undrained strength of these soils. Additionally, a consolidated undrained shear test with pore pressure measurements was also performed on sample #3, obtained from boring HLK-1 at a depth of about 35 feet, for an estimation of the drained strength properties. The Atterberg limits were also determined for each of the samples obtained and the results included on the Triaxial Shear Test laboratory test reports.

11.5.2 Consolidation Test For estimation of the consolidation settlement properties of the laucustrine silts and clays, a consolidation test was performed on an undisturbed sample taken at a depth of 28 to 31 feet from Boring HLK-1. Undisturbed samples of the organic stratum were not obtained in this investigation. However, consolidation test data for these materials had been previously determined by the USACE for the Newark Streambank Restoration Project to be located across the Passaic River from the proposed South First Street levee/floodwall system. This data was used for the tidal area protection levees in estimating future consolidation settlement of the organic soils.

11.6 DESIGN PARAMETERS

The soil strengths, unit weights and plasticity index for the various strata used in the design of the tidal area protection levees and floodwalls are summarized below in Table 1. The design analyses for the levee/floodwall system considered both the undrained and drained soil strength conditions. The values indicated in the table were based on the results of the laboratory testing program and the subsurface investigation.

TABLE 1
SOIL STRENGTH PARAMETERS

Material	Unit Weight (PCF)	Plasticity Index	Friction Angle (Degrees)	Cohesion (PSF)	Friction Angle (Degrees)	Cohesion (PSF)
			Undrained	Undrained	Drained	Drained
Levee Fill	125	-	32	-	32	-
Existing Fill	120	-	28	-	28	-
Organic Soils	100	48	-	300	23	-
Alluvial Silty Sands	120	8	20	350	28	-
Dense Silty Sands	120	-	34	-	34	-
Silts & Clays	120	12-15	-	600	8	1000
Glacial Till	125	-	40	-	40	-

For the design of sheet pile floodwall structures, active, passive and at-rest earth pressure coefficients were determined based on the assigned soil friction angle for the undrained or drained conditions. Table 2 lists the earth pressure coefficients for each soil strata used in the design of the various floodwalls and special structures.

TABLE 2
EARTH PRESSURE COEFFICIENTS

Material	Friction Angle (Degree)	Active Pressure (Ka)	Passive Pressure (Kp)	At-Rest Pressure (Ko)
Existing Fill	28	0.36	2.77	0.53
Organic Soils	23 (drained)	0.44	2.28	0.61
Alluvial Silty Sands	28 (drained)	0.36	2.77	0.53
Dense Silty Sands	34	0.28	3.54	0.44
Silts & Clays	8 (drained)	0.75	1.32	0.86
Glacial Till	40	0.22	4.60	0.36

Consolidation settlement of the organic soils and the laucustrine silts and clays was evaluated for the construction of the various levee embankments proposed for each system. The consolidation properties for these strata were determined from the consolidation tests performed on the recovered undisturbed samples. The results of the consolidation tests for both strata are summarized below in Table 3.

TABLE 3
CONSOLIDATION SETTLEMENT DATA

Material	Initial Void Ratio eo	Compression Index Cc	Stress Increase (PSF)
Organic Soils	1.46	0.45	1000
Silts & Clays	0.94	0.18	1000

Estimated settlements for each of the levee systems will vary depending on the levee height and actual soil stratigraphy. Based on the available field and laboratory data; estimated settlements for an eight feet high levee would range from approximately 4 to 9 inches for the three systems.

11.7 DESIGN ALTERNATIVES

The subsurface soil conditions throughout all three levee/floodwall systems can be generally considered as poor for support of levees or sheetpile I-walls. The soft organic and laucustrine soil deposits present stability problems for levee construction and will require deep penetration depths for sheetpiled floodwalls. Accordingly, levees were located in areas where adequate land was available along the waterfront for stability; otherwise, floodwalls were utilized where constrained by existing structures or utilities along the river. The design details of each flood control structure are discussed further below.

Specialized flood control structures will be required at three locations within the Kearny Point system and at three locations within the Lister/Turnpike/Doremus system. The special structures include cantilever box piling, cellular cofferdams and conventional sheetpile I-Walls installed within a cement bentonite slurry trench. Each structure is discussed in further detail below.

Included in the tidal area protection levee/floodwall system are gated closure structures which will permit access to riverfront facilities and will enable unimpeded operation of railways, roads and pedestrian walkways that will be crossed by the levees or floodwalls. The closure structures have been designed with typical gate widths of 15, 25 and 30 feet and double gate widths of 50 and 60 feet. Geotechnical design details of the closure structures are discussed further below.

11.7.1 Levees

Based on the stability analyses performed for the critical loading and flood stage conditions, the riverside toe of all levees must be at least 80 feet from the edge of any existing bulkhead structure for adequate stability. For sloping river embankments without bulkheads, docks or wharf structures, the riverside toe of levees must be at least 30 feet from the top edge of the riverbank for proper stability. The area beneath the entire levee footprint will be stripped to a minimum depth of 6 inches to remove all vegetation and other objectionable materials. Then, prior to construction of the levees, a roughly 6 foot deep inspection trench would be excavated along centerline of the levee alignment for evaluation of the existing fill and removal of any unsuitable materials. The inspection trench would be fully backfilled with the excavated material and compacted to at least in-situ density. Refer to the accompanying plans for a typical construction detail of the levee.

Fill materials for the levees would consist of clays or clayey sands with a minimum plasticity index (PI) of 7 and a minimum of 25 percent fines by weight passing the number 200 sieve. If fill with suitable piping resistance is not available, a 3 ft. thick riverside clay blanket will be placed to control throughseepage. All fill would be placed in maximum 12 inch thick loose lifts and compacted to at least 90 percent of the material's standard proctor density. The levees would be constructed with three horizontal to one vertical (3H:1V) side/slopes and a 10 foot wide emergency access road at the top. It is currently assumed that the levee fill would be obtained from a commercial borrow source.

Alternatively, excavated tunneling spoils (tunnel muck) may also be used for levee embankments provided a 3' thick cover of clay and/or silty clay is placed and compacted on the embankment surface. The availability of suitable clay materials will be investigated further during FDM studies.

11.7.1.1 Existing Embankments

Several sections of levees and floodwalls within each of the tidal area protection systems terminate within existing railroad or roadway embankments. In some cases, these embankments are incorporated into the adjoining levees and floodwalls to provide the design level of flood protection. Specific areas where existing embankments will be used in the flood protection system are listed below:

System	Area
South First Street	South 4th St. Bridge Approach Embankment, Sta. 63+00
Lister, Turnpike, Doremus	Conrail Railroad Embankment, Sta. 243+00
Kearny Point	PATH Train Railroad Embankment, Northeast Corner

The existing embankments to be utilized within the South First Street and Lister, Turnpike, Doremus systems are large enough in width (120 to 240 feet minimum) such that seepage paths are extended and landside exit gradients are within acceptable limits established by the USACE. Since these embankments provide structural support of active roads and railways, it can be reasonably assumed that they consist of well compacted granular fill materials that are inherently stable and moderately resistant to piping and through seepage. Erosion of these embankments during flood periods is also anticipated to be minimal since they act only in preventing flanking of the flood protection system and will experience negligable stream flow velocities. All existing embankments to be utilized within the tidal area protection system are well above the design flood level of Elevation 14.9 which includes the additional height or freeboard requirement recommended by the USACE. A more comprehensive study of the embankment materials will be performed for the FDM to verify the stability, piping and through seepage assumptions discussed above.

Existing railroad (PATH Train) embankments located at the northern end of the Kearny Point Levee/Floodwall system will require special riverside surface protection to provide adequate throughseepage resistance. The embankments are assumed to consist primarily of crushed stone ballast which is fairly pervious. In areas where adequate space is available, a 3 foot (minimum) thick clay blanket would be placed in compacted lifts over the floodside slope of the embankment. To facilitate placement and prevent erosion, the clay blanket would be placed to create a 3H:1V slope along the embankment. Alternatively, where space or access is limited, a 4 inch thick unreinforced concrete paving surface would be constructed on the existing embankment slope. To limit underseepage, the concrete surfacing would extend to approximately 2 feet below existing grades. It is assumed that these existing embankments are stable since they presently support active railway systems. Refer to the Typical Construction Details Plan, Plate 11.17, for details on the

typical embankment protection.

11.7.2 I-Wall Floodwalls The floodwalls for the three levee/floodwall systems will consist of continuous cantilever PZ-27 steel sheetpiling with a cast-in-place reinforced concrete (I-Wall) cap. All piling would be corrosion protected with a zinc and coal tar epoxy coating. Based on the results of the sheetpiling design analysis, a penetration depth to wall height ratio of approximately 3:1 is recommended for minimum pile penetration depths. All sheet piling should be driven to a minimum depth of 10 feet below the existing ground surface.

An existing concrete dock and former power plant located on the Hackensack River at the north end of Kearny Point will require specialized flood protection that will not limit access or general use of the docking area. The riverside foundation wall of the existing building adjacent to the dock will be slightly modified to accommodate construction of a concrete floodwall adjoining the exterior face of the building. The modifications would consist of excavating a trench along the face of the wall and constructing a new wall that will structurally tie-in to the existing foundation wall. These modifications will close off several existing doorways and loading areas; however, these are no longer utilized. Available as-built foundation drawings of the facility indicate the foundation walls extend sufficiently below grade to prevent underseepage and extend upward to Elevation 15 which is slightly above the design flood level of Elevation 14.9. To minimize disturbance of the existing structure, electrical power facilities and dock area; sheet piling for the I-Walls adjoining the existing building will be inserted rather than driven within a pre-excavated cement/bentonite slurry trench that extends to a depth of about 20 feet for stability and control of underseepage. The cured slurry trench will provide lateral support of the sheet piling equivalent to or better than the surrounding subsurface soils and will reduce the horizontal load transfer to adjacent structures. Refer to Plate E-11.9 for a site plan of this facility.

11.7.3 Box Pile Floodwalls

Due to the presence of several structures and facilities located at the water's edge, the proposed floodwalls in these areas must be located in the river. To accomodate the higher stresses induced by the flood level condition, combination PZ40-PZ35 continuous box piling were selected as the most efficient pile section for support of the design loads. Approximately 950 linear feet would be utilized for the Lister/Turnpike/Doremus System and about 560 linear feet would be utilized for the Kearny Point System. Minimum penetration depth requirements for the

cantilever box piling would be a minimum tip elevation of approximately -45.

A cast-in-place reinforced concrete cap would be constructed over the exterior of the box piling extending from the top to one foot below mean low water at Elevation -3. All box piling would also be corrosion protected with both a zinc and coal tar epoxy coating. Refer to Plate No. 11.17 for typical construction details of the cantilever box piling.

11.7.4 Cellular Cofferdam

Two abandoned boat basins located at the southeast corner of Kearny Point on the Hackensack River will require a specialized floodwall to cross the mouths of the basins. The basin mouths are each approximately 320 feet wide with bottom depths of generally about 9 to 14 feet. It is reported by the River Terminal Development Company that these basins were formerly dredged to about 40 feet in depth. Preliminary analyses indicated that conventional braced box piling systems were inadequate in resisting the maximum flood level condition. A cellular cofferdam across the basin mouths was selected based on efficient development of stability against the maximum flood level using readily available construction materials and overall ease of construction.

Other alternatives investigated include the construction of a levee across the basin mouths using tunnel spoils and construction of floodwalls around the perimeter of the basins. However, construction of a stable levee would require a levee with a minimum base width of 240 feet and a height of about 35 feet. Substantial costs associated with hauling of fill materials and general earthwork construction exceeded the estimated cost of the cofferdam cells. Likewise, the construction of a floodwall around the perimeter of the boat basins would result in an additional 4200 linear feet of I-wall construction which also exceeded the cost of the cells.

The proposed cellular cofferdam would consist of 25.5 foot diameter circular cells with 90° T-connections using standard PSA 23 sheet piling with zinc and coal tar epoxy corrosion protection. For adequate stability, the piles would be installed to Elevation -50 and a soil berm consisting of tunnel spoils constructed on the inland side of the cofferdam. The individual cells would also be filled with tunnel spoils. It is anticipated that construction of the cofferdam could be performed through river access and barge mounted pile driving equipment. Refer to the site plan, Plates 11.8 through 11.13 and construction details, Plate 11.17 for the location, layout and general details

of the cellular cofferdams.

11.7.5 Internal Drainage System Storm water runoff from interior sections would be collected by a system of interior drainage ditches located immediately adjacent to the inland sides of the levees and floodwalls. The drainage ditch will consist of a 10 feet wide by 12 inch deep swale surfaced with about 4 inches of compacted crushed stone. Cuts and fills for the ditches will typically be balanced so that additional fill will not be required. Excess material would remain on-site and be spread in low areas along the wall to facilitate surface drainage towards the ditch. The drainage ditch would flow by gravity towards outlet stuctures located at regular intervals within the levees and floodwalls. The surfaced drainage ditch will also function as a temporary access road for emergencies and floodfighting. In areas with limited space or existing structures/utilities immediately adjacent to proposed floodwalls; toe-drains have been designated in the areas to facilitate interior drainage. Refer to the Construction Details and Interior Flood Drainage Facilities drawings, Plates 11.17 and 11.18, respectively.

11.7.6 Closure Structures

The closure structures will be supported by 40 foot timber piles. Piles were chosen due to the large forces of the loading conditions, and the existence of weak silts and clays in the borings. It was apparent by site visits to the area that most waterfront structures are founded on piles. Timber piles were selected due to their sufficient capacity and the fact that they are economical for this small application. Chemically treated timber piles which are tapered from 12" to 7" in diameter were selected.

The design of the foundation is goverened by bearing capacity and settlement criteria. Criteria for bearing capacity and settlement are included in EM 1110-2-2906 "Design of Pile Foundations". The factor of safety of 2.25 was used for the pile capacity analysis.

The majority of the closure structures are supported directly on a reinforced concrete pile cap with dimensions of 15 feet by 10 feet by 3 feet thick. The tops of the piles will be embedded at least 6" into the cap. An array of five rows of three piles each was selected for the pile foundation. All five rows of pile will be battered at 2.5V to 1H to resist the horizontal loads on the structure.

The closure structure foundation for the railroad closures is somewhat larger to accommodate the Cooper E80 axle loads. The

pile cap is 18 feet by 12 feet by 3 feet thick. An array of six rows of four piles each was selected. Of the six rows of piles, four of them will be battered at 2.5V to 1H to resist the horizontal loads on the structure. Additional piles will be located underneath the railroad tracks. Refer to Appendix G - Structural, Section 13 - Closure Structures, for more detail and drawings regarding the design and configuration of the closure structures and their foundation system.

11.7.7 Utility Crossings

Construction of the proposed floodwalls will involve crossing numerous existing subsurface utility lines located along the alignment of the flood protection system. Most utility crossings will consist of the following:
1) temporary shutdown/closure of the utility service; 2) disconnection and removal of a segment of the line at the floodwall alingment; 3) installation of the sheetpiling through the former utility alignment; 4) construction of a sleeve type opening within the sheetpiling; 5) installation of a new segment of utiliy line through the sheetpiling and reconnection of the utility service. Typical details for utility crossings through sheetpile walls are presented on Plate 11.19, Utility Crossing Details.

In cases where temporary shutdown of service through a utility is cost prohibitive; the utility line will be left in-place and in service and the floodwall will structurally bridge the utility line. Structurally bridging in-place utility lines will consist of the following: 1) excavate and expose the utiliy line segment within the floodwall alignment; 2) install the sheet pile floodwall to within several feet of the in-place utility line; 3) construct structurally enhanced I-wall cap to bridge the gap over the utility line; and 4) backfill excavation around the utility line and below I-wall cap with a cement bentonite slurry mix to prevent underseepage. Refer to the In-place Pipe Crossing Details, Plate 11.17, Construction Details, for an illustration of the procedure.

11.8 STABILITY ANALYSIS

The critical sections for both the levees and floodwalls for each of the three systems was generally based upon selection of representative subsurface soil conditions for each reach of the various systems. Additionally, surface topography and existing structures such as bulkheads, subsurface utilities and building foundations were also considered in evaluating critical areas. All levee and floodwall systems were designed in accordance with

the criteria and minimum factors of safety presented in the USACE design manuals EM 1110-2-1913, Design and Construction of Levees and EM 1110-2-2504, Design of Sheet Pile Walls.

11.8.1 Levee Stability

Two critical site conditions were evaluated for the levee systems; the first assumed an existing bulkhead structure and a river bottom elevation of -10. Because of their highly deteriorated condition, the existing bulkheads were assumed to posses no embankment support strength. To achieve the minimum factor of safety for adequate stability under all loading conditions, the toe of the levee must be at least 80 feet from the bulkhead edge. For this site condition, both circular shear surface stability analyses and wedge type stability analyses were performed. The wedge analyses produced the lower factors of safety and are presented below in Table 4A. The critical loading case for this site condition is the sudden drawdown. Presently, a levee adjacent to an existing bulkhead is proposed for only one segment of the South 1st Street system.

The second critical site condition assumed a sloping river bank (1 horizontal: 1 vertical) at the rivers edge. For adequate stability, the levee must be at least 30 feet from the top of the river bank. The critical loading case is again the sudden drawdown. Tables 4A, 4B and 4C below summarize the estimated minimum factor of safety for each loading case for the three flood protection systems. The factors of safety shown below were determined using the USACE computer program for slope stability analysis (UTEXAS3).

TABLE 4A
SOUTH 1st STREET LEVEE STABILITY

ANALYSIS CASE	FACTOR OF SAFETY 30' FROM RIVER BANK	FACTOR OF SAFETY 80' FROM BULKHEAD
END OF CONSTRUCTION	1.7	1.5
SUDDEN DRAWDOWN	1.5	1.3
MAXIMUM FLOOD	3.2	2.9

TABLE 4B
LISTER/TURNPIKE/DOREMUS LEVEE STABILITY

ANALYSIS CASE	FACTOR OF SAFETY 30' FROM RIVER BANK
END OF CONSTRUCTION	1.5
SUDDEN DRAWDOWN	1.4
MAXIMUM FLOOD	2.8

TABLE 4C
KEARNY POINT LEVEE STABILITY

ANALYSIS CASE	FACTOR OF SAFETY PASSAIC R./NEWARK BAY	FACTOR OF SAFETY HACKENSACK RIVER
END OF CONSTRUCTION	1.7	1.5
SUDDEN DRAWDOWN	1.2	1.3
MAXIMUM FLOOD	2.4	2.7

11.8.1.1 Levee Settlement The construction of the levee embankments will result in settlement of the underlying fill materials, organic soils and the laucustrine silts and clays where present. Since the levees will be constructed in compacted lifts according to the compaction construction method, settlement of the levee fill itself will be negligable. The actual settlements that will occur will be a function of the levee height, the thickness of the compressible strata and the specific engineering properties of the various strata at that location. Based on the available subsurface information, it is estimated that maximum settlements along the center line of the individual levee systems will be as follows:

Levee System	Estimated Settlement
South 1st Street	4" to 6"
Lister/Turnpike/Doremus	8" to 10"
Kearny Point (Passaic River)	4" to 6"
Kearny Point (Hackensack River)	6" to 8"

11.8.1.2 Levee Underseepage Underseepage of the proposed levees was considered for the three flood protection systems. Based on the available boring data, it is assumed the levees will be underlain by a layer of irregular fill materials

that vary in relative density and permeability. It is anticipated that slight underseepage may occur in isolated areas of looser, more permeable fill. Consequently, any loose zones of high permeability such as remnant building rubble encountered during the excavation of the levee inspection trench, would be backfilled with compacted levee fill to mitigate localized areas of potential underseepage. Assuming the fill materials range from about 10 to 20 feet in thickness, the estimated landside exit gradient for the typical levee section is approximately 0.2. Seepage berms will not be required for the levees based on the low exit gradient and the relatively short duration of the flood stage.

11.8.2 Floodwall Stability The minimum sheetpile penetration depths determined for adequate floodwall stability were computed using the USACE computer program for design and analysis of sheetpile walls (CWALSHT). Use of undrained soil shear strengths (Q-Case) in the analysis typically resulted in the most critical case for wall stability. All floodwalls were designed assuming factors of safety of 1.5 for the undrained soil strength case and 1.1 for the drained strength case. The minimum penetration depth to wall height ratio of 3:1 was developed based on the computed penetration depths for typical wall heights and various soil conditions. A minimum penetration depth of 10 feet is recommended to provide adequate embedment depth for the sheetpiling and to provide sufficient cut-off from underseepage during flood stage. The typical I-Wall section is presented on the Construction Details drawing included in the attached plans. Typical earth pressures acting on the sheet piling during flood stage are illustrated on the Typical I-Wall Earth Pressure Diagram, Plate E-11.18.

11.8.3 Box Pile Floodwall Stability

For the special structures requiring cantiliver box piling, the minimum penetration depths were determined using CWALSHT (computer program for design and analysis of sheet-pile walls). The cantilever box piling were designed in accordance with the procedures and minimum factors of safety outlined in EM 1110-2-2504, Design of Sheet Pile Walls. The estimated minimum penetration depth for the cantilever box piling is a tip elevation of -45. Undrained soil strengths typically resulted in the most critical condition for wall stability and consequently were used in the design.

11.8.4 Closure Structure Stability/Bearing Capacity

The individual pile bearing capacity based on tip bearing and skin resistance was calculated for a 40 ft. timber pile fully

embedded in the soil. This value was calculated in accordance with criteria given in EM 1110-2-2906 "Design of Pile Foundations" and guidance from R. Koerner (1984). The theoretical allowable capacity assigned to the timber piles is 53 kips per pile.

A pile group configuration along with the number of piles required to resist the design load was arrived at through trial and error. The critical loading condition involves the weight of the structure and the hydrostatic forces from the maximum flood load. The solution with the smallest base dimensions and least amount of piles was selected. The vertical components of the pile reactions were computed because some of the piles are battered. The maximum vertical loads applied to individual piles are 18.4 kips for railroad stuctures and 13.2 kips for non-railroad strctures.

11.8.4.1 Closure Structure Settlement The settlement analysis was performed in accordance with Peck, Hanson, and Thornburn (1974). It has been conservatively assumed that the soil beneath the pile tips is essentially clay, and that it extends to bedrock. Therefore, a consolidation settlement analysis was performed. The coefficient of consolidation for 90% consolidation and double drainage conditions was estimated. The estimated settlements are less than one inch and are generally acceptable since the soils beneath the pile embedment depth are actually a mixture of fine grained and granular materials and a portion of these estimated settlements will occur during construction.

11.8.4.2 Closure Structure Seepage Seepage analyses were performed in accordance to EM 1110-2-1901 entitled "Seepage Analysis and Control for Dams" for the closure structures. A flow net which best represents the existing soil conditions was drawn to determine the exit gradient, which is located at the toe or the downstream end of the structure. The exit gradient was calculated to be 1.43, which has a factor of safety of 0.76 (minimum FS=2.5). Therefore, a sheet pile seepage cut-off wall was needed to reduce the exit gradient. The exit gradient with the sheet pile wall was calculated to be 0.30, with a factor safety of 3.7, therefore, there is no danger of a piping failure underneath the closure structure.

11.8.5 Cellular Cofferdam Stability

An overall stability analyses was performed for the cellular cofferdam with sufficient detail such that the cells were sized for adequate stability and the required penetration depth for the sheet piling determined. Included in the preliminary stability

analyses were checks on bearing capacity, sliding and shear failure along the center line of the cell. The design methodology followed in the stability analysis and the minimum factors of safety were based on the procedures presented in the USS Steel Sheet Piling Design Manual.

The cofferdam cell diameter was determined by incrementally increasing the cell diameter to resist the driving force created by the maximum flood stage condition. Since the foundation soils for the cells are anticipated to consist primarily of silts and clays, an inland soil berm was included to provide additional resistance to shear failure (sliding) within these soils and to minimize the required cell diameter. A standard cell diameter of 25.5 feet and a inland berm constructed to Elevation -5 were selected to develop the required minimum factor of safety against sliding. Overturning and internal stability of the cell was confirmed by a bearing capacity analysis and an estimation of the resistance to shear failure along the centerline. Table 5 below summarizes the minumum required factors of safety for stability and lists the computed values for the proposed cellular cofferdam.

TABLE 5
CELLULAR COFFERDAM STABILITY
FACTORS OF SAFETY

Stability Check	Computed Factor of Safety	Required Minimum Factor of Safety
Sliding	1.6	1.5
Overturning Bearing Capacity	2.5	2.5 - 3.0
Internal Shear Failure	5.5	1.5

11.8.5.1 Cofferdam Settlement Since the cell fill (tunnel spoils) will be primarily granular, most of the settlement within the fill will occur during construction as the fill is placed. Additionally, the underlying river sediments are also granular (silts and fine sands) and will experience elastic settlement as the overlying fill is placed within the cells. Consequently, it is anticipated that post construction settlement of the fill within the cells will be insignificant.

The cofferdam cells, however, will be founded on

compressible clays. Based on the available boring and laboratory test data, it is estimated that the cofferdam cells may experience up to approximately 4 to 8 inches of post construction settlement. Consequently, an additional foot of freeboard should be included in the cofferdam cell height to account for future settlement.

11.9 DESIGN AND CONSTRUCTION CONSIDERATIONS

11.9.1 Detail Design Considerations During FDM studies many additional borings will be required to better define soil conditions along the floodwall/levee alignment. In addition, design details need to be obtained for the many existing structures along and adjacent to the floodwall/levee alignment. It is anticipated that box piling type floodwalls may be needed for additional areas such as where old wharfs are present. In addition, the section of the South First Street floodwall along Cape May Avenue may need to be changed to a T-Wall because of the close proximity to an existing historical building. The construction contingency in the GDM cost estimate is expected to cover these increased costs.

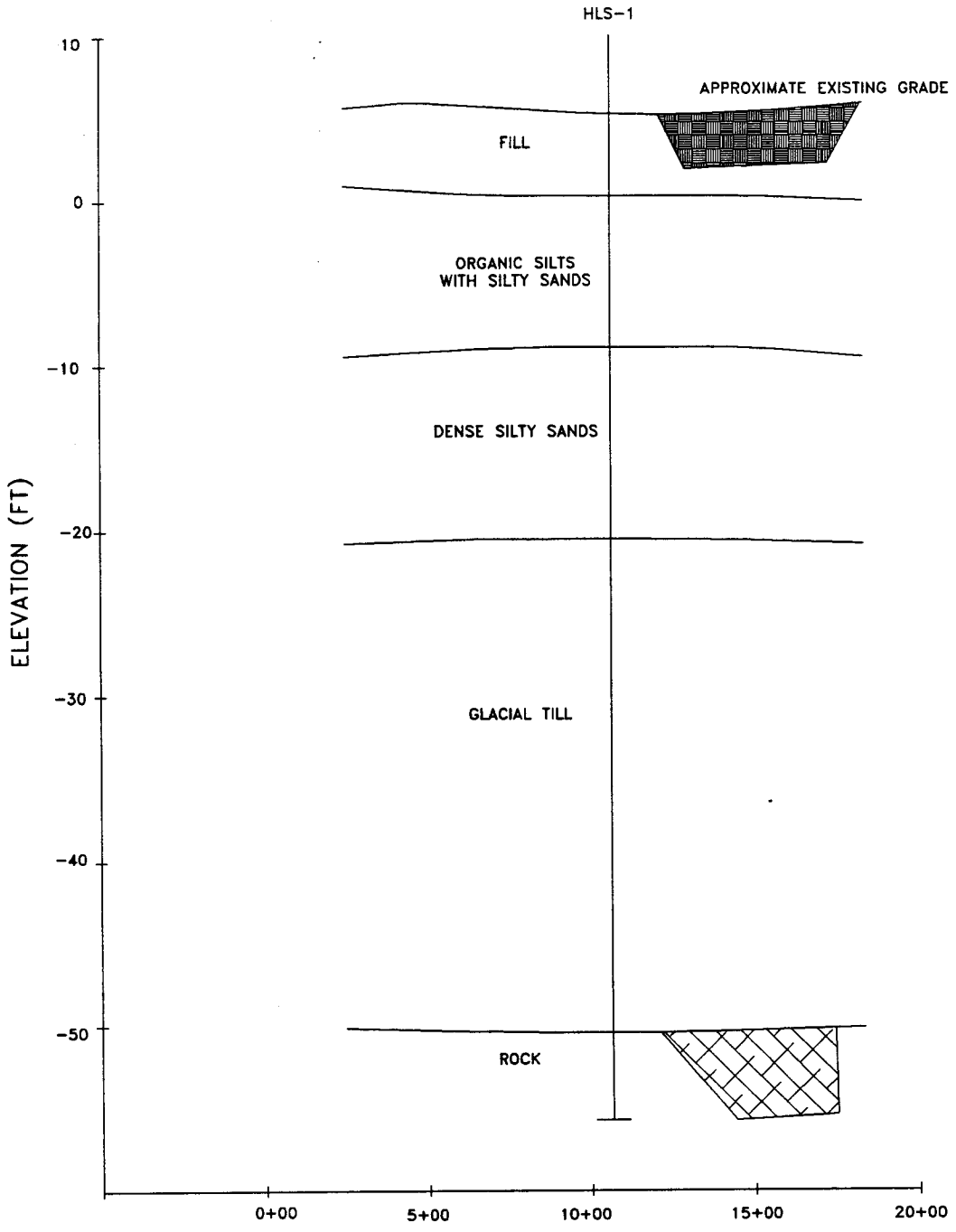
11.9.2 Site Preparation Any surficial topsoil, organic matter, vegetation or deleterious materials should be stripped from the footprint of proposed levees prior to the placement of embankment fill. Any buried debris such as remnant building foundations, construction rubble, wood, tree stumps or abandoned drain piping disclosed by the inspection trench should be removed from below the levee footprint. Excavated unsuitable materials should be replaced with compacted levee fill. The stripped and/or overexcavated materials, if satisfactory, may be reused as topsoil on the levee slopes.

11.9.3 Obstructions Due to the extensive industrial development along the water front and the presence of substantial areas of fill, it is anticipated that occasional obstructions within the fill will be encountered during driving of the sheetpiles. Spudding, pre-augering or other measures may be necessary to penetrate obstructions or dense zones within the fill to facilitate installation of the sheetpiling and prevent damage during driving. Spudding or pre-augering should not extend below the fill layer to avoid disturbance of the natural soils which will provide overall stabiliy to the floodwall system. It is assumed that any voids or open spaces within the fill materials created at the ground surface during installation of the pile would be backfilled with a cement-bentonite grout mix.

PASSAIC RIVER FLOOD DAMAGE REDUCTION PROJECT

SECTION 11
TIDAL AREA PROTECTION

PLATES



LEVEE/FLOODWALL STATIONING

GENERALIZED SUBSURFACE PROFILE
SOUTH FIRST ST. LEVEE/FLOODWALL SYSTEM

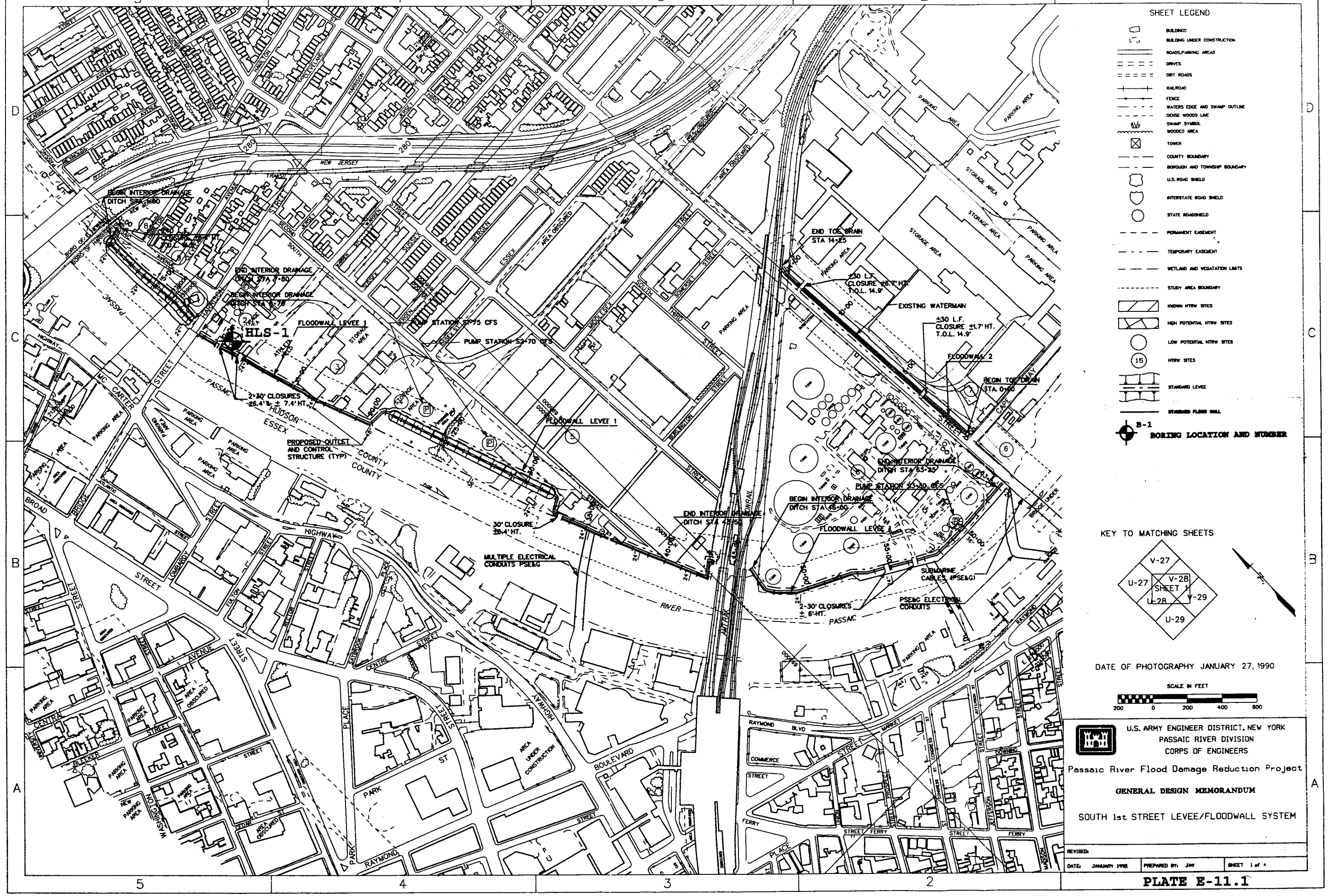
U.S. ARMY ENGINEER DISTRICT, NEW YORK
PASSAIC RIVER DIVISION
CORPS OF ENGINEERS

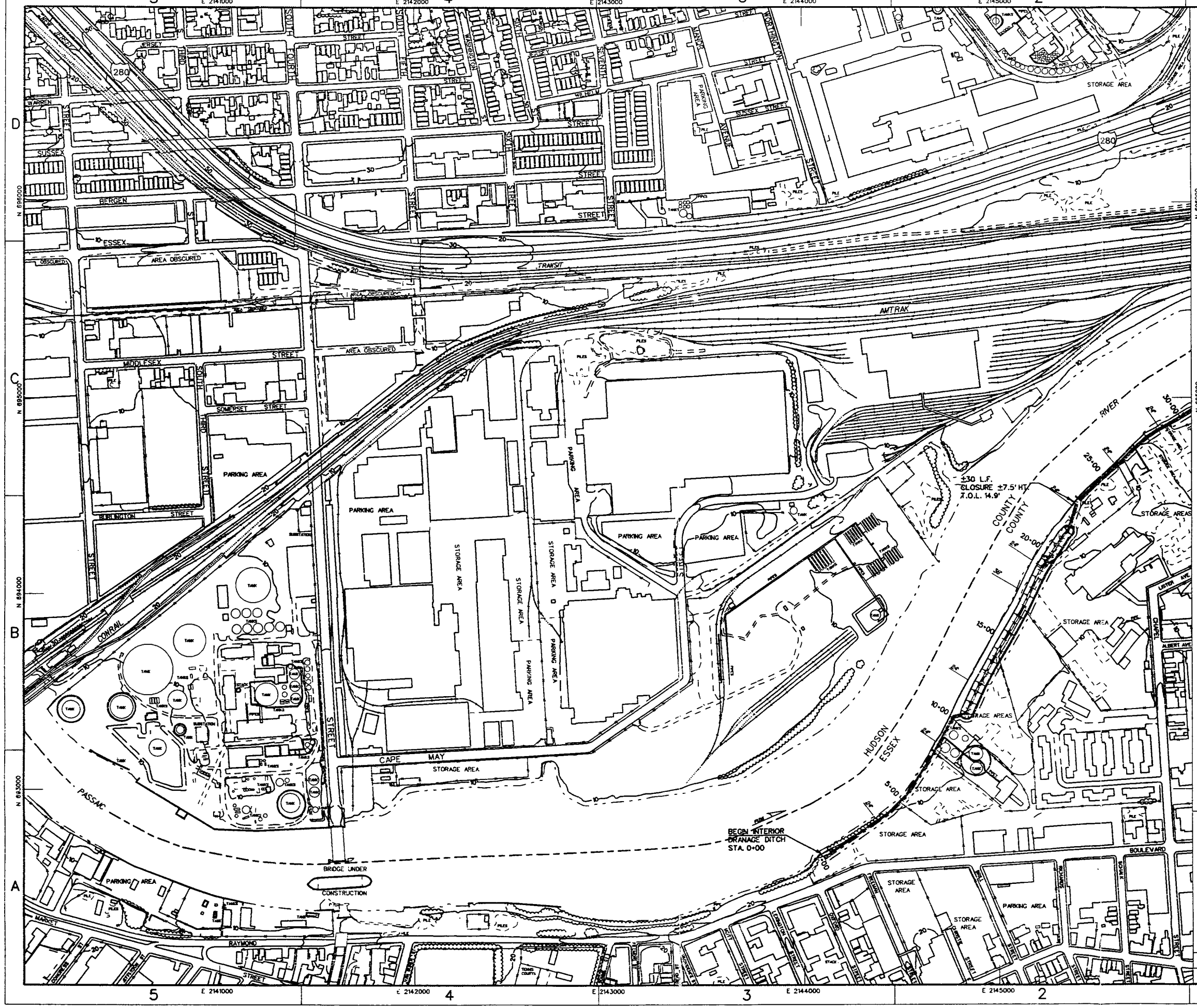
Passaic River Flood Damage Reduction Project

GENERALIZED SUBSURFACE PROFILE
SOUTH FIRST ST. LEVEE/FLOODWALL SYSTEM

DATE: 8/1/95 | PREPARED BY: CENAN-PR-TG

PLATE E-11.13


SHEET LEGEND
BUILDINGS
BUILDING UNDER CONSTRUCTION
ROADS, PARKING AREAS
DRIVES
DIRT ROADS
RAILROAD
FENCE
WATERS EDGE AND SWAMP OUTLINE
DENSE WOODS LINE
SWAMP SYMBOL
WOODED AREA
TOWER
COUNTY BOUNDARY
BOROUGH AND TOWNSHIP BOUNDARY
U.S. ROAD SHIELD
INTERSTATE ROAD SHIELD
STATE ROADSHIELD
PERMANENT EASEMENT
TEMPORARY EASEMENT
WETLAND AND VEGATATION LIMITS
STUDY AREA BOUNDARY
KNOWN HTRW SITES
HIGH POTENTIAL HTRW SITES
LOW POTENTIAL HTRW SITES
HTRW SITES
STANDARD LEVEE
STANDARD FLOOD WALL
B-1
BORING LOCATION AND NUMBER
BEGIN INTERIOR DRAINAGE DITCH STA 4+80
END INTERIOR DRAINAGE DITCH STA 7+80
BEGIN INTERIOR DRAINAGE DITCH STA 8+78
HLS-1
FLOODWALL LEVEE 1
PUMP STATION S1-75 CFS
PUMP STATION S2-70 CFS
2-30' CLOSURES ±6.4' & ± 7.4' HT.
PROPOSED OUTLET AND CONTROL STRUCTURE (TYP)
30' CLOSURE ±9.4' HT.
MULTIPLE ELECTRICAL CONDUITS PSE&G
END TOE DRAIN STA 14+25
±30 L.F. CLOSURE ±6.7' HT. T.O.L. 14.9'
EXISTING WATERMAIN
±30 L.F. CLOSURE ±1.7' HT. T.O.L. 14.9'
FLOODWALL 2
BEGIN TOE DRAIN STA 0+60
END INTERIOR DRAINAGE DITCH STA 63+25
PUMP STATION S3-30 CFS
BEGIN INTERIOR DRAINAGE DITCH STA 45+00
END INTERIOR DRAINAGE DITCH STA 43+15
FLOODWALL LEVEE 1
2-30' CLOSURES ± 6'HT.
SUBMARINE CABLES (PSE&G)
PSE&G ELECTRICAL CONDUITS
AREA UNDER CONSTRUCTION
AREA OBSCURED
PASSAIC RIVER
HUDSON COUNTY
ESSEX COUNTY
KEY TO MATCHING SHEETS
V-27
U-27
V-28
SHEET 1
U-28
V-29
U-29
DATE OF PHOTOGRAPHY JANUARY 27, 1990
SCALE IN FEET
200 0 200 400 600
U.S. ARMY ENGINEER DISTRICT, NEW YORK
PASSAIC RIVER DIVISION
CORPS OF ENGINEERS
Passaic River Flood Damage Reduction Project
GENERAL DESIGN MEMORANDUM
SOUTH 1st STREET LEVEE/FLOODWALL SYSTEM
REVISED:
DATE: JANUARY 1995
PREPARED BY: JAV
SHEET 1 of 4
PLATE E-11.1



SHEET LEGEND

- BUILDINGS
- BUILDING UNDER CONSTRUCTION
- ROADS/PARKING AREAS
- DRIVES
- DIRT ROADS
- RAILROAD
- FENCE
- WATERS EDGE AND SWAMP OUTLINE
- DENSE WOODS LINE
- SWAMP SYMBOL
- WOODED AREA
- TOWER
- COUNTY BOUNDARY
- BOROUGH AND TOWNSHIP BOUNDARY
- U.S. ROAD SHIELD
- INTERSTATE ROAD SHIELD
- STATE ROADSHIELD
- PERMANENT EASEMENT
- TEMPORARY EASEMENT
- WETLAND AND VEGATATION LIMITS
- STUDY AREA BOUNDARY
- KNOWN HTRW SITES
- HIGH POTENTIAL HTRW SITES
- LOW POTENTIAL HTRW SITES
- (15) HTRW SITES
- STANDARD LEVEE
- STANDARD FLOOD WALL
- B-1 BORING LOCATION AND NUMBER

WETLAND LEGEND

PF - PALUSTRINE FORESTED

PSS - PALUSTRINE SCRUB/SCRUB

EM - PALUSTRINE EMERGENT
CAT - CATTAIL
SSO - SAWGRASS

KEY TO MATCHING SHEETS

(V-28)	(W-28)
	(W-29)
	(W-30)
	(W-31)

DATE OF PHOTOGRAPHY JANUARY 5, 1990

SCALE IN FEET

200 0 200 400 800

U.S. ARMY ENGINEER DISTRICT, NEW YORK
PASSAIC RIVER DIVISION
CORPS OF ENGINEERS

Passaic River Flood Damage Reduction Project

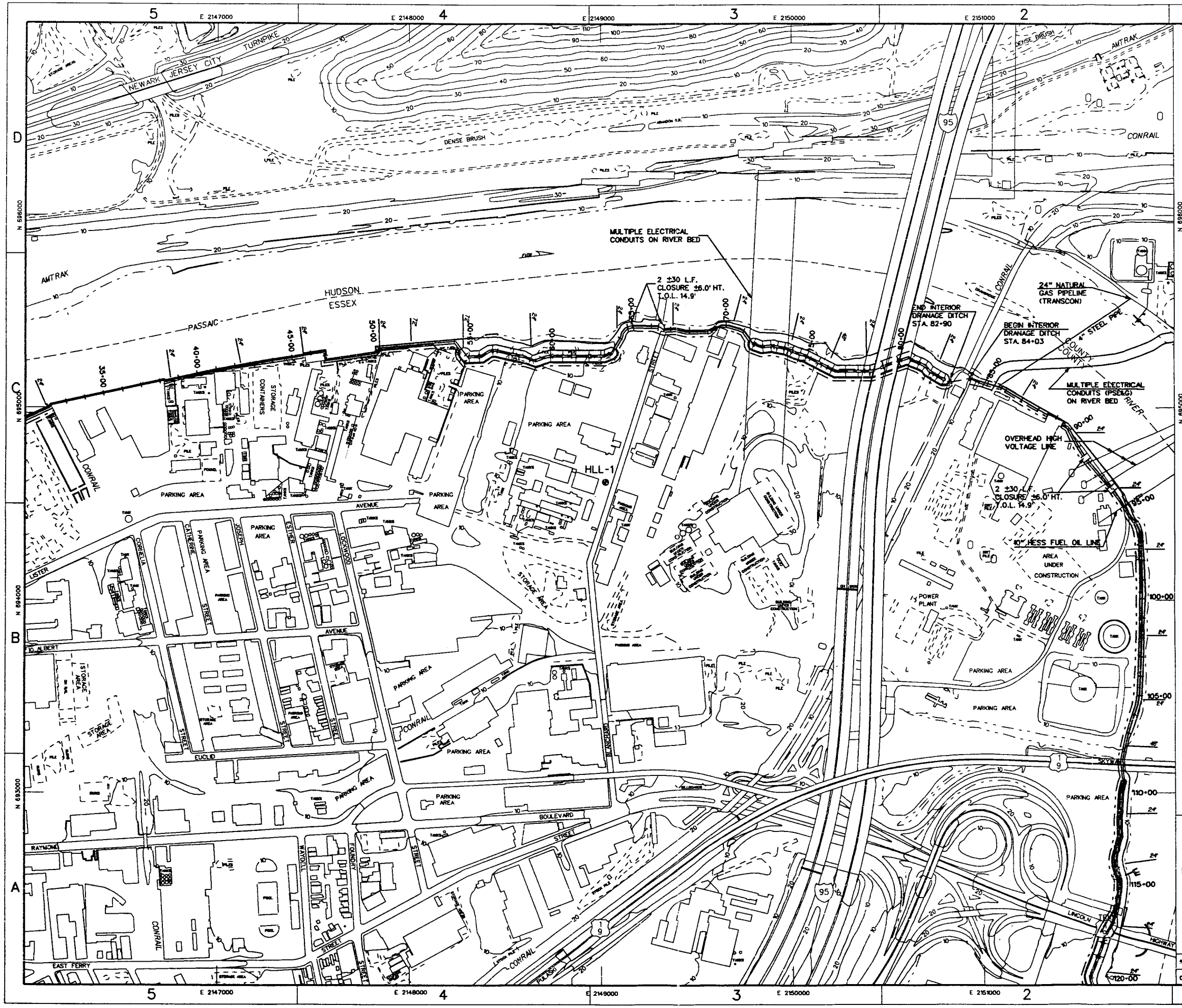
GENERAL DESIGN MEMORANDUM

LISTER/TURNPIKE/DOREMUS LEVEE/
FLOOD WALL SYSTEM

REVISED:

DATE: JANUARY 1995 | PREPARED BY: JWR | SHEET 1 of 9

PLATE E-11.2



SHEET LEGEND

- BUILDINGS
- BUILDING UNDER CONSTRUCTION
- ROADS,PARKING AREAS
- DRIVES
- DIRT ROADS
- RAILROAD
- FENCE
- WATERS EDGE AND SWAMP OUTLINE
- DENSE WOODS LINE
- SWAMP SYMBOL
- WOODED AREA
- TOWER
- COUNTY BOUNDARY
- BOROUGH AND TOWNSHIP BOUNDARY
- U.S. ROAD SHIELD
- INTERSTATE ROAD SHIELD
- STATE ROADSHIELD
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- TEMPORARY EASEMENT
- WETLAND AND VEGATATION LIMITS
- STUDY AREA BOUNDARY
- KNOWN HTRW SITES
- HIGH POTENTIAL HTRW SITES
- LOW POTENTIAL HTRW SITES
- 15 HTRW SITES
- STANDARD LEVEE
- STANDARD FLOOD WALL
- B-1 BORING LOCATION AND NUMBER

WETLAND LEGEND

PF - PALUSTRINE FORESTED

PSS - PALUSTRINE SCRUB/SCRUB

EM - PALUSTRINE EMERGENT
CAT - CATTAIL
3SQ - 3-SQUARE

KEY TO MATCHING SHEETS

SHEET 1 (V-28)	SHEET 2 (W-28)
	SHEET 3 (W-29)
	SHEET 4 (W-30)
	SHEET 5 (W-31)

DATE OF PHOTOGRAPHY JANUARY 5, 1990

SCALE IN FEET

200 0 200 400 800

U.S. ARMY ENGINEER DISTRICT, NEW YORK
PASSAIC RIVER DIVISION
CORPS OF ENGINEERS

Passaic River Flood Damage Reduction Project

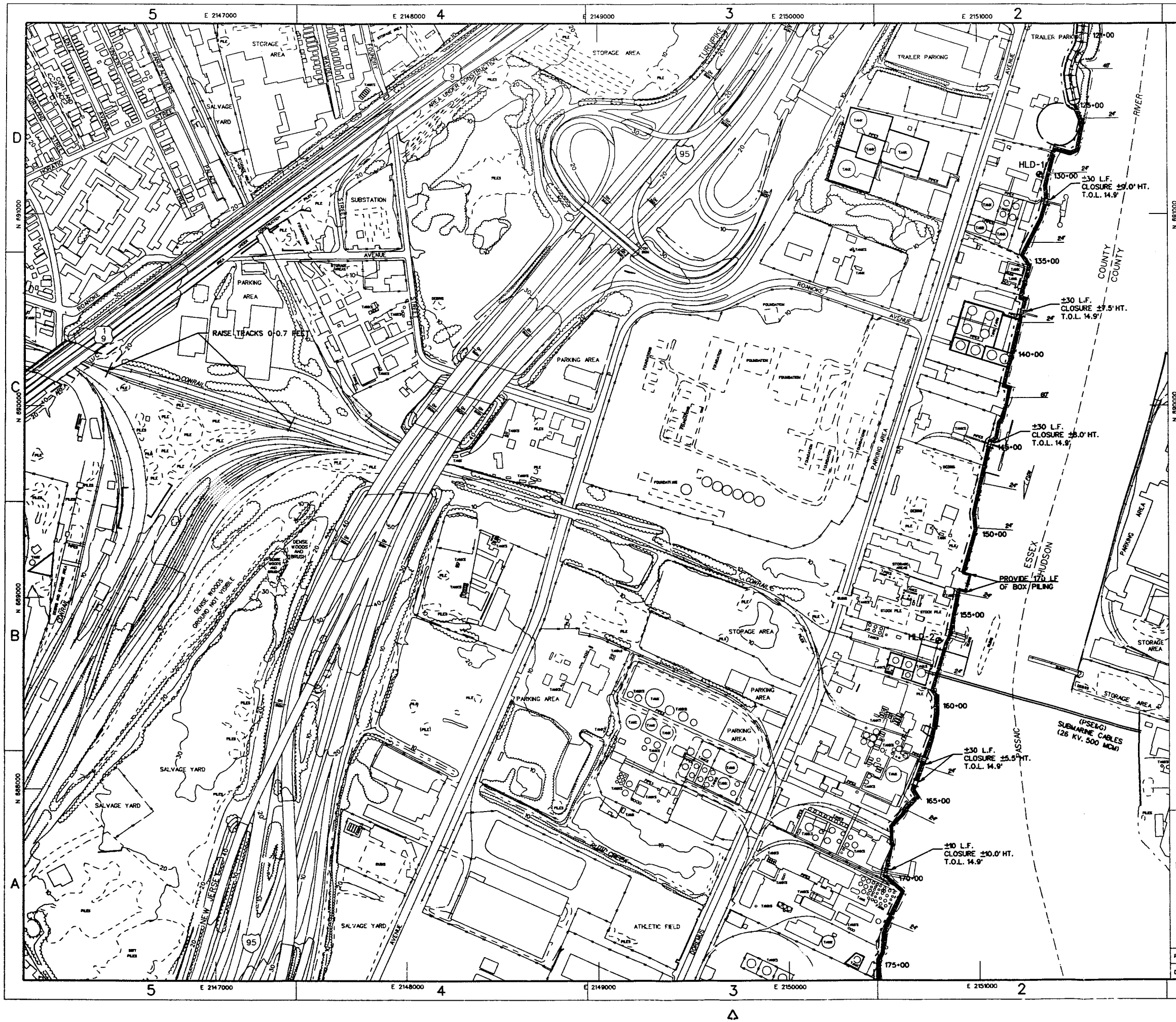
GENERAL DESIGN MEMORANDUM

LISTER/TURNPIKE/DOREMUS LEVEE/
FLOOD WALL SYSTEM

REVISED:

DATE: JANUARY 1990 | PREPARED BY: JMM | SHEET 2 OF 9

PLATE E-11.3



SHEET LEGEND

- BUILDINGS
- BUILDING UNDER CONSTRUCTION
- ROADS,PARKING AREAS
- DRIVES
- DIRT ROADS
- RAILROAD
- FENCE
- WATERS EDGE AND SWAMP OUTLINE
- DENSE WOODS LINE
- SWAMP SYMBOL
- WOODED AREA
- TOWER
- COUNTY BOUNDARY
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- U.S. ROAD SHIELD
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- TEMPORARY EASEMENT
- WETLAND AND VEGATATION LIMITS
- STUDY AREA BOUNDARY
- KNOWN HTRW SITES
- HIGH POTENTIAL HTRW SITES
- LOW POTENTIAL HTRW SITES
- HTRW SITES
- STANDARD LEVEE
- STANDARD FLOOD WALL
- B-1 BORING LOCATION AND NUMBER

WETLAND LEGEND

PF - PALUSTRINE FORESTED

PSS - PALUSTRINE SCRUB/SCHRUB

EM - PALUSTRINE EMERGENT
CAT - CATTAIL
3SQ - 3-SQUARE

KEY TO MATCHING SHEETS

SHEET 1 (V-28)	SHEET 2 (W-28)
	SHEET 3 (W-29)
	SHEET 4 (W-30)
	SHEET 5 (W-31)

DATE OF PHOTOGRAPHY JANUARY 5, 1990

SCALE IN FEET

200 0 200 400 600

U.S. ARMY ENGINEER DISTRICT, NEW YORK
PASSAIC RIVER DIVISION
CORPS OF ENGINEERS

Passaic River Flood Damage Reduction Project

GENERAL DESIGN MEMORANDUM

LISTER/TURNPIKE/DOREMUS LEVEE
FLOOD WALL SYSTEM

REVISED:

DATE: JANUARY 1995 | PREPARED BY: JWR | SHEET 3 of 9

PLATE E-11.4

AREA CURRENTLY BEING FILLED IN AS PART OF TURNPIKE WIDENING

SALVAGE YARD

±45' WIDE BY ±20' HIGH CLOSURE

SEE INSET

4-±30 L.F. CLOSURE ±9.0' HT. T.O.L. 14.9'

PROVIDE 1-10' CLOSURE 2-4' CLOSURE

PIPELINE CROSSING (30" SANITARY SEWER FORCE MAIN FROM KEARNY POINT)

72" VENT PIPE TO NEWARK BAY

NEWARK BAY

2-30' CLOSURE ±5.5' HT.

PROVIDE 170 LF OF BOX PILING

20 L.F. CLOSURE ±6.0' HT.

4-±10 L.F. CLOSURE ±6.0' HT. T.O.L. 14.9'

2-30' CLOSURE ±4.5' HT.

RELOCATE EXISTING DOLPHINS IN FRONT OF WALL

20' CLOSURE ±4' HT.

AREA UNDER CONSTRUCTION

PARKING AREA

STORAGE AREA

HUDSON COUNTY / ESSEX COUNTY

TOWN OF KEARNY / CITY OF NEWARK

LAST OF AVAILABLE TOPOGRAPHY ON SHEET W-31

ROAD INCREASES IN GRADE AS IT PASSES UNDER NEW JERSEY TURNPIKE THEREFORE NO CLOSURE REQUIRED

PROPOSED LEVEE BETWEEN EMBANKMENTS (TOP OF LEVEE ELEV. 14.9)

NOTE: LOCATIONS OF ALL FEATURES ARE APPROXIMATE AND ARE SHOWN FOR CONCEPT ONLY.

INSET

SHEET LEGEND

- BUILDINGS
- BUILDING UNDER CONSTRUCTION
- ROADS, PARKING AREAS
- DRIVES
- DIRT ROADS
- RAILROAD
- FENCE
- WATERS EDGE AND SWAMP OUTLINE
- DENSE WOODS LINE
- SWAMP SYMBOL
- WOODED AREA
- TOWER
- COUNTY BOUNDARY
- BOROUGH AND TOWNSHIP BOUNDARY
- U.S. ROAD SHIELD
- INTERSTATE ROAD SHIELD
- STATE ROADSHIELD
- PERMANENT EASEMENT
- TEMPORARY EASEMENT
- WETLAND AND VEGATATION LIMITS
- STUDY AREA BOUNDARY
- KNOWN HTRW SITES
- HIGH POTENTIAL HTRW SITES
- LOW POTENTIAL HTRW SITES
- (18) HTRW SITES
- STANDARD LEVEE
- STANDARD FLOOD WALL
- B-1 BORING LOCATION AND NUMBER

WETLAND LEGEND

PF - PALUSTRINE FORESTED

PSS - PALUSTRINE SCRUB/SCRUB

EM - PALUSTRINE EMERGENT
CAT - CATTAIL
3SQ - 3-SQUARE

KEY TO MATCHING SHEETS

SHEET 1 (V-28)	SHEET 2 (W-28)
	SHEET 3 (W-29)
	SHEET 4 (W-30)
	SHEET 5 (W-31)

DATE OF PHOTOGRAPHY JANUARY 5, 1990

SCALE IN FEET

200 0 200 400 600

U.S. ARMY ENGINEER DISTRICT, NEW YORK
PASSAIC RIVER DIVISION
CORPS OF ENGINEERS

Passaic River Flood Damage Reduction Project

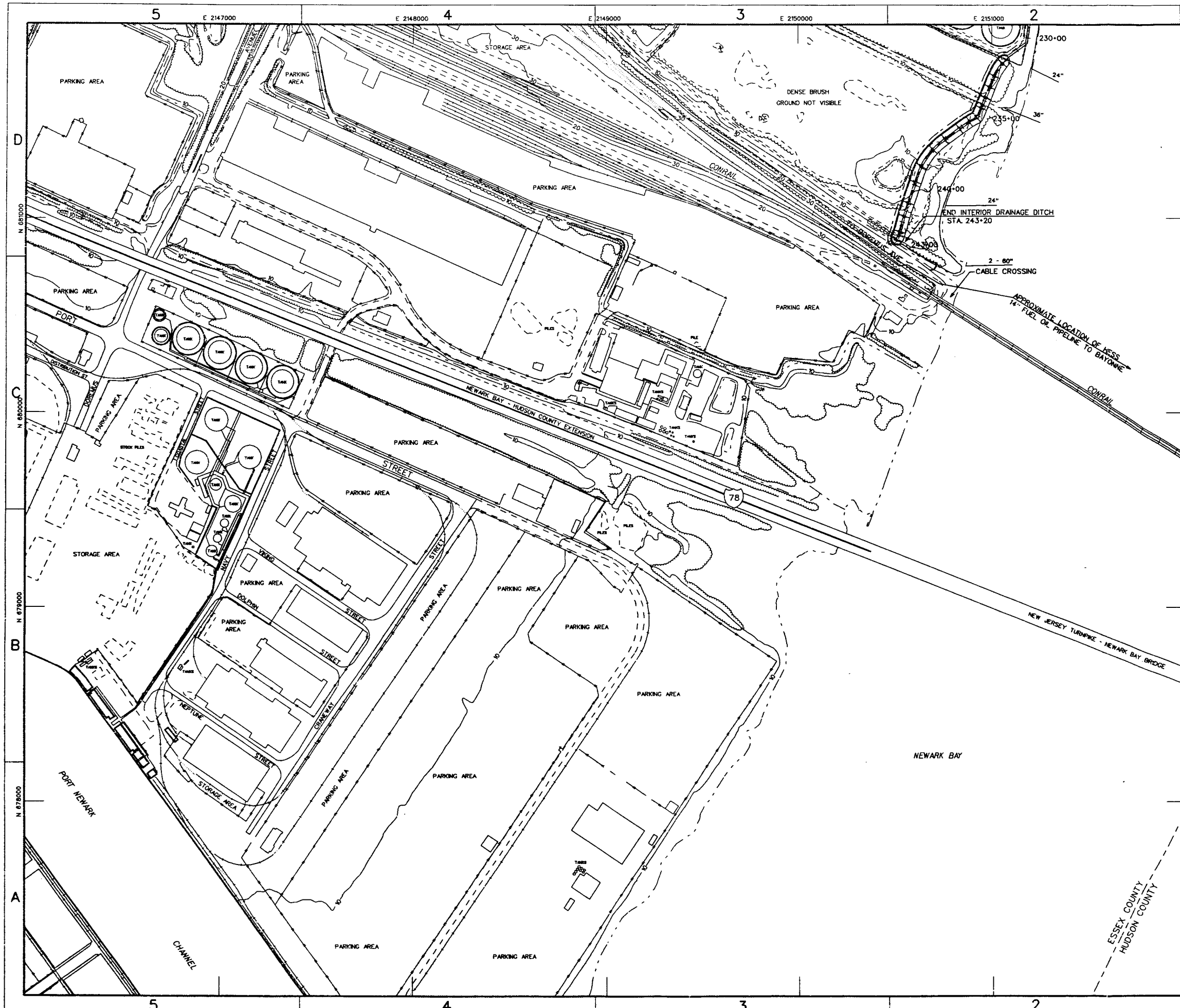
GENERAL DESIGN MEMORANDUM

LISTER/TURNPIKE/DOREMUS LEVEE FLOOD WALL SYSTEM

REVISED:

DATE: JANUARY 1995 | PREPARED BY: JMV | SHEET 4 of 9

PLATE E-11.5



SHEET LEGEND

- BUILDINGS
- BUILDING UNDER CONSTRUCTION
- ROADS,PARKING AREAS
- DRIVES
- DIRT ROADS
- RAILROAD
- FENCE
- WATERS EDGE AND SWAMP OUTLINE
- DENSE WOODS LINE
- SWAMP SYMBOL
- WOODED AREA
- TOWER
- COUNTY BOUNDARY
- BOROUGH AND TOWNSHIP BOUNDARY
- U.S. ROAD SHIELD
- INTERSTATE ROAD SHIELD
- STATE ROADSHIELD
- PERMANENT EASEMENT
- TEMPORARY EASEMENT
- WETLAND AND VEGATATION LIMITS
- STUDY AREA BOUNDARY
- KNOWN HTRW SITES
- HIGH POTENTIAL HTRW SITES
- LOW POTENTIAL HTRW SITES
- 15 HTRW SITES
- STANDARD LEVEE
- STANDARD FLOOD WALL
- B-1 BORING LOCATION AND NUMBER

WETLAND LEGEND

PF - PALUSTRINE FORESTED

PSS - PALUSTRINE SCRUB/SCHRUB

EM - PALUSTRINE EMERGENT
CAT - CATTAIL
3SQ - 3-SQAURE

KEY TO MATCHING SHEETS

SHEET 1 (V-28)	SHEET 2 (W-28)
	SHEET 3 (W-29)
	SHEET 4 (W-30)
	SHEET 5 (W-31)

DATE OF PHOTOGRAPHY JANUARY 5, 1990

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U.S. ARMY ENGINEER DISTRICT, NEW YORK
PASSAIC RIVER DIVISION
CORPS OF ENGINEERS

Passaic River Flood Damage Reduction Project

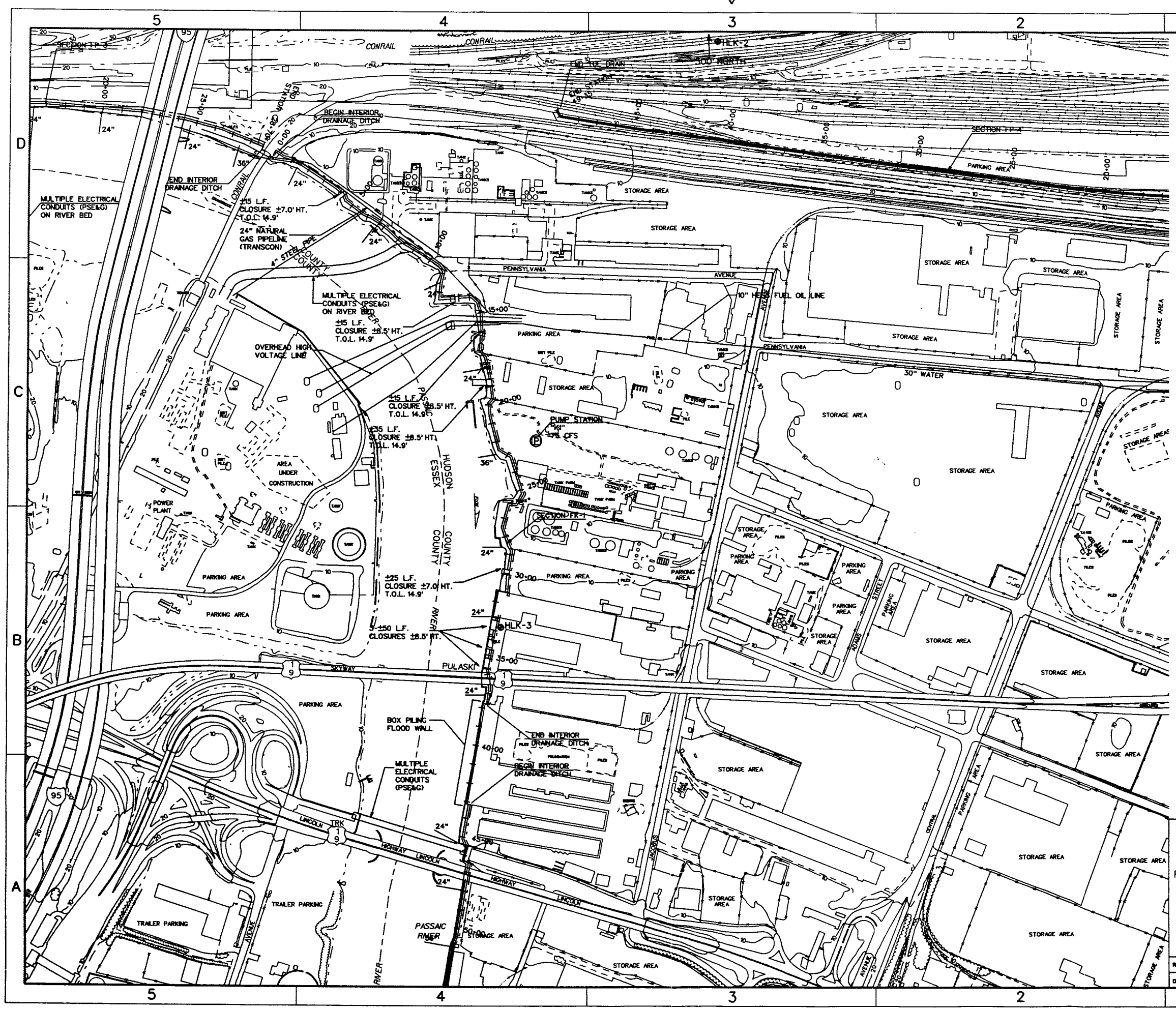
GENERAL DESIGN MEMORANDUM

LISTER/TURNPIKE/DOREMUS LEVEE
FLOOD WALL SYSTEM

REVISED:

DATE: JANUARY 1994 | PREPARED BY: JRW | SHEET 5 of 9

PLATE E-11.6



SHEET LEGEND

- BUILDINGS
- BUILDING UNDER CONSTRUCTION
- ROADS, PARKING AREAS
- DRIVES
- DIRT ROADS
- RAILROAD
- FENCE
- WATERS EDGE AND SWAMP OUTLINE
- DENSE WOODS LINE
- SWAMP SYMBOL
- WOODED AREA
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- HIGH POTENTIAL HTRW SITES
- LOW POTENTIAL HTRW SITES
- 15 HTRW SITES
- STANDARD LEVEE
- STANDARD FLOOD WALL
- B-1 BORING LOCATION AND NUMBER

KEY TO MATCHING SHEETS

6	W6-29	X4-28	3
		2	4

DATE OF PHOTOGRAPHY JANUARY 27, 1990

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Passaic River Flood Damage Reduction Project

GENERAL DESIGN MEMORANDUM

KEARNY POINT LEVEE/FLOOD WALL SYSTEM

REVISED:

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PLATE E-11.7

5 4 3 2 1

D C B A

ROANOKE AVENUE

COUNTY

COUNTY

ESSEX

HUDSON

CENTRAL

PASSAIC

24" 55+00 60+00 65+00 70+00 75+00 80+00 85+00 90+00 95+00 100+00 105+00 110+00 115+00 120+00 125+00 130+00 135+00 140+00 145+00

HKL-5

HKL-4 (C-6)

C-5 (IT-26PB21)

C-146

OUTLET STRUCTURE (TYP.)

SECTION FK-1

10'± FROM TOP OF BANK (TYP.)

PLACE AND COMPACT FILL TO ELEVATION 14.9

CABLE CROSSING

30' CLOSURE ±5.9' HT.

30' CLOSURE ±7.2' HT.

OUTLET PIPE AND STRUCTURE (TYP.)

30" SANITARY SEWER FORCE MAIN TO PVSC (LOCATION APPROXIMATE)

BEGIN INTERIOR DRAINAGE DITCH

END INTERIOR DRAINAGE DITCH

CIRCULAR CELLULAR COFFERDAM TYPE CONSTRUCTION

PARKING AREA

STORAGE AREA

BUILDING UNDER CONSTRUCTION

SHADOW

SHEET LEGEND

- BUILDINGS
- BUILDING UNDER CONSTRUCTION
- ROADS/PARKING AREAS
- DRIVES
- DIRT ROADS
- RAILROAD
- FENCE
- WATERS EDGE AND SWAMP OUTLINE
- DENSE WOODS LINE
- SWAMP SYMBOL
- WOODED AREA
- TOWER
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- STUDY AREA BOUNDARY
- KNOWN HTRW SITES
- HIGH POTENTIAL HTRW SITES
- LOW POTENTIAL HTRW SITES
- (15) HTRW SITES
- STANDARD LEVEE
- STANDARD FLOOD WALL

B-1 BORING LOCATION AND NUMBER

KEY TO MATCHING SHEETS

6	5	1	3
	W-29	X-29	4
	W-30	X-30	

DATE OF PHOTOGRAPHY JANUARY 27, 1990

SCALE IN FEET

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U.S. ARMY ENGINEER DISTRICT, NEW YORK
PASSAIC RIVER DIVISION
CORPS OF ENGINEERS

Passaic River Flood Damage Reduction Project

GENERAL DESIGN MEMORANDUM

KEARNY POINT LEVEE/FLOOD WALL SYSTEM

REVISED:

DATE: JANUARY 1995 | PREPARED BY: MRW | SHEET 2 of 11

PLATE E-11.8

5 4 3 2 1

D C B A

CONRAIL
PARKING AREA
STORAGE AREA
BEGIN TOE DRAIN
EMBANKMENT PROTECTION
END INTERIOR DRAINAGE DITCH
BEGIN INTERIOR DRAINAGE DITCH
TURNPIKE
ROAD
30" WATER
24"
48"
WATER MAIN TOWN OF KEARNY (APPROXIMATELY 4 FT. DEEP)
30' DOUBLE RAILROAD CLOSURE
60' WIDE X ± 5' HIGH ROADWAY CLOSURE
HOUSH
FISH
AVENUE
RAISE ROAD
PROVIDE INTERIOR DRAINAGE DITCH AT THESE LOCATIONS
24" NATURAL GAS PIPELINE (TRANSCO)
10" HESS FUEL OIL LINE
TANK
EMBANKMENT PROTECTION
± 20 L.F. CLOSURE 6.0' HT. T.O.L. 14.9'
REINFORCED CONCRETE I-WALL CONSTRUCTED ON EXITING BUILDING PILE CAP FOUNDATION
I-WALL CONSTRUCTED WITHIN SLURRY TRENCH
± 50 L.F CLOSURE ACROSS EXISTING DISCHARGE CANAL 6.0' HT. T.O.L. 14.9'
± 35 L.F. CLOSURE ±8.9' HT. T.O.L. 14.9'
±30 L.F. CLOSURE ±8.9' LOCATION MAY VARY T.O.L. 14.9'
BASEBALL FIELD
SKYWAY
PULASKI
STREET
AVENUE
HACKENSACK
HACKENSACK RIVER
DUNCAN
DENSE WOODS AND BRUSH
HOLY CEMETERY
200-00
195-00
190-00
185-00
66"

SHEET LEGEND

- BUILDINGS
- BUILDING UNDER CONSTRUCTION
- ROADS/PARKING AREAS
- DRIVES
- DIRT ROADS
- RAILROAD
- FENCE
- WATERS EDGE AND SWAMP OUTLINE
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- STUDY AREA BOUNDARY
- KNOWN HTRW SITES
- HIGH POTENTIAL HTRW SITES
- LOW POTENTIAL HTRW SITES
- (15) HTRW SITES
- STANDARD LEVEE
- STANDARD FLOOD WALL

B-1 BORING LOCATION AND NUMBER

KEY TO MATCHING SHEETS

6	5	X_1-28	Y_3-28
		X_2-29	Y_4-29

DATE OF PHOTOGRAPHY JANUARY 27, 1990

SCALE IN FEET
200 0 200 400 800

U.S. ARMY ENGINEER DISTRICT, NEW YORK
PASSAIC RIVER DIVISION
CORPS OF ENGINEERS

Passaic River Flood Damage Reduction Project

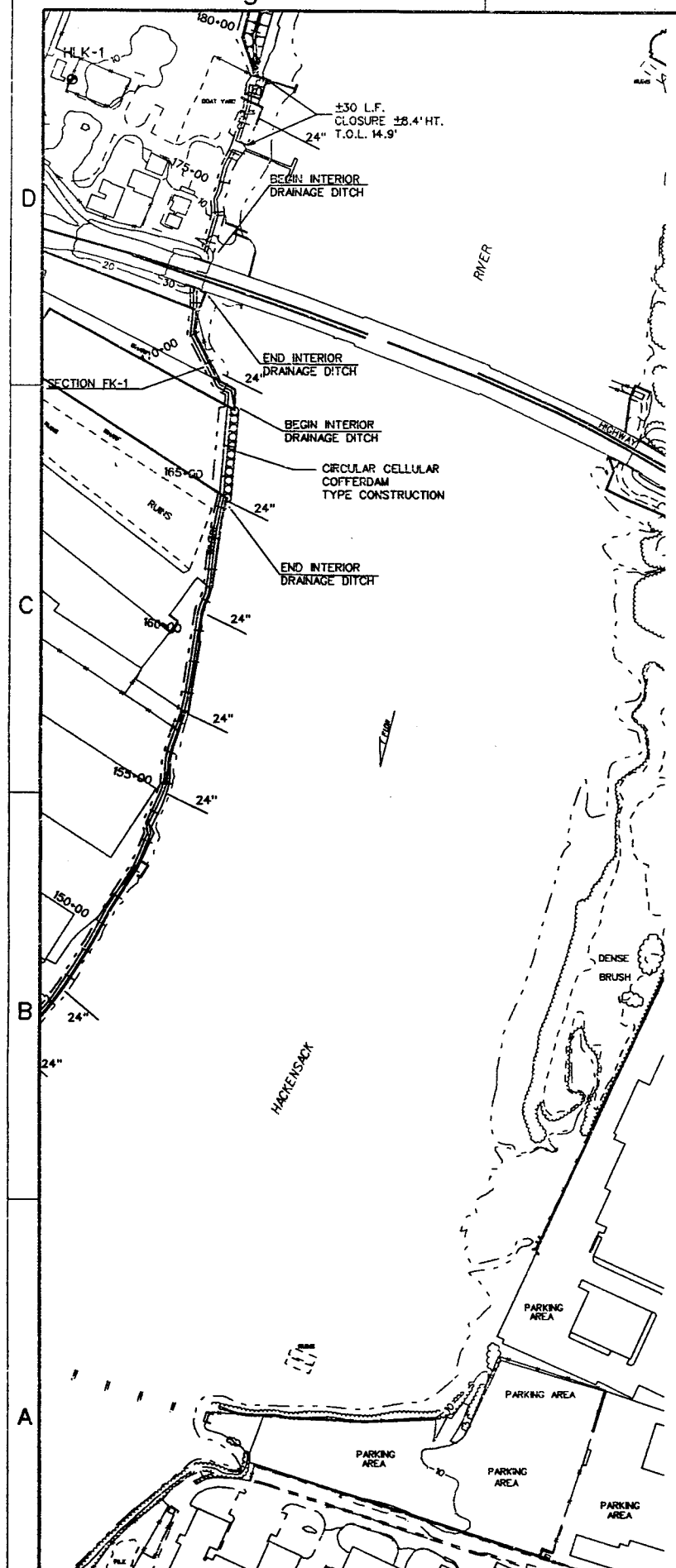
GENERAL DESIGN MEMORANDUM

KEARNY POINT LEVEE/FLOOD WALL SYSTEM

REVISED:		
DATE: JANUARY 1995	PREPARED BY: MRW	SHEET 3 of 11

PLATE E-11.9

sheet3.dgn



SHEET LEGEND

- BUILDINGS
- BUILDING UNDER CONSTRUCTION
- ROADS,PARKING AREAS
- DRIVES
- DIRT ROADS
- RAILROAD
- FENCE
- WATERS EDGE AND SWAMP OUTLINE
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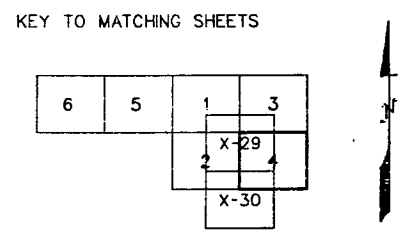
- HIGH POTENTIAL HTRW SITES
- LOW POTENTIAL HTRW SITES
- 15 HTRW SITES
- STANDARD LEVEE
- STANDARD FLOOD WALL
- B-1 BORING LOCATION AND NUMBER

KEY TO MATCHING SHEETS



DATE OF PHOTOGRAPHY JANUARY 27, 1990

SCALE IN FEET

200 0 200 400 800

U.S. ARMY ENGINEER DISTRICT, NEW YORK
PASSAIC RIVER DIVISION
CORPS OF ENGINEERS

Passaic River Flood Damage Reduction Project

GENERAL DESIGN MEMORANDUM

KEARNY POINT LEVEE/FLOOD WALL SYSTEM

REVISED:

DATE: JANUARY 1995 | PREPARED BY: HRW | SHEET 4 of 11

PLATE E-11.10

PLATE E-11.11

U.S. ARMY ENGINEER DISTRICT, NEW YORK
PASSAIC RIVER DIVISION
CORPS OF ENGINEERS

Passaic River Flood Damage Reduction Project

GENERAL DESIGN MEMORANDUM

KEARNY POINT LEVEE/FLOOD WALL SYSTEM

DATE: JANUARY 1995	PREPARED BY: MRW	SHEET 5 of 11

REVISED:

SCALE IN FEET
200 0 200 400 600

DATE OF PHOTOGRAPHY JANUARY 5, 1990

KEY TO MATCHING SHEETS

SHEET 6 (V-28)	SHEET 5 (W-28)	SHEET 1 SHEET 3
		SHEET 2 SHEET 4

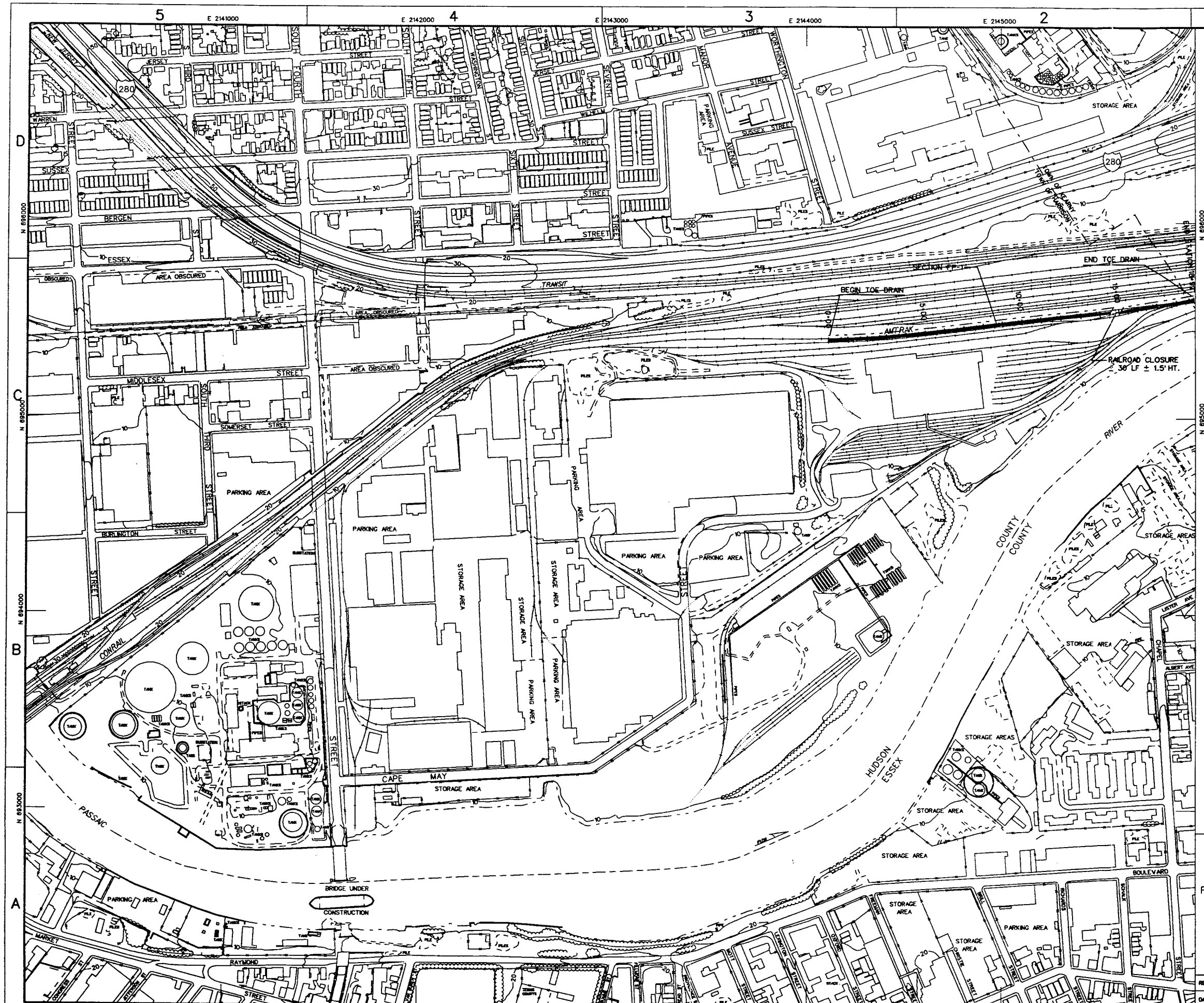
SHEET LEGEND

BUILDINGS
BUILDING UNDER CONSTRUCTION
ROADS/PARKING AREAS
DRIVES
DIRT ROADS
RAILROAD
FENCE
WATERS EDGE AND SWAMP OUTLINE
DENSE WOODS LINE
WOODED AREA
SWAMP SYMBOL
TOWER
COUNTY BOUNDARY
BOROUGH AND TOWNSHIP BOUNDARY
U.S. ROAD SHIELD
INTERSTATE ROAD SHIELD
STATE ROADSHIELD
POWERLINE EASEMENT
TELEPOWER EASEMENT
WETLAND AND VEGETATION LIMITS
STUDY AREA BOUNDARY
HIGH MOTIVE SITES
LOW POTENTIAL MITRE SITES
MITRE SITES
LEVEE
STANDARD FLOOD WALL

B-1 BORING LOCATION AND NUMBER

WETLAND LEGEND

PF - PALUSTRINE FORESTED
PSS - PALUSTRINE SCRUB/SHRUB
EM - PALUSTRINE EMERGENT
CAT - CATTAIL
3SQ - 3-SQUARE



SHEET LEGEND

- BUILDINGS
- BUILDING UNDER CONSTRUCTION
- ROADS,PARKING AREAS
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- DIRT ROADS
- RAILROAD
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- LOW POTENTIAL HTRW SITES
- (15) HTRW SITES
- STANDARD LEVEE
- STANDARD FLOOD WALL
- B-1 BORING LOCATION AND NUMBER

WETLAND LEGEND

PF - PALUSTRINE FORESTED

PSS - PALUSTRINE SCRUB/SCRUB

EM - PALUSTRINE EMERGENT
CAT - CATTAIL
3SQ - 3-SQUARE

KEY TO MATCHING SHEETS

SHEET 6 (V-28)	SHEET 5 (W-28)	SHEET 1	SHEET 3
		SHEET 2	SHEET 4

DATE OF PHOTOGRAPHY JANUARY 5, 1990

SCALE IN FEET

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Passaic River Flood Damage Reduction Project

GENERAL DESIGN MEMORANDUM

KEARNY POINT LEVEE/FLOOD WALL SYSTEM

REVISED:

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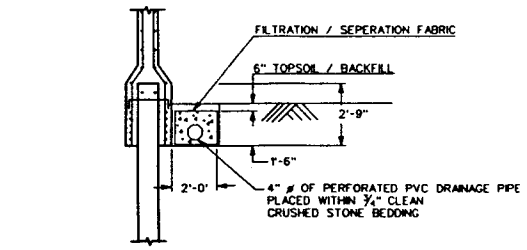
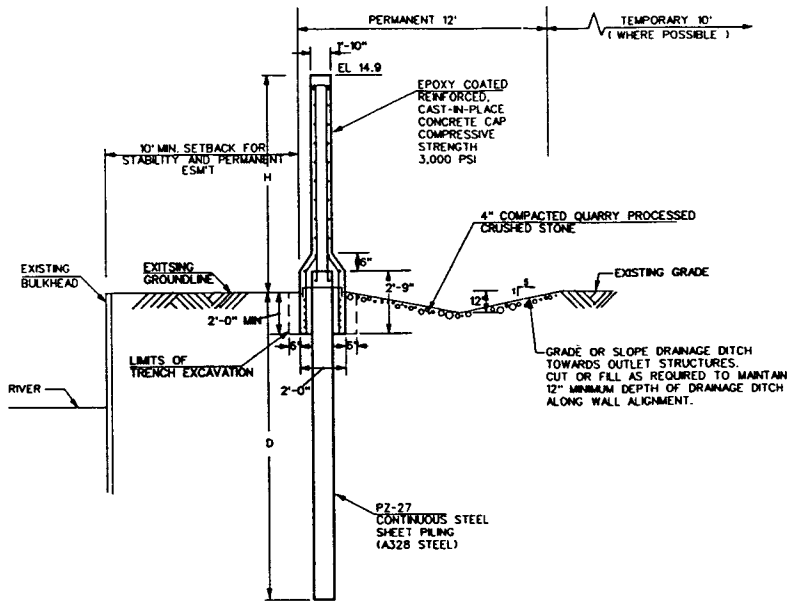
PLATE E-11.12



SUBSURFACE TOE DRAIN DETAIL
N.T.S.

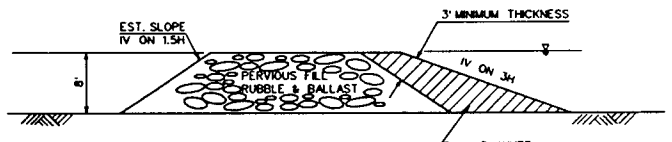


FLOODWALL (I- WALL)
TYPICAL SECTION
N. T. S.

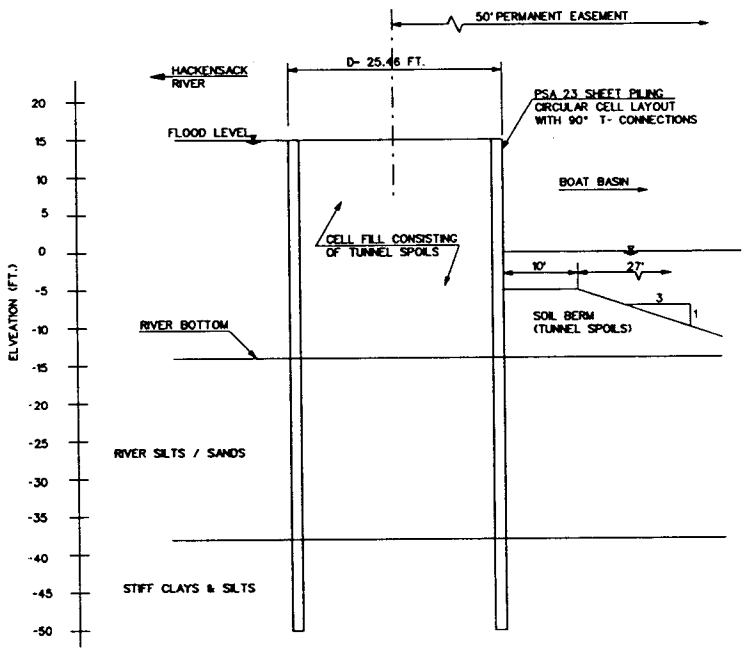
NOTE: I - WALL EASEMENTS ADJACENT TO EXISTING BULKHEAD SHOWN

TABLE OF WALL HEIGTHS AND SHEET PILE PENETRATION DEPTHS

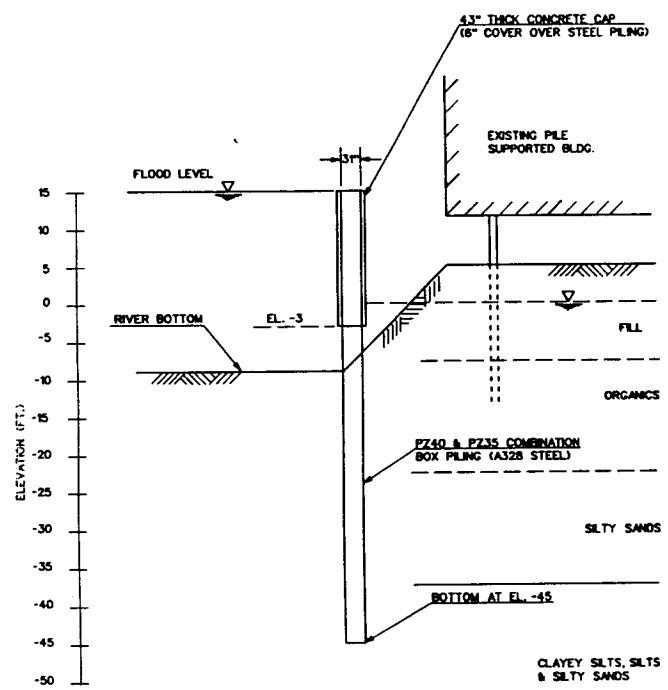
PROJECT	WALL HEIGHT (H)	SHEET PILE DEPTH (D)
SOUTH FIRST STREET		
FLOODWALL 1	6.73	22.56
FLOODWALL 2	5.69	20.98
KEARNY POINT	7.35	24.65
LISTER/TURNPIKE/DOREMUS		
SECTION A	8.12	26.15
SECTION B	8.14	26.28



FLOODSIDE CLAY BLANKET
FOR RAILROAD EMBANKMENT
SCALE: 1" = 10'



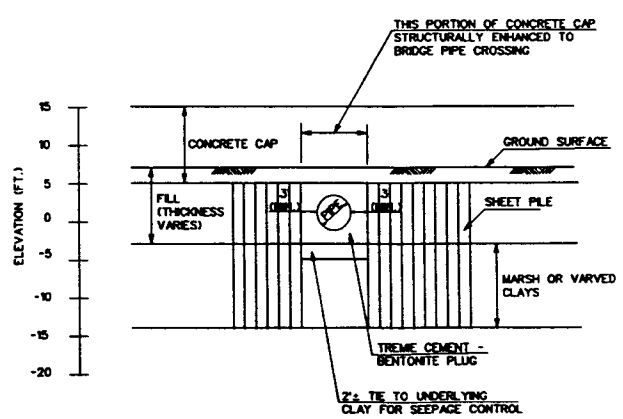
CELLULAR COFFERDAM
CIRCULAR - TYPE
TYPICAL SECTION
SCALE: 1" = 10'



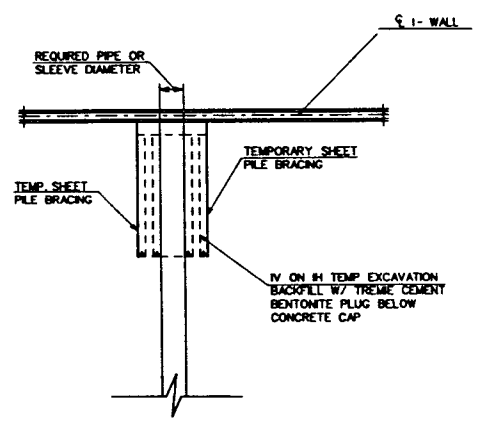
BOX PILING TYPICAL SECTION
NO EASEMENTS REQUIRED
SCALE: 1" = 10'

NOTE: 80' MINIMUM SETBACK REQUIRED FOR LEVEES ADJUSTED TO EXISTING BULKHEADS

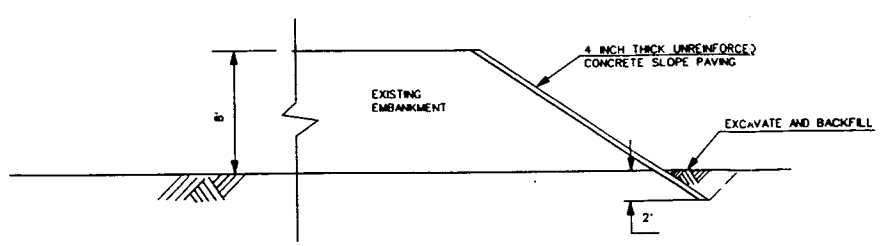
PROPOSED LEVEE DETAIL
N.T.S



IN - PLACE PIPE CROSSING DETAIL
SCALE: 1" = 5'



IN - PLACE PIPE CROSSING DETAIL PLAN
SCALE: 1" = 5'



FLOODSIDE CONCRETE SLOPE PAVING
FOR PSE & G AND RR EMBANKMENTS
SCALE: 1" = 5'

SCALE IN FEET
10 0 10 20 30

U.S. ARMY ENGINEER DISTRICT, NEW YORK
PASSAIC RIVER DIVISION
CORPS OF ENGINEERS

Passaic River Flood Damage Reduction Project

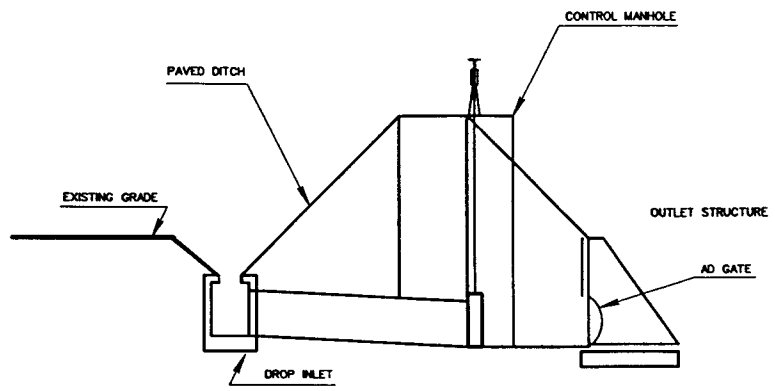
GENERAL DESIGN MEMORANDUM

TYPICAL CONSTRUCTION DETAILS PASSAIC RIVER TIDAL AREA PROTECTION LEVEE / FLOODWALL SYSTEMS

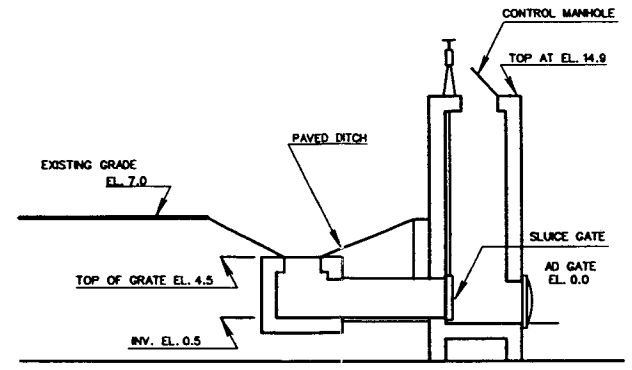
REVISED:

DATE: MARCH 1998 | PREPARED BY: J.A.R. | SHEET 87

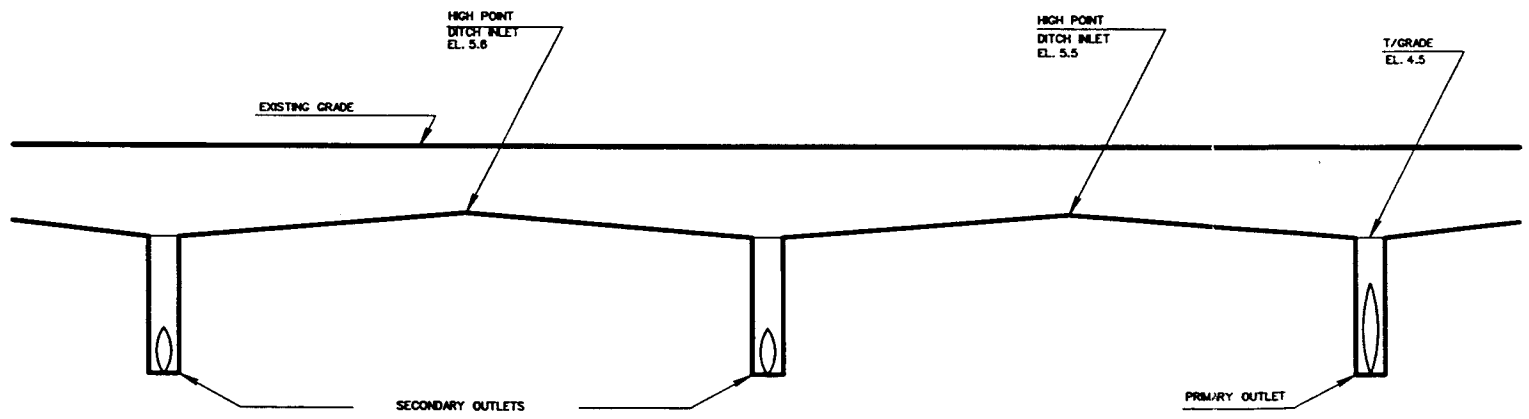
PLATE E-11.16



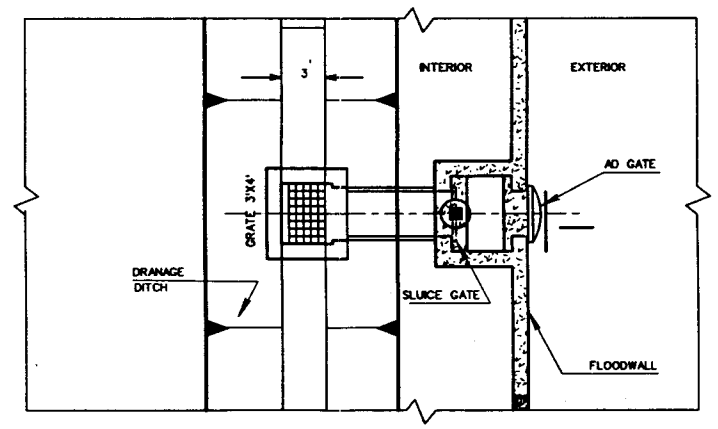
LEVEE SECTION - CROSS SECTION DETAILS



FLOOD WALL SECTION - CROSS SECTION DETAILS



DRANAGE DITCH DETAILS



FLOODWALL SECTION - PLAN VIEW DETAILS

U.S. ARMY ENGINEER DISTRICT, NEW YORK
PASSAIC RIVER DIVISION
CORPS OF ENGINEERS

Passaic River Flood Damage Reduction Project

GENERAL DESIGN MEMORANDUM

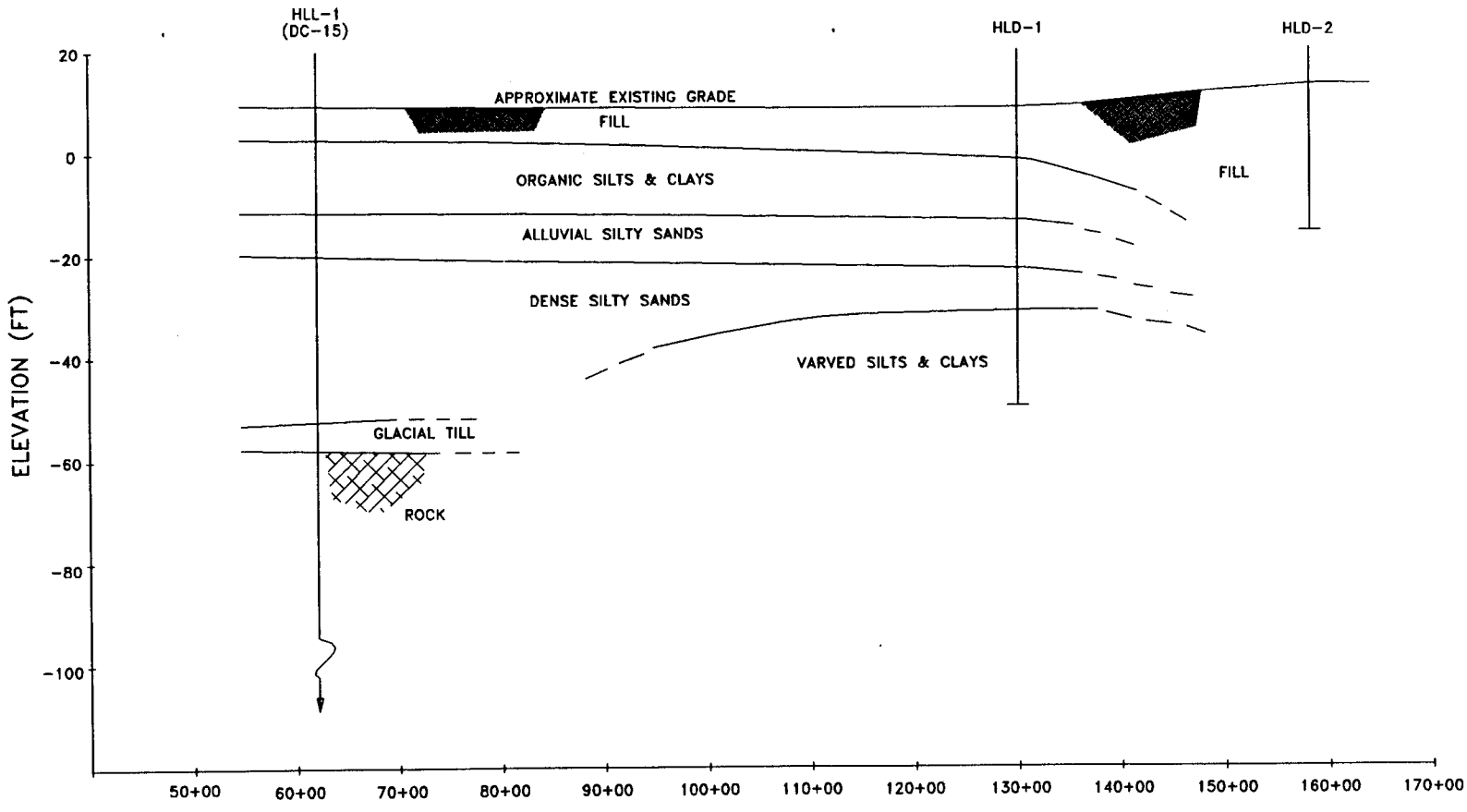
PASSIAC RIVER TIDAL AREA PROTECTION
TYPICAL INTERIOR FLOOD
DAMAGE REDUCTION FACILITIES

REVISED:

DATE: MARCH 1985 | PREPARED BY: JAW | SHEET OF OF

E 2101000 E 2102000 E 2103000

PLATE E-11.17



LEVEE/FLOODWALL STATIONING

GENERALIZED SUBSURFACE PROFILE
LISTER/TURNPIKE/DORMUS LEVEE/FLOODWALL SYSTEM

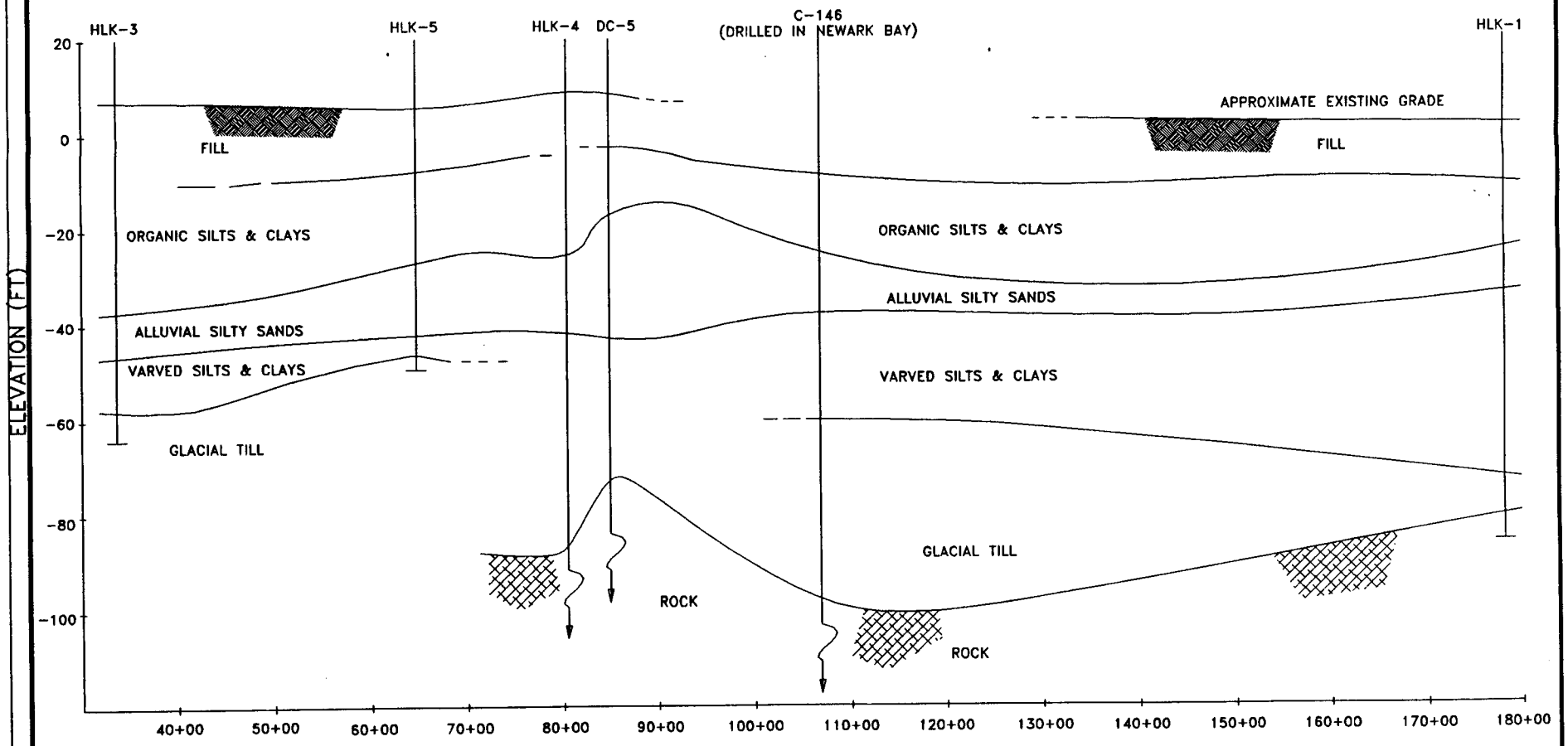
U.S. ARMY ENGINEER DISTRICT, NEW YORK
PASSAIC RIVER DIVISION
CORPS OF ENGINEERS

Passaic River Flood Damage Reduction Project

GENERALIZED SUBSURFACE PROFILE
LISTER/TURNPIKE/DORMUS LEVEE/FLOODWALL SYSTEM

DATE: 8/1/95 PREPARED BY: CENAN-PR-TG

PLATE E-11.14



LEVEE/FLOODWALL STATIONING

GENERALIZED SUBSURFACE PROFILE
KEARNY POINT LEVEE/FLOODWALL SYSTEM

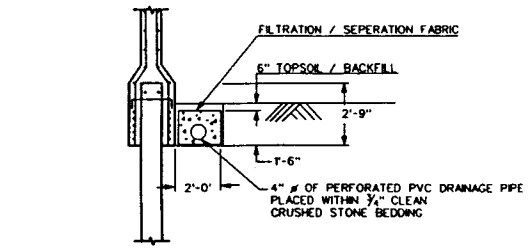
U.S. ARMY ENGINEER DISTRICT, NEW YORK
PASSAIC RIVER DIVISION
CORPS OF ENGINEERS

Passaic River Flood Damage Reduction Project

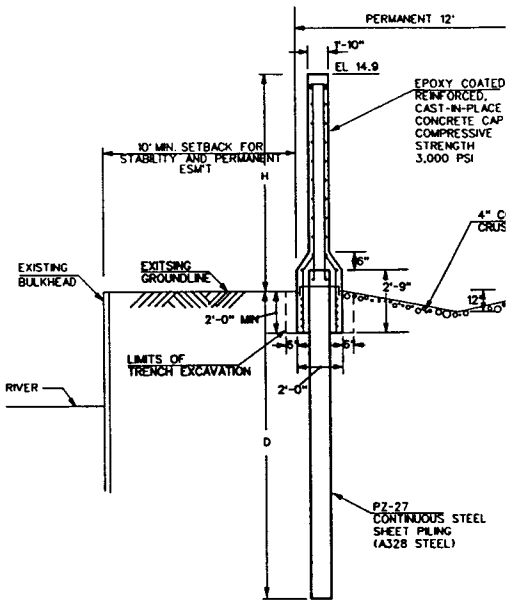
GENERALIZED SUBSURFACE PROFILE
KEARNY POINT LEVEE/FLOODWALL SYSTEM

DATE: 8/1/95 PREPARED BY: CENAN-PR-TG

PLATE E-11.15

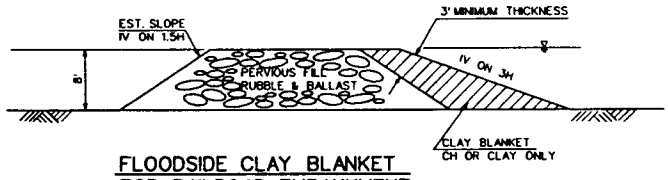


SUBSURFACE TOE DRAIN DETAIL
N.T.S.

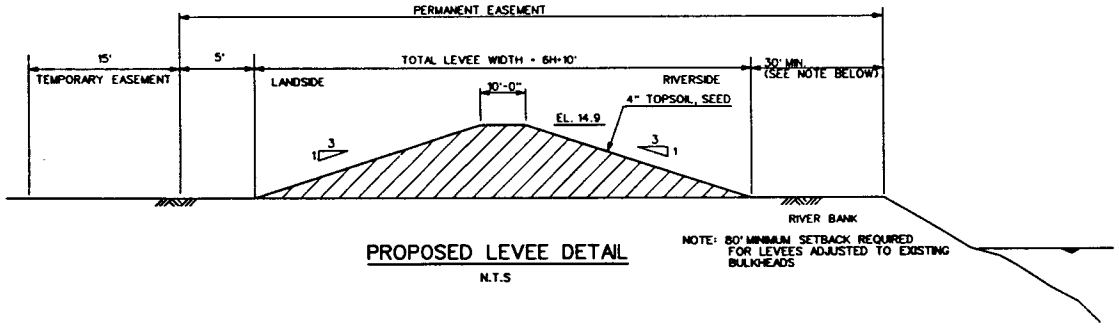


FLOODWALL (I - WALL)
TYPICAL SECTION
N. T. S.

NOTE: I - WALL EASEMENTS ADJACENT TO EXISTING BULKHEAD SHOWN

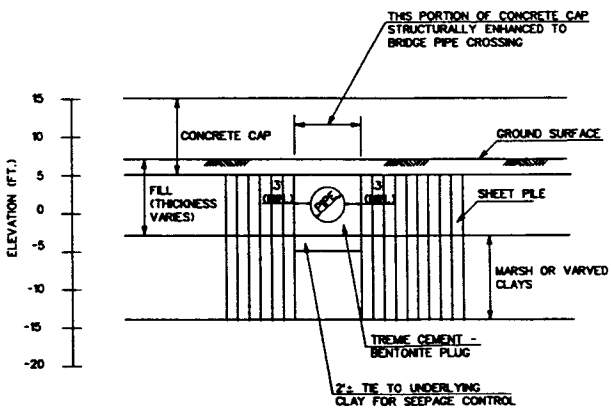


FLOODSIDE CLAY BLANKET
FOR RAILROAD EMBANKMENT
SCALE: 1" = 10'

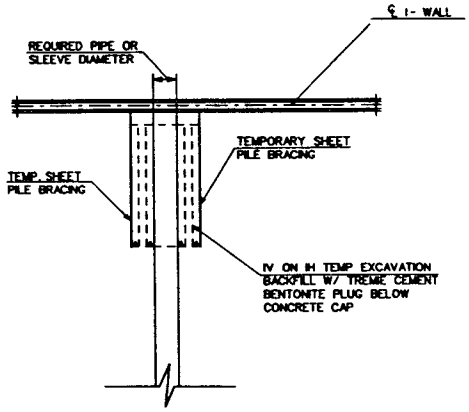


PROPOSED LEVEE DETAIL
N.T.S

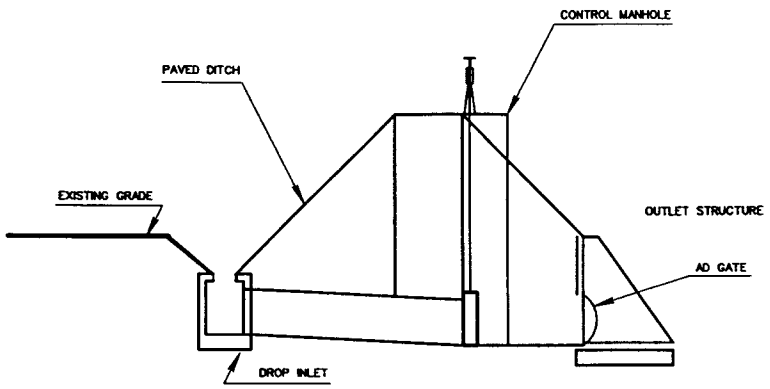
NOTE: 80' MINIMUM SETBACK REQUIRED FOR LEVEES ADJUSTED TO EXISTING BULKHEADS



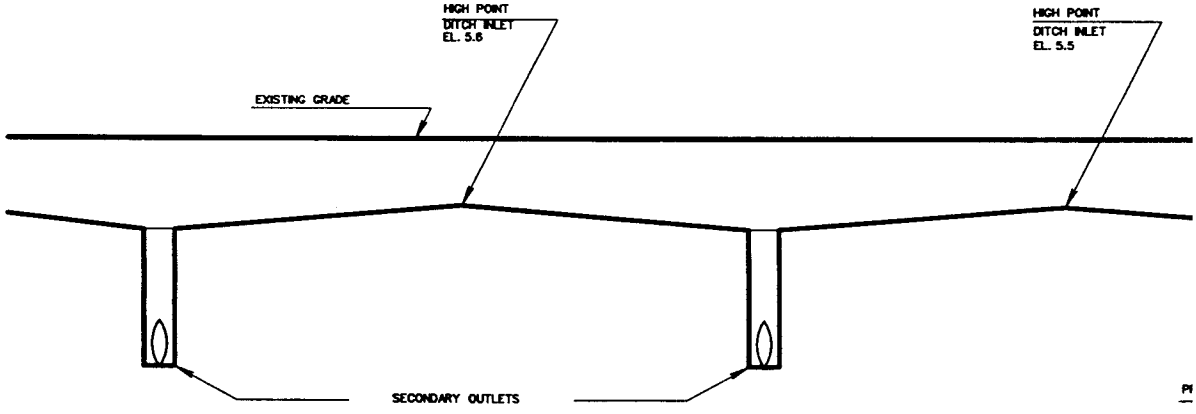
IN - PLACE PIPE CROSSING DETAIL
SCALE: 1" = 5'



IN - PLACE PIPE CROSSING DETAIL PLAN
SCALE: 1" = 5'



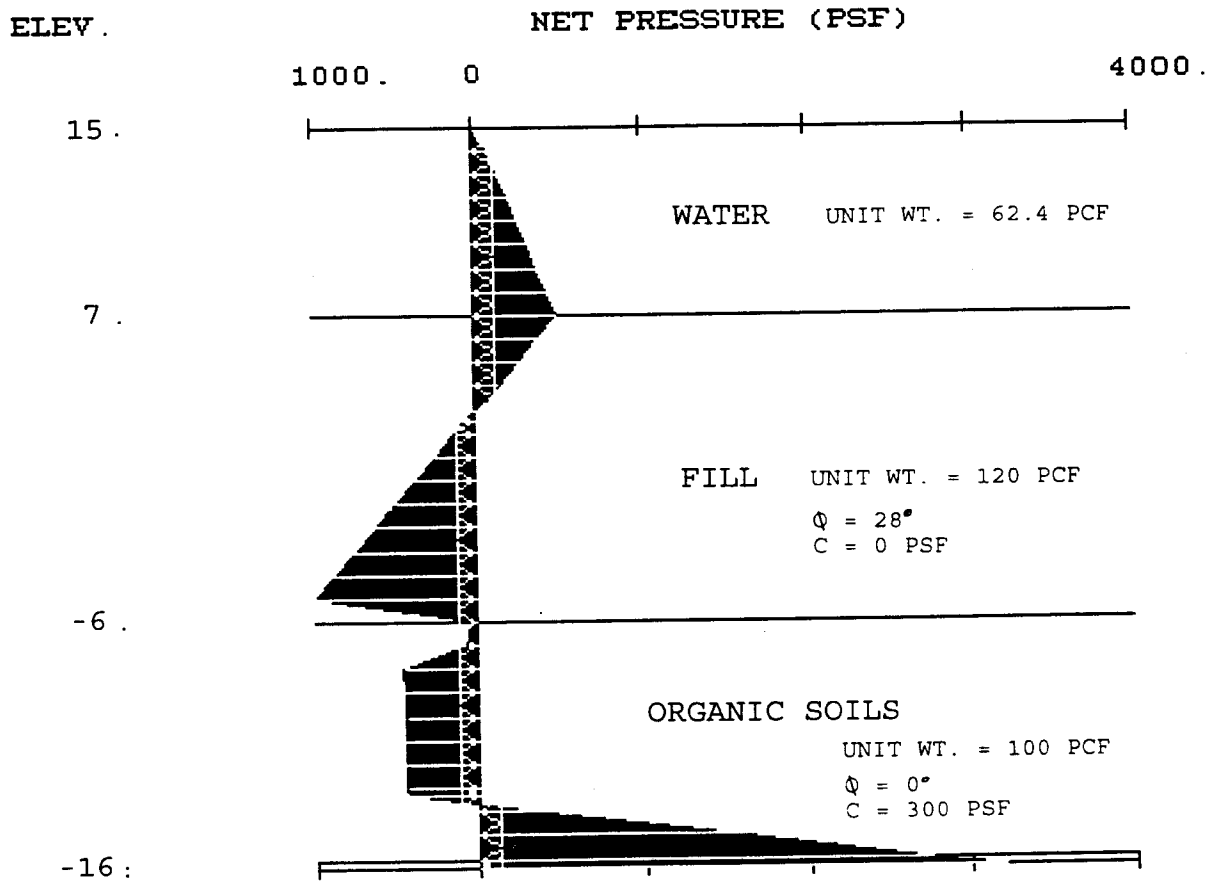
LEVEE SECTION - CROSS SECTION DETAILS



DRANAGE DITCH DETAILS

E 2101000

TYPICAL EARTH PRESSURE DIAGRAM
SHEET PILE I-WALLS



NOTE: NET EARTH PRESSURES ARE BASED UPON GENERALIZED SUBSURFACE SOIL CONDITIONS IN THE VICINITY OF BORING HLK-1 (ASSUMED WEAKEST CONDITIONS).

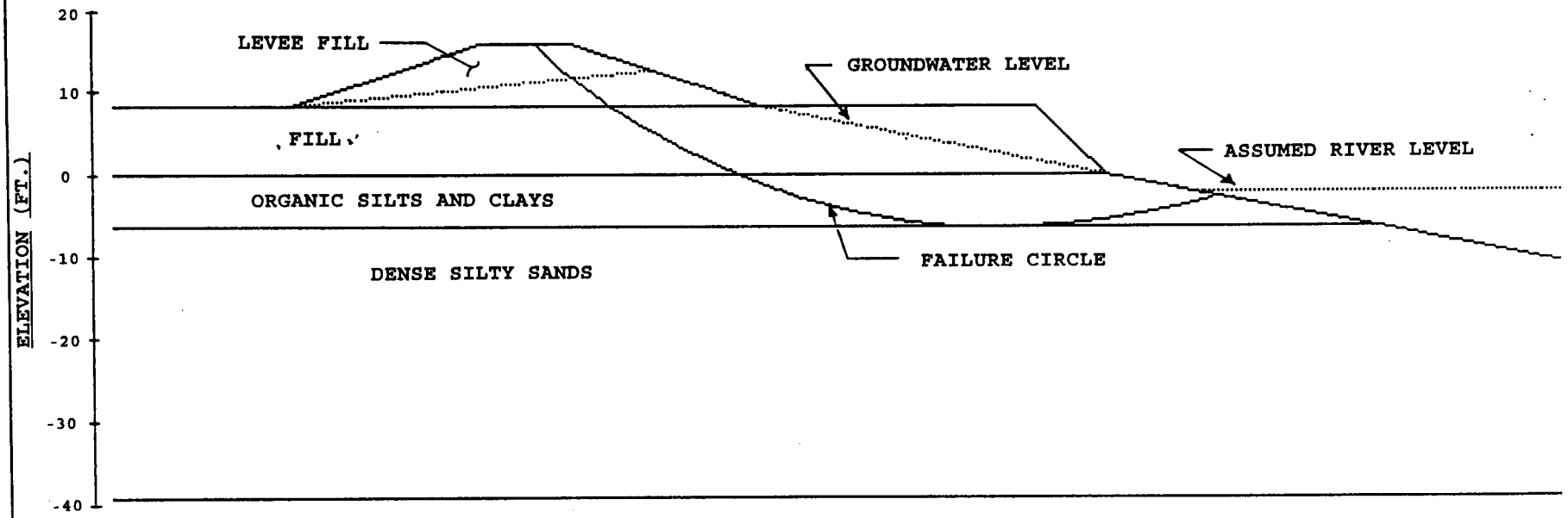
U.S. ARMY ENGINEER DISTRICT, NEW YORK
PASSAIC RIVER DIVISION
CORPS OF ENGINEERS

Passaic River Flood Damage Reduction Project
GENERAL DESIGN MEMORANDUM

TYPICAL I-WALL EARTH PRESSURE DIAGRAM

REVISED:	
DATE: 7/95	PREPARED BY: CENAN-PR-TG

PLATE E-11.18



SOUTH FIRST LEVEE SYSTEM
RIVER BANK AREAS
SUDDEN DRAWDOWN CASE

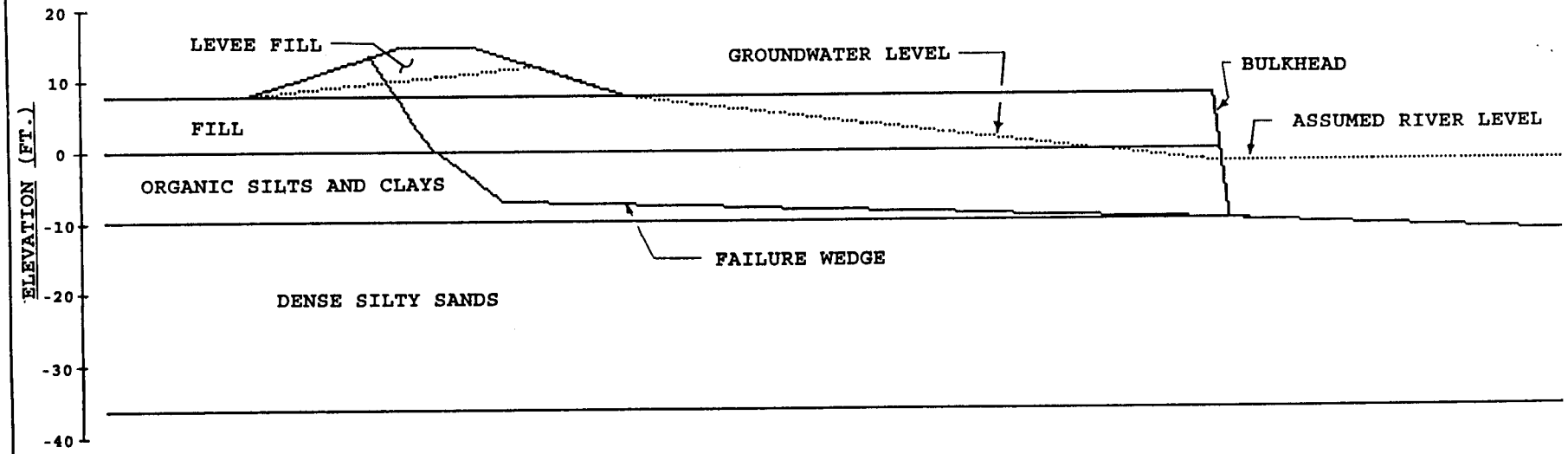
FACTOR OF SAFETY = 1.5

U.S. ARMY ENGINEER DISTRICT, NEW YORK
PASSAIC RIVER DIVISION
CORPS OF ENGINEERS

Passaic River Flood Damage Reduction Project
GENERAL DESIGN MEMORANDUM
CRITICAL LEVEE SECTION
SOUTH FIRST LEVEE SYSTEM
RIVER BANK AREAS

REVISED:	
DATE: 7/14/95	PREPARED BY: CENAN-PR-TG

PLATE E-11.19



SOUTH FIRST LEVEE SYSTEM
BULKHEAD AREAS
SUDDEN DRAWDOWN CASE

FACTOR OF SAFETY = 1.3

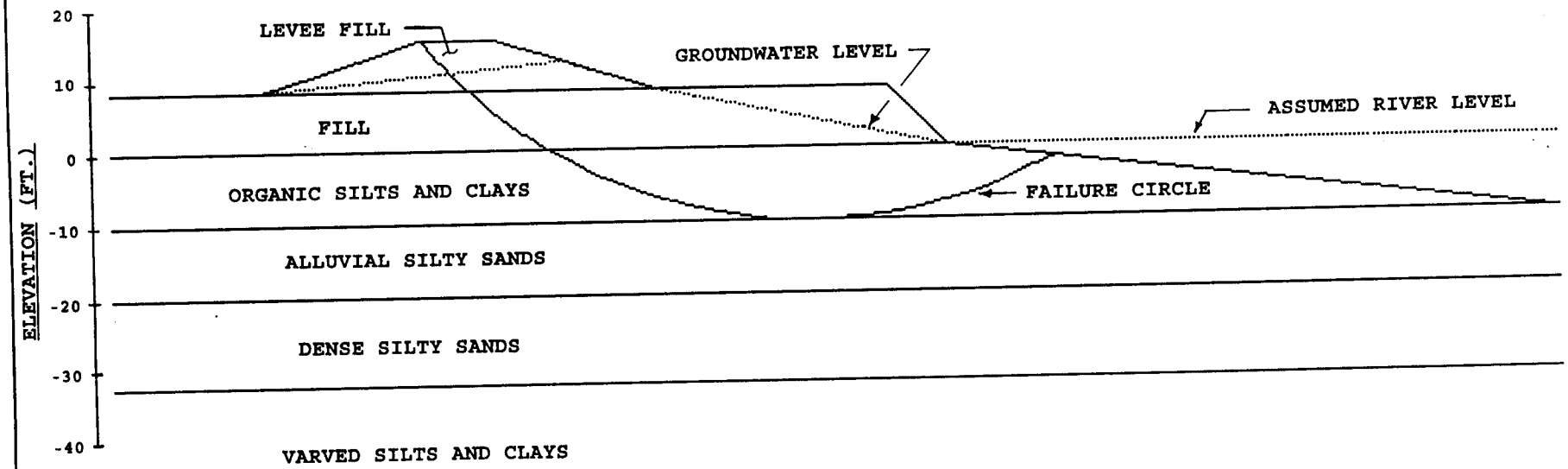
U.S. ARMY ENGINEER DISTRICT, NEW YORK
PASSAIC RIVER DIVISION
CORPS OF ENGINEERS

Passaic River Flood Damage Reduction Project
GENERAL DESIGN MEMORANDUM
CRITICAL LEVEE SECTION
SOUTH FIRST LEVEE SYSTEM
BULKHEAD AREAS

REVISED:

DATE: 7/14/95 | PREPARED BY: CENAN-PR-TG

PLATE E-11.20



LISTER/TURNPIKE/DOREMUS LEVEE SYSTEM
SUDDEN DRAWDOWN CASE

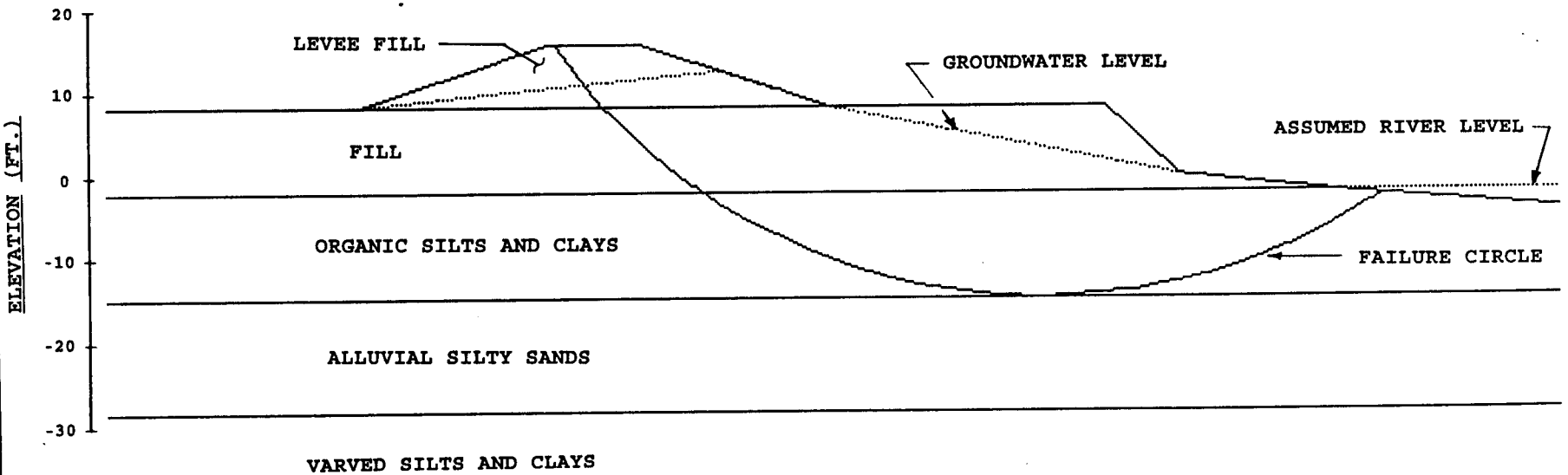
FACTOR OF SAFETY = 1.4

U.S. ARMY ENGINEER DISTRICT, NEW YORK
PASSAIC RIVER DIVISION
CORPS OF ENGINEERS

Passaic River Flood Damage Reduction Project
GENERAL DESIGN MEMORANDUM
CRITICAL LEVEE SECTION
LISTER/TURNPIKE/DOREMUS LEVEE SYSTEM
SUDDEN DRAWDOWN CASE

REVISED:	
DATE:	PREPARED BY:

PLATE E-11.21



KEARNY POINT LEVEE SYSTEM
PASSAIC RIVER / NEWARK BAY
SUDDEN DRAWDOWN CASE

FACTOR OF SAFETY = 1.2

U.S. ARMY ENGINEER DISTRICT, NEW YORK
PASSAIC RIVER DIVISION
CORPS OF ENGINEERS

Passaic River Flood Damage Reduction Project
GENERAL DESIGN MEMORANDUM
CRITICAL LEVEE SECTION
KEARNY POINT LEVEE SYSTEM
PASSAIC RIVER / NEWARK BAY

REVISED:

DATE: 7/14/95 | PREPARED BY: CENAN-PR-TG

PLATE E-11.22

PASSAIC RIVER FLOOD DAMAGE
REDUCTION PROJECT

SECTION 11
TIDAL AREA PROTECTION

ATTACHMENT E.11.1
SOIL BORING LOGS

Attachment E.11.1

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DC - 5	26-30
HLD - 1	31-34
HLD - 2	35-36
HLL - 1	37-40
HLS - 1	41-44

DRILLING LOG	DIVISION NORTH ATLANTIC	INSTALLATION NEW YORK DISTRICT	SHEET 1 OF 6 SHEETS

1. PROJECT	PASSAIC RIVER FLOOD PROTECTION, MAIN TUNNEL
2. LOCATION (Coordinates or Station)	KEARNY POINT, N.J.
3. DRILLING AGENCY	MOBILE DIST.
4. HOLE NO. (As shown on drawing title and file number)	HLK-1-94
5. NAME OF DRILLER	C. MOON
6. DIRECTION OF HOLE	[X] VERTICAL [ ] INCLINED _____ DEGREES FROM VERTICAL
7. THICKNESS OF OVERBURDEN	88.0'
8. DEPTH DRILLED INTO ROCK	2.4'
9. TOTAL DEPTH OF HOLE	90.4'
10. SIZE AND TYPE OF BIT	5" AUGUR & 3-5/8" ROCKBIT
11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	NGVD
12. MANUFACTURER'S DESIGNATION OF DRILL	F-314, CD-38
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED 25 / UNDISTURBED
14. TOTAL NUMBER CORE BOXES	
15. ELEVATION GROUND WATER	4±
16. DATE HOLE	STARTED 9-20-94 / COMPLETED 9-23-94
17. ELEVATION TOP OF HOLE	7±
18. TOTAL CORE RECOVERY FOR BORING	
19. SIGNATURE OF INSPECTOR	B. BRYANT

ELEVATION a.	DEPTH b.	LEGEND c.	CLASSIFICATION OF MATERIALS (Description) d.	SPT BLOWS	SAMPLE/ BOX NO. f.	REMARKS (Drilling Time, water loss, etc.) g.
	1'		BROWN SILTY SAND, FINE GRAIN, WITH TRACES OF ROOTS, MOIST-FILL (SM)	2 4 3	1	
	2'		SAME WITH TRACES OF ROCK FRAGMENTS, 1/2"MAX	3 3 5	2	
	3'		DARKBROWN SILTY GRAVEL 1" MAX WITH TRACES OF WOOD, WET -FILL (GM)	3 6 5	3	
	5'		DARKBROWN SILTY GRAVEL 1/2" MAX, WET -FILL (GM)	1 1 1	4	
	6'		SAME WITH TRACES OF WOOD AND COAL FRAGMENTS -FILL	2 1 2	5	
	8'			3 1 2	6	
	9'			5 1 1	7	
	11'		DARK BROWN SILTY SAND COARSE GRAVEL, WET -FILL (SM)	1 1 1	8	
	12'		DARKBROWN SILTY GRAVEL 1/2" MAX, WITH TRACES OF WOOD, MOIST -FILL (GM)	1 1 1	9	
	13'			1	10	
	14'		(OH)			

ENG FORM 1836

PROJECT PASSAIC RIVER FLOOD PROTECTION, MAIN TUNNEL | HOLE NO. HLK-1-94

Hole No. HLK-1-94

DRILLING LOG	DIVISION NORTH ATLANTIC	INSTALLATION NEW YORK DISTRICT	SHEET 2 OF 6 SHEETS

ELEVATION a.	DEPTH b.	LEGEND c.	CLASSIFICATION OF MATERIALS (Description) d.	SPT BLOWS	SAMPLE/ BOX NO. f.	REMARKS (Drilling Time, water loss, etc.) g.
	15'		DARKBROWN ORGANIC SILT WITH TRACES OF WOOD (OH)	1 1	10	
	16'		NO RECOVERY	1 1 2	11	
	17'		DARKBROWN SILTY SAND COARSE GRAVEL, MOIST (SP)	3 8 6	12	
	18'		GRAY/BROWN CLAYEY SILT (ML)	3 5	13	
	19'		GRAY/BROWN SILTY SAND FINE GRAVEL, MOIST (SM)	7		
	20'		DARK BROWN SILT WITH TRACE OF SAND, MOIST (ML)	3 3 3	14	
	21'		UNDISTURBED SAMPLE 21' - 24' (SM/ML)		#1	
	24'		GRAY/BROWN SILTY LEAN CLAY, MOIST (CL/CH)	2 3 4	15	
	26'			1 1 1	16	
	27'			1 1 1	17	
	28'		UNDISTURBED SAMPLE 28' - 31' SAME	1 1 1	18	
	30'		ROCKBITTED: NO SAMPLE			
	31'					
	32'					
	33'					

ENG FORM 1836A
(CADD Facsimilie)

PROJECT PASSAIC RIVER FLOOD PROTECTION, MAIN TUNNEL

HOLE NO. HLK-1-94

Hole No. HLK-1-94

DRILLING LOG	DIVISION NORTH ATLANTIC	INSTALLATION NEW YORK DISTRICT	SHEET 3 OF 6 SHEETS

LEVATION a.	DEPTH b.	LEGEND c.	CLASSIFICATION OF MATERIALS (Description) d.	SPT BLOWS	SAMPLE/ BOX NO. f.	REMARKS (Drilling Time, water loss, etc.) g.
	34'		UNDISTURBED SAMPLE 33' - 36' SAME			
	35'		GRAY /BROWN SILTY CLAY MOIST (CH)	WT/HMR	19	
	36'			"		
				"		
	37'		ROCKBITTED: NO SAMPLE			
	38'					
	39'					
	40'		GRAY/BROWN SILTY CLAY MOIST (CH)	1	20	
				1		
	41'			2		
			ROCKBITTED: NO SAMPLE			
	42'					
	43'					
	44'					
	45'		GRAY/BROWN SILTY LEAN CLAY, MOIST (CL)	1	21	
				1		
	46'			2		
			ROCKBITTED: NO SAMPLE			
	47'					
	48'					
	49'					
	50'		GRAY/BROWN SILTY CLAY MOIST (CH)	1	22	
				1		
	51'			2		
	52'		ROCKBITTED: NO SAMPLE			

Hole No. HLK-1-94

DRILLING LOG	DIVISION NORTH ATLANTIC	INSTALLATION NEW YORK DISTRICT	SHEET 4 OF 6 SHEETS

ELEVATION a.	DEPTH b.	LEGEND c.	CLASSIFICATION OF MATERIALS (Description) d.	SPT BLOWS	SAMPLE/ BOX NO. f.	REMARKS (Drilling Time, water loss, etc.) g.
	53'		SAME			
	54'					
	55'		REDDISH/BROWN SILTY	2		
			LEAN CLAY WITH SAND	2	23	
	56'		SEAM, MOIST	3		
			(CL)			
			ROCKBITTED:			
	57'		NO SAMPLE			
	58'					
	59'					
	60'		REDDISH/BROWN CLAYEY	1		
			SILT WITH TRACE OF	3	24	
	61'		SAND, MOIST	6		
			(ML)			
			ROCKBITTED:			
	62'		NO SAMPLE			
	63'					
	64'					
	65'		REDDISH/BROWN SILTY	2		
			CLAY, MOIST	2	25	
	66'		(CH)	3		
			ROCKBITTED:			
	67'		NO SAMPLE			
	68'					
	69'					
	70'		REDDISH/BROWN SILTY	2		
			CLAY, MOIST	2	26	
	71'		(CH)			

ENG FORM 1836A

(CADD Facsimilie)

PROJECT PASSAIC RIVER FLOOD PROTECTION, MAIN TUNNEL

HOLE NO. HLK-1-94

Hole No. HLK-1-94

DRILLING LOG	DIVISION NORTH ATLANTIC	INSTALLATION NEW YORK DISTRICT	SHEET 5 OF 6 SHEETS

ELEVATION a.	DEPTH b.	LEGEND c.	CLASSIFICATION OF MATERIALS (Description) d.	SPT BLOWS	SAMPLE/ BOX NO. f.	REMARKS (Drilling Time, water loss, etc.) g.
				3	26	
	72'		ROCKBITTED: NO SAMPLE			
	73'					
	74'					
	75'		REDDISH/BROWN SILTY LEAN CLAY, MOIST (CL)	2		
	76'			2	27	
				3		
	77'		ROCKBITTED: NO SAMPLE			
	78'					
	79'					
	80'		REDDISH/BROWN CLAYEY SILT, MOIST (ML)	2		
	81'			3	28	
				2		
	82'		ROCKBITTED: NO SAMPLE			
	83'					
	84'					
	85'		CLAYEY SAND, COARSE GRAVEL, MOIST (SC)	9		
	86'			18	29	
				24		
	87'		ROCKBITTED: NO SAMPLE			
	88'		WEATHERED ROCK-SHALE			
	89'					
	90'					

ENG FORM 1836A
(CADD Facsimilie)

PROJECT PASSAIC RIVER FLOOD PROTECTION, MAIN TUNNEL

HOLE NO. HLK-1-94

Hole No. HLK-1-94

DRILLING LOG	DIVISION NORTH ATLANTIC	INSTALLATION NEW YORK DISTRICT	SHEET 6 OF 6 SHEETS

ELEVATION a.	DEPTH b.	LEGEND c.	CLASSIFICATION OF MATERIALS (Description) d.	SPT BLOWS	SAMPLE/ BOX NO. f.	REMARKS (Drilling Time, water loss, etc.) g.
			WEATHERED ROCK-SHALE		30	
			BOTTOM OF HOLE = 90.4'			
	91'					
	92'					
	93'					
	94'					
	95'					
	96'					
	97'					
	98'					
	99'					
	100'					
	101'					
	102'					
	103'					
	104'					
	105'					
	106'					
	107'					
	108'					
	109'					

ENG FORM 1836A
(CADD Facsimilie)

PROJECT PASSAIC RIVER FLOOD PROTECTION, MAIN TUNNEL

HOLE NO. HLK-1-94

Hole No. HLK-2

DRILLING LOG	DIVISION NORTH ATLANTIC	INSTALLATION NEW YORK DISTRICT	SHEET 1 OF 6 SHEETS

1. PROJECT PASSAIC RIVER FLOOD PROTECTION, MAIN TUNNEL		10. SIZE AND TYPE OF BIT	
2. LOCATION (Coordinates or Station) HURRICANE LEVEE-KEARNY		11. DATUM FOR ELEVATION SHOWN (TBM or MSL) NGVD	
3. DRILLING AGENCY MOBILE		12. MANUFACTURER'S DESIGNATION OF DRILL FAILING 314	
4. HOLE NO. (As shown on drawing title and file number)	HLK-2	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED 36 / UNDISTURBED
5. NAME OF DRILLER CHARLIE BROWN		14. TOTAL NUMBER CORE BOXES	
6. DIRECTION OF HOLE [X] VERTICAL [ ] INCLINED _____ DEGREES FROM VERTICAL		15. ELEVATION GROUND WATER 2 ±	
		16. DATE HOLE	STARTED 12-5-94 / COMPLETED 12-7-94
7. THICKNESS OF OVERBURDEN		17. ELEVATION TOP OF HOLE 8 ±	
8. DEPTH DRILLED INTO ROCK		18. TOTAL CORE RECOVERY FOR BORING	
9. TOTAL DEPTH OF HOLE 101.5		19. SIGNATURE OF INSPECTOR LESLIE	

ELEVATION a.	DEPTH b.	LEGEND c.	CLASSIFICATION OF MATERIALS (Description) d.	SPT BLOWS	SAMPLE/ BOX NO. f.	REMARKS (Drilling Time, water loss, etc.) g.
			ASPHALT PAVEMENT			
	1'		BROWN SILT WITH COARSE GRAVEL (ML) FILL	8 16	1	0.3' RECOVERY
	2'		SAME -FILL	7 15 16	2	0.4' RECOVERY
	3'		SAME -FILL	11 7 4	3	0.4' RECOVERY
	4'					
	5'		RED BROWN SANDY CLAY TRACE OF FINE GRAVEL (CL) -FILL	3 2 7	4	0.4' RECOVERY GROUNDWATER AT 6.0'
	6'		RED BROWN SILT WITH GRAVEL (ML) -FILL	2 5 25	5	0.7' RECOVERY
	7'					
	8'		REFUSAL ON BOULDER/ OBSTRUCTION AT 7.3'			
	9'		RED BROWN SAND, LITTLE SILT (SM) -FILL	3 3 3	6	1.5' RECOVERY
	10'					
	11'		RED BROWN SILTY GRAVEL, WITH WOOD FRAGMENTS (GM) -FILL	3 1 1	7	0.0' RECOVERY
	12'		DARK BROWN ORGANIC SILT TRACES OF ORGANIC MATTER (OL)	1 2 5	8	0.1' RECOVERY
	13'					
	14'		(SM-SP)	6	9	1.5' RECOVERY

ENG FORM 1836
(CADD Facsimile)

PROJECT PASSAIC RIVER FLOOD PROTECTION, MAIN TUNNEL | HOLE NO. HLK-2

Hole No. HLK-2

DRILLING LOG	DIVISION NORTH ATLANTIC	INSTALLATION NEW YORK DISTRICT	SHEET 2 OF 6 SHEETS

ELEVATION a.	DEPTH b.	LEGEND c.	CLASSIFICATION OF MATERIALS (Description) d.	SPT BLOWS	SAMPLE/ BOX NO. f.	REMARKS (Drilling Time, water loss, etc.) g.
	15'		BROWN SAND, LITTLE FINE GRAVEL, LITTLE SILT (SM-SP)	8 11	9	1.5' RECOVERY
	16'		SAME	11 12 15	10	1.0' RECOVERY
	17'		SAME	8 8 8	11	0.5' RECOVERY
	18'		GRAY SILTY CLAY, TRACE OF FINE SAND, VARVED (CL)	5 8 10	12	1.5' RECOVERY
	19'		SAME	9 10 12	13	1.0' RECOVERY
	20'		SAME	7 10 12	14 15	1.0' RECOVERY
	21'		BROWN FINE SAND, TRACE (f-c) GRAVEL, TRACE SILT (SM-SP)	9 8 11	16 17	0.8' RECOVERY
	22'		SAME	8 10 12	18	1.2' RECOVERY
	23'		SAME	4 8 11	19	1.0' RECOVERY
	24'		SAME	8 9 8	20	1.0' RECOVERY
	25'		SAME	3 4 6	21	0.7' RECOVERY
	26'		GRAY SILTY CLAY, TRACE OF FINE SAND, VARVED (CL)	6 8 11	22	1.0' RECOVERY
	27'					
	28'					
	29'					
	30'					
	31'					
	32'					
	33'					

ENG FORM 1836A
(CADD Facsimilie)

PROJECT PASSAIC RIVER FLOOD PREVENTION, MAIN TUNNEL | HOLE NO. HLK-2

Hole No. HLK-2

DRILLING LOG	DIVISION NORTH ATLANTIC	INSTALLATION NEW YORK DISTRICT	SHEET 3 OF 6 SHEETS

ELEVATION a.	DEPTH b.	LEGEND c.	CLASSIFICATION OF MATERIALS (Description) d.	SPT BLOWS	SAMPLE/ BOX NO. f.	REMARKS (Drilling Time, water loss, etc.) g.
	34'					
	35'		SAME	9	23	1.5' RECOVERY
	36'			16		
				16		
	37'					
	38'					
	39'					
	40'		SAME	5	24	1.5' RECOVERY
	41'			8		
				9		
	42'					
	43'					
	44'					
	45'		SAME	4	25	1.5' RECOVERY
	46'			8		
				8		
	47'					
	48'					
	49'					
	50'		SAME	5	26	1.5' RECOVERY
	51'			7		
				7		
	52'					

ENG FORM 1836A
(CADD Facsimilie)

PROJECT PASSAIC RIVER FLOOD PROTECTION, MAIN TUNNEL | HOLE NO. HLK-2

Hole No. HLK-2

DRILLING LOG	DIVISION NORTH ATLANTIC	INSTALLATION NEW YORK DISTRICT	SHEET 4 OF 6 SHEETS

ELEVATION a.	DEPTH b.	LEGEND c.	CLASSIFICATION OF MATERIALS (Description) d.	SPT BLOWS	SAMPLE/ BOX NO. f.	REMARKS (Drilling Time, water loss, etc.) g.
	53'					
	54'					
	55'		SAME	4		1.5' RECOVERY
	56'			5	27	
				8		
	57'					
	58'					
	59'					
	60'		SAME	6		1.5' RECOVERY
	61'			4	28	
				5		
	62'					
	63'					
	64'					
	65'		SAME	WH		1.5' RECOVERY
	66'			WH	29	
				5		
	67'					
	68'					
	69'					
	70'		SAME	1		1.5' RECOVERY
	71'			1	30	

ENG FORM 1836A
(CADD Facsimilie)

PROJECT PASSAIC RIVER FLOOD PROTECTION, MAIN TUNNEL | HOLE NO. HLK-2

Hole No. HLK-2

DRILLING LOG	DIVISION NORTH ATLANTIC	INSTALLATION NEW YORK DISTRICT	SHEET 5 OF 6 SHEETS

ELEVATION a.	DEPTH b.	LEGEND c.	CLASSIFICATION OF MATERIALS (Description) d.	SPT BLOWS	SAMPLE/ BOX NO. f.	REMARKS (Drilling Time, water loss, etc.) g.
	72'		SAME	2	30	
	73'					
	74'					
	75'		SAME	2		1.5' RECOVERY
	76'			3	31	
				4		
	77'					
	78'					
	79'					
	80'		SAME	6		1.5' RECOVERY
	81'			6	32	
				7		
	82'					
	83'					
	84'					
	85'		SAME	9		1.0' RECOVERY
	86'			8	33	
				9		
	87'					
	88'					
	89'					
	90'					

ENG FORM 1836A
(CADD Facsimilie)

PROJECT PASSAIC RIVER FLOOD PROTECTION, MAIN TUNNEL | HOLE NO. HLK-2

Hole No. HLK-2

DRILLING LOG	DIVISION NORTH ATLANTIC	INSTALLATION NEW YORK DISTRICT	SHEET 6 OF 6 SHEETS

ELEVATION a.	DEPTH b.	LEGEND c.	CLASSIFICATION OF MATERIALS (Description) d.	SPT BLOWS	SAMPLE/ BOX NO. f.	REMARKS (Drilling Time, water loss, etc.) g.
	91'		SAME	2 3 3	34	1.5' RECOVERY
	92'					
	93'					
	94'					
	95'		SAME	2 4 6	35	1.5' RECOVERY
	96'					
	97'					
	98'					
	99'					
	100'		SAME	2 3 3	36	1.5' RECOVERY
	101'					
	102'		BOTTOM OF HOLE = 101.5'			
	103'					
	104'					
	105'					
	106'					
	107'					
	108'					
	109'					

ENG FORM 1836A
(CADD Facsimilie)

PROJECT PASSAIC RIVER FLOOD PROTECTION, MAIN TUNNEL | HOLE NO. HLK-2

Hole No. HLK-3

DRILLING LOG	DIVISION NORTH ATLANTIC	INSTALLATION NEW YORK DISTRICT	SHEET 1 OF 4 SHEETS

1. PROJECT	PASSAIC RIVER FLOOD PROTECTION, HURRICANE LEVEE
2. LOCATION (Coordinates or Station)	KEARNY POINT, NJ
3. DRILLING AGENCY	MOBILE DIST.
4. HOLE NO. (As shown on drawing title and file number)	HLK-3
5. NAME OF DRILLER	C. MOON
6. DIRECTION OF HOLE	[X] VERTICAL [ ] INCLINED _____ DEGREES FROM VERTICAL
7. THICKNESS OF OVERBURDEN	65.0
8. DEPTH DRILLED INTO ROCK	5.2
9. TOTAL DEPTH OF HOLE	70.2
10. SIZE AND TYPE OF BIT	5" AUGUR, 3-7/8" ROCK
11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	NGVD
12. MANUFACTURER'S DESIGNATION OF DRILL	F-314, CD-38
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED 29 / UNDISTURBED
14. TOTAL NUMBER CORE BOXES	
15. ELEVATION GROUND WATER	1 ±
16. DATE HOLE	STARTED 8-10-94 / COMPLETED 8-16-94
17. ELEVATION TOP OF HOLE	7 ±
18. TOTAL CORE RECOVERY FOR BORING	
19. SIGNATURE OF INSPECTOR	BEN W. BRYANT

ELEVATION a.	DEPTH b.	LEGEND c.	CLASSIFICATION OF MATERIALS (Description) d.	SPT BLOWS	SAMPLE/ BOX NO. f.	REMARKS (Drilling Time, water loss, etc.) g.
	1'		ASPHALT PAVEMENT BROWN SILTY GRAVEL, MOIST (GM) -FILL	2 7 6	1	
	2'		DARK GRAY, SAME	4 4 3	2	
	3'		SAME	7 4 4	3	
	5'			21 25 40	4	
	6'		RED/BROWN SANDY SILTY GRAVEL, MOIST (GM) -FILL	28 16 22	5	
	8'		NO RECOVERY	11 13 10	6	SLIPPED OUT OF SPOON
	9'		RED/BROWN SANDY SILTY GRAVEL, MOIST (GM) -FILL	5 10 5	7	
	11'		SAME	7 9 15	8	
	12'		NO RECOVERY	7 5 8	9	SLIPPED OUT OF SPOON
	14'		(SM)	8	10	

ENG FORM 1836
(CADD Facsimilie)

PROJECT PASSAIC RIVER FLOOD PROTECTION, HURRICANE LEVEE | HOLE NO. HLK-3

Hole No. HLK-3

DRILLING LOG | DIVISION NORTH ATLANTIC | INSTALLATION NEW YORK DISTRICT | SHEET 2 OF 4 SHEETS

ELEVATION a.	DEPTH b.	LEGEND c.	CLASSIFICATION OF MATERIALS (Description) d.	SPT BLOWS	SAMPLE/ BOX NO. f.	REMARKS (Drilling Time, water loss, etc.) g.
	15'		RED/BROWN SILTY SAND, COURSE GRAVEL, MOIST (SM) –FILL	8 10	10	
	16'		SAME	10 10 9	11	
	17'		NO RECOVERY	32 13 9	12	SLIPPED OUT OF SPOON
	18'		SANDY SILTY GRAVEL, MOIST (GM) –FILL	8 8 7	13	
	20'			12 9 12	14	
	21'		NO RECOVERY	19 12 8	15	SLIPPED OUT OF SPOON
	23'		RED/BROWN SANDY SILTY GRAVEL, MOIST (GM) –FILL	12 12 13	16	
	24'		NO RECOVERY	15 7 9	17	SLIPPED OUT OF SPOON
	26'		RED/BROWN SANDY SILTY GRAVEL, MOIST (GM)	13 12 9	18	
	27'		NO RECOVERY	7 6	19	SLIPPED OUT OF SPOON
	28'		NO RECOVERY	1 1 6 10	20	SLIPPED OUT OF SPOON
	30'		BLACK ORGANIC CLAY, WET (OH)	9 8 5 6	21	
	32'		ROCKBITTED: NO SAMPLE			
	33'					

ENG FORM 1836A
(CADD Facsimilie)

PROJECT PASSAIC RIVER FLOOD PREVENTION, HURRICANE LEVEE | HOLE NO. HLK-3

Hole No. HLK-3

DRILLING LOG	DIVISION NORTH ATLANTIC	INSTALLATION NEW YORK DISTRICT	SHEET 3 OF 4 SHEETS

ELEVATION a.	DEPTH b.	LEGEND c.	CLASSIFICATION OF MATERIALS (Description) d.	SPT BLOWS	SAMPLE/ BOX NO. f.	REMARKS (Drilling Time, water loss, etc.) g.
	34					
	35		NO RECOVERY	16		SLIPPED OUT OF SPOON
				11	22	
	36			8		
	37					
	38					
	39					
	40		BROWN SILTY LEAN CLAY, MOIST (CL)	6		
				8	23	
	41			8		
	42					
	43					
	44					
	45		BROWN SILTY SAND, MEDIUM GRAVEL, MOIST (SM)	15		
				13	24	
	46			9		
	47					
	48					
	49					
	50		BROWN SILTY SAND, MEDIUM GRAVEL, MOIST (SM)	27		
				30	25	
	51			45		
	52		ROCKBITTED: NO SAMPLE			

ENG FORM 1836A
(CADD Facsimilie)

PROJECT PASSAIC RIVER FLOOD PROTECTION, MAIN TUNNEL | HOLE NO. HLK-3

Hole No. HLK-3

DRILLING LOG	DIVISION NORTH ATLANTIC	INSTALLATION NEW YORK DISTRICT	SHEET 4 OF 4 SHEETS

ELEVATION a.	DEPTH b.	LEGEND c.	CLASSIFICATION OF MATERIALS (Description) d.	SPT BLOWS	SAMPLE/ BOX NO. f.	REMARKS (Drilling Time, water loss, etc.) g.
	53'					
	54'					
	55'		NO RECOVERY	10		SLIPPED OUT OF SPOON
				10	26	
	56'			24		
			ROCKBITTED: NO SAMPLE			
	57'					
	58'					
	59'					
	60'		BROWN SILTY LEAN CLAY, MOIST (CL)	7		
				6	27	
	61'			6		
			ROCKBITTED: NO SAMPLE			
	62'					
	63'					
	64'					
	65'		RED/BROWN SILTY GRAVEL, MOIST (WEATHERED ROCK)	6		
				28	28	
	66'		TOP OF ROCK = 65'	50		
			ROCKBITTED NO SAMPLE			
	67'					
	68'					
	69'					
	70'		RED/BROWN SILTY GRAVEL	50		
					29	
	71'		-BOTTOM OF HOLE=70.2'			

ENG FORM 1836A
(CADD Facsimilie)

PROJECT PASSAIC RIVER FLOOD PROTECTION, MAIN TUNNEL | HOLE NO. HLK-3

Hole No. HLK-4

DRILLING LOG	DIVISION NORTH ATLANTIC	INSTALLATION NEW YORK DISTRICT	SHEET 1 OF 6 SHEETS

1. PROJECT	PASSAIC RIVER FLOOD PROTECTION, HURRICANE LEVEE
2. LOCATION (Coordinates or Station)	KEARNY POINT, NJ
3. DRILLING AGENCY	MOBILE DIST.
4. HOLE NO. (As shown on drawing title and file number)	HLK-4 (C-6)
5. NAME OF DRILLER	C. MOON
6. DIRECTION OF HOLE	☒ VERTICAL ☐ INCLINED _____ DEGREES FROM VERTICAL
7. THICKNESS OF OVERBURDEN	99.6
8. DEPTH DRILLED INTO ROCK	403.1
9. TOTAL DEPTH OF HOLE	504.7
10. SIZE AND TYPE OF BIT	5" AUGUR
11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	NGVD
12. MANUFACTURER'S DESIGNATION OF DRILL	F-314, CD-38
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED 27 / UNDISTURBED
14. TOTAL NUMBER CORE BOXES	39
15. ELEVATION GROUND WATER	0 ±
16. DATE HOLE	STARTED 7-21-94 / COMPLETED 8-30-94
17. ELEVATION TOP OF HOLE	9 ±
18. TOTAL CORE RECOVERY FOR BORING	99.6
19. SIGNATURE OF INSPECTOR	BEN BRYANT

ELEVATION a.	DEPTH b.	LEGEND c.	CLASSIFICATION OF MATERIALS (Description) d.	SPT BLOWS	SAMPLE/ BOX NO. f.	REMARKS (Drilling Time, water loss, etc.) g.
			ASPHALT PAVEMENT	6		NO SAMPLE
	1'		GRAY SILTY SAND, COARSE GRAVEL (SM) -FILL	6	1	
				7		
	2'		GRAY AND BROWN SILTY GRAVEL, WITH SOME WOOD, MOIST CINDERS. (GM) -FILL	14		
				10	2	
				9		
	3'		DARK GRAY SILTY SAND, COARSE GRAVEL, MOIST (SM) -FILL	5		
				7	3	
	4'			4		
	5'			3		
				2	4	
				2		
	6'		NO RECOVERY	1		SLIPPED OUT OF SPOON
				1	5	
	7'			2		
	8'		BROWN SILTY SAND, FINE GRAVEL WITH SOME WOOD, MOIST (SM) -FILL	6		
				12	6	
				50		
	9'		NO RECOVERY	50	7	ROD DROP
	10'					
	11'				8	
	12'				9	
	13'					
	14'				10	

ENG FORM 1836
(CADD Facsimilie)

PROJECT PASSAIC RIVER FLOOD PROTECTION, HURRICANE LEVEE | HOLE NO. HLK-4

Hole No. HLK-4

DRILLING LOG	DIVISION NORTH ATLANTIC	INSTALLATION NEW YORK DISTRICT	SHEET 2 OF 6 SHEETS

ELEVATION a.	DEPTH b.	LEGEND c.	CLASSIFICATION OF MATERIALS (Description) d.	SPT BLOWS	SAMPLE/ BOX NO. f.	REMARKS (Drilling Time, water loss, etc.) g.
	15'		NO RECOVERY		10	
	16'				11	
	17'				12	
	18'				13	
	19'				14	
	20'				15	
	21'				16	
	22'				17	
	23'				18	
	24'		BLACK ORGANIC CLAY, WET VERY SOFT (OH)		19	
	25'				20	
	26'		NO RECOVERY		21	
	27'					
	28'					
	29'					
	30'					
	31'					
	32'		GRAY SILTY SAND, MEDIUM GRAVEL, MOIST (SM)	8	22	
	33'			8		

ENG FORM 1836A
(CADD Facsimilie)

PROJECT PASSAIC RIVER FLOOD PREVENTION, HURRICANE LEVEE | HOLE NO. HLK-4

Hole No. HLK-4

DRILLING LOG	DIVISION NORTH ATLANTIC	INSTALLATION NEW YORK DISTRICT	SHEET 3 OF 6 SHEETS

ELEVATION a.	DEPTH b.	LEGEND c.	CLASSIFICATION OF MATERIALS (Description) d.	SPT BLOWS	SAMPLE/ BOX NO. f.	REMARKS (Drilling Time, water loss, etc.) g.
	34'		SAME	7 8	22	
			ROCKBITTED: NO SAMPLE			
	35'		BROWN/GRAY SILTY SAND, FINE GRAVEL, MOIST (SM)	20 18 17	23	
	36'					
	37'		ROCKBITTED: NO SAMPLE			
	38'					
	39'					
	40'		BROWN/GRAY SILTY SAND, FINE GRAVEL, MOIST (SM)		24	
	41'					
	42'		ROCKBITTED: NO SAMPLE			
	43'					
	44'					
	45'		RED/BROWN CLAYEY SILT, MOIST (ML)	5 7 14	25	
	46'					
	47'		ROCKBITTED: NO SAMPLE			
	48'					
	49'					
	50'		NO RECOVERY	14 17 16	26	SLIPPED OUT OF SPOON
	51'					
	52'		ROCKBITTED: NO SAMPLE			

ENG FORM 1836A
(CADD Facsimilie)

PROJECT PASSAIC RIVER FLOOD PROTECTION, HURRICANE LEVEE | HOLE NO. HLK-4

Hole No. HLK-4

DRILLING LOG	DIVISION NORTH ATLANTIC	INSTALLATION NEW YORK DISTRICT	SHEET 4 OF 6 SHEETS

ELEVATION a.	DEPTH b.	LEGEND c.	CLASSIFICATION OF MATERIALS (Description) d.	SPT BLOWS	SAMPLE/ BOX NO. f.	REMARKS (Drilling Time, water loss, etc.) g.
	53'					
	54'					
	55'		RED/BROWN CLAYEY SILT MOIST (ML)		27	
	56'					
	57'		DRILLED AHEAD TO TOP OF ROCK, NO SAMPLING			
	58'					
	59'					
	60'					
	61'					
	62'					
	63'					
	64'					
	65'					
	66'					
	67'					
	68'					
	69'					
	70'					
	71'					

ENG FORM 1836A
(CADD Facsimilie)

PROJECT PASSAIC RIVER FLOOD PROTECTION, HURRICANE LEVEE | HOLE NO. HLK-4

Hole No. HLK-4

DRILLING LOG	DIVISION NORTH ATLANTIC	INSTALLATION NEW YORK DISTRICT	SHEET 5 OF 6 SHEETS

ELEVATION a.	DEPTH b.	LEGEND c.	CLASSIFICATION OF MATERIALS (Description) d.	SPT BLOWS	SAMPLE/ BOX NO. f.	REMARKS (Drilling Time, water loss, etc.) g.
	72'		ROCKBITTED: NO SAMPLE			
	73'					
	74'					
	75'					
	76'					
	77'					
	78'					
	79'					
	80'					
	81'					
	82'					
	83'					
	84'					
	85'					
	86'					
	87'					
	88'					
	89'					
	90'					

ENG FORM 1836A
(CADD Facsimilie)

PROJECT PASSAIC RIVER FLOOD CONTROL HURRICANE LEVEE

HOLE NO. HLK-4

Hole No. HLK-4

DRILLING LOG	DIVISION NORTH ATLANTIC	INSTALLATION NEW YORK DISTRICT	SHEET 6 OF 6 SHEETS

ELEVATION a.	DEPTH b.	LEGEND c.	CLASSIFICATION OF MATERIALS (Description) d.	SPT BLOWS	SAMPLE/ BOX NO. f.	REMARKS (Drilling Time, water loss, etc.) g.
	91'		ROCKBITTED: NO SAMPLE			
	92'					
	93'					
	94'					
	95'					
	96'					
	97'					
	98'					
	99'		TOP OF ROCK = 99.6'			
	100'		RED/BROWN MODERATLY WEATHERED SILT STONE, FRACTURED			
	101'		ROCK CORE DRILLING TO 504.7'			
	102'					
	103'					
	104'					
	105'					
	106'					
	107'					
	108'					
	109'					

ENG FORM 1836A
(CADD Facsimilie)

PROJECT PASSAIC RIVER FLOOD PROTECTION HURRICANE LEVEE

HOLE NO. HLK-4

DRILLING LOG	DIVISION NORTH ATLANTIC	INSTALLATION NEW YORK DISTRICT	SHEET 1 OF 3 SHEETS

1. PROJECT PASSAIC RIVER FLOOD PROTECTION, HURRICANE LEVEE	10. SIZE AND TYPE OF BIT 5" AUGUR&3-5/8" ROCKBIT
2. LOCATION (Coordinates or Station) KEARNY POINT, NJ	11. DATUM FOR ELEVATION SHOWN (TBM or MSL) NGVD
3. DRILLING AGENCY MOBILE DIST.	12. MANUFACTURER'S DESIGNATION OF DRILL F-314, CD-38
4. HOLE NO. (As shown on drawing title and file number) HLK-5	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN — DISTURBED 24 — UNDISTURBED
5. NAME OF DRILLER C. MOON	14. TOTAL NUMBER CORE BOXES
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED _____ DEGREES FROM VERTICAL	15. ELEVATION GROUND WATER 1.5 ±
	16. DATE HOLE — STARTED 9-16-94 — COMPLETED 9-19-94
7. THICKNESS OF OVERBURDEN	17. ELEVATION TOP OF HOLE 7.5±
8. DEPTH DRILLED INTO ROCK	18. TOTAL CORE RECOVERY FOR BORING
9. TOTAL DEPTH OF HOLE 51.5'	19. SIGNATURE OF INSPECTOR BEN W. BRYANT

ELEVATION a.	DEPTH b.	LEGEND c.	CLASSIFICATION OF MATERIALS (Description) d.	SPT BLOWS	SAMPLE/ BOX NO. f.	REMARKS (Drilling Time, water loss, etc.) g.
			CONC. PAVEMENT			
	1'		BLACK SILTY GRAVEL, WITH SAND -FILL (GM)	18	1	
				21	2	
	2'			20		
				12		
	3'		-CINDERS (FILL)	7	3	
				6		
	4'			5		
				50	4	
	5'		AUGURED: NO SAMPLE			
	6'		BLACK SILTY GRAVEL, WITH SAND -FILL (GM)	6	5	
				10		
	7'			8		
			NO RECOVERY	8	6	
	8'			5		
				4		
	9'		BLACK SILTY SAND, COARSE GRAVEL, WET WITH BRICK FRAGMENTS -FILL (SM)	5	7	
				3		
	10'			2		
			BLACK SILTY GRAVEL, WITH SOME WOOD, WET -FILL (GM)	7	8	
	11'			8		
				10		
	12'		SAME WITH TRACE OF WOOD	8	9	
				10		
	13'			3		
			(SM)	1	10	
	14'					

ENG FORM 1836
(CADD Facsimilie)

PROJECT PASSAIC RIVER FLOOD PROTECTION, HURRICANE LEVEE | HOLE NO. HLK-5

Hole No. HLK-5

DRILLING LOG	DIVISION NORTH ATLANTIC	INSTALLATION NEW YORK DISTRICT	SHEET 2 OF 3 SHEETS

ELEVATION a.	DEPTH b.	LEGEND c.	CLASSIFICATION OF MATERIALS (Description) d.	SPT BLOWS	SAMPLE/ BOX NO. f.	REMARKS (Drilling Time, water loss, etc.) g.
	15'		BLACK SILTY SAND, COARSE GRAVEL, WET (SM)	2 1	10	
	16'		DARK GRAY SILTY LEAN CLAY, MOIST, VERY SOFT (OL)	1 1 1	11	
	17'			1 1 1	12	
	18'			HMR 1 1	13	
	20'		NO RECOVERY	HMR 1 1	14	
	21'		DARK GRAY SILTY LEAN CLAY, MOIST (OL)	1 1 1	15	
	23'		DARK GRAY AND BROWN SANDY SILTY LEAN CLAY, WITH TRACE ORGANIC MATL. MOIST (OL)	HMR HMR 1	16	
	24'		DARK BROWN SILTY SAND, FINE GRAVEL, MOIST (SM)	2 3 2	17	
	26'		NO RECOVERY	2 2 6	18	
	27'		DARK BROWN SILTY SAND, FINE GRAVEL, MOIST (SM)	6 5 8	19	
	29'			6 10 10	20	
	30'		ROCKBITTED: NO SAMPLE			
	31'					
	32'					
	33'					

ENG FORM 1836A
(CADD Facsimilie)

PROJECT PASSAIC RIVER FLOOD PREVENTION, HURRICANE LEVEE | HOLE NO. HLK-5

Hole No. HLK-5

DRILLING LOG	DIVISION NORTH ATLANTIC	INSTALLATION NEW YORK DISTRICT	SHEET 3 OF 3 SHEETS

ELEVATION a.	DEPTH b.	LEGEND c.	CLASSIFICATION OF MATERIALS (Description) d.	SPT BLOWS	SAMPLE/ BOX NO. f.	REMARKS (Drilling Time, water loss, etc.) g.
	34		ROCKBITTED: NO SAMPLE			
	35		NO RECOVERY	6		
				6	21	
	36			6		
	37		ROCKBITTED: NO SAMPLE			
	38					
	39					
	40		DARK BROWN SILTY SAND, WITH TRACE COARSE GRAVEL MOIST (SW)	5		
				8	22	
	41			6		
			ROCKBITTED: NO SAMPLE			
	42					
	43					
	44					
	45		RED/BROWN CLAYEY SILT, MOIST (ML)	5		
				10	23	
	46			7		
			ROCKBITTED: NO SAMPLE			
	47					
	48					
	49					
	50		RED/BROWN SILTY SAND, FINE GRAVEL, MOIST (SM)	9		
				19	24	
	51			27		
	52		BOTTOM OF HOLE = 51.5'			

ENG FORM 1836A
(CADD Facsimilie)

PROJECT PASSAIC RIVER FLOOD PROTECTION, HURRICANE LEVEE | HOLE NO. HLK-5

Hole No. DC-5

DRILLING LOG	DIVISION NORTH ATLANTIC	INSTALLATION NEW YORK DISTRICT	SHEET 1 OF 5 SHEETS

1. PROJECT	PASSAIC RIVER FLOOD PROTECTION, MAIN TUNNEL
2. LOCATION (Coordinates or Station)	WORKSHAFT 2C, 100 CENTRAL AVE, KEARNY, NJ
3. DRILLING AGENCY	B & B DRILLING
4. HOLE NO. (As shown on drawing title and file number)	DC-5 / IT-2C-PB01
5. NAME OF DRILLER	DOUG MYERCHIN
6. DIRECTION OF HOLE	[X] VERTICAL [ ] INCLINED _____ DEGREES FROM VERTICAL
7. THICKNESS OF OVERBURDEN	81'
8. DEPTH DRILLED INTO ROCK	429'
9. TOTAL DEPTH OF HOLE	510.2'
10. SIZE AND TYPE OF BIT	
11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	
12. MANUFACTURER'S DESIGNATION OF DRILL	
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED: / UNDISTURBED:
14. TOTAL NUMBER CORE BOXES	
15. ELEVATION GROUND WATER	
16. DATE HOLE	STARTED: / COMPLETED:
17. ELEVATION TOP OF HOLE	+8.89
18. TOTAL CORE RECOVERY FOR BORING	
19. SIGNATURE OF INSPECTOR	GERRY GILLILAND

ELEVATION a.	DEPTH b.	LEGEND c.	CLASSIFICATION OF MATERIALS (Description) d.	SPT BLOWS	SAMPLE/ BOX NO. f.	REMARKS (Drilling Time, water loss, etc.) g.
	1'					
	2'		REDDISH BROWN TO BLACK, F-M GRAVEL WITH SOME SAND AND SILT, TRACE BRICK FRAGMENTS -FILL (GM)	3		16" RECOVERY
	3'			10		
				26		
				33		
	4'					
	5'					
	6'		REDDISH BROWN, SANDY FINE GRAVEL (GM)	5		15" RECOVERY
	7'			5		
				2		
			BROWNISH-GRAY TO BLACK CLAY WITH SOME SILT AND LITTLE FINE SAND (OL)	2		
	8'					
	9'					
	10'		DARK BROWNISH-GRAY, ORGANIC CLAYEY SILT WITH TRACE SAND, VEG. REMAINS (OL)	1		20" RECOVERY
	11'			1		
				1		
	12'			1		
	13'					
	14'					

ENG FORM 1836
(CADD Facsimilie)

PROJECT PASSAIC RIVER FLOOD PROTECTION, MAIN TUNNEL

Hole No. DC-5

DRILLING LOG	DIVISION NORTH ATLANTIC	INSTALLATION NEW YORK DISTRICT	SHEET 2 OF 5 SHEETS

ELEVATION a.	DEPTH b.	LEGEND c.	CLASSIFICATION OF MATERIALS (Description) d.	SPT BLOWS	SAMPLE/ BOX NO. f.	REMARKS (Drilling Time, water loss, etc.) g.
	15'		SAME	1 1 1/12"		24" RECOVERY
	16'		...TRACE SHELL FRAGMENTS			
	17'					
	18'		...THIN PEAT LAYER AT BASE (PT)	1 1		24" RECOVERY
	19'		SATURATED, RECENT COURSE SAND WITH SOME SILT AND CLAY, TRACE GRAVEL (SM)	1 1		
	20'					
	21'					
	22'		SATURATED, SILTY M-C SAND WITH TRACE FINE GRAVEL (SM)	4 5		24" RECOVERY
	23'		DARK REDDISH/BROWN, SATURATED, CLEAN COURSE SAND AND FINE GRAVEL WITH TRACE SILT (GW)	7 9		
	24'					
	25'					
	26'		...GRADES TO LOWER GRAVEL CONTENT	6 18		24" RECOVERY
	27'			34		
			MODERATE BROWN, CLAYEY SILT, HIGH DILATANCY	82		
	28'		(ML)			
	29'					
	30'			8		24" RECOVERY
	31'		...LAMINATED	13 16		
	32'			22		
	33'					

ENG FORM 1836A
(CADD Facsimilie)

PROJECT PASSAIC RIVER FLOOD PREVENTION, MAIN TUNNEL | HOLE NO. DC-5

Hole No. DC-5

DRILLING LOG	DIVISION NORTH ATLANTIC	INSTALLATION NEW YORK DISTRICT	SHEET 3 OF 5 SHEETS

ELEVATION a.	DEPTH b.	LEGEND c.	CLASSIFICATION OF MATERIALS (Description) d.	SPT BLOWS	SAMPLE/ BOX NO. f.	REMARKS (Drilling Time, water loss, etc.) g.
	34		MODERATE REDDISH/BROWN TO MOD-BROWN, VARVED, CLAYEY SILT AND SILTY CLAY TRACE FINE SAND IN SOME LAYERS; HIGH DILATANCY (ML-CL)	9 9 10 11		24" RECOVERY
	35					
	36					
	37					
	38			7 5 4 17		24" RECOVERY
	39		F-M SAND, INTERBEDDED WITH SILT AND CLAY AT TOP (SM)			
	40					
	41					
	42		MOD-REDDISH/BROWN, F-M SAND, GRADING TO FINE/ VERY FINE SAND WITH LITTLE SILT (SP-SM)	7 11 15 12		24" RECOVERY
	43					
	44					
	45					
	46			5 6 10 14		24" RECOVERY
	47		MODERATE BROWN TO GRAYISH/BROWN, VARVED CLAYEY SILT AND CLAY AND FINE SAND (CL)			
	48					
	49					
	50		SAME	3 5 4 7		24" RECOVERY
	51					
	52					

ENG FORM 1836A
(CADD Facsimilie)

PROJECT PASSAIC RIVER FLOOD PROTECTION, MAIN TUNNEL | HOLE NO. DC-5

Hole No. DC-5

DRILLING LOG	DIVISION NORTH ATLANTIC	INSTALLATION NEW YORK DISTRICT	SHEET 4 OF 5 SHEETS

ELEVATION a.	DEPTH b.	LEGEND c.	CLASSIFICATION OF MATERIALS (Description) d.	SPT BLOWS	SAMPLE/ BOX NO. f.	REMARKS (Drilling Time, water loss, etc.) g.
	53'		SAME			
	54'					
	55'			4		20" RECOVERY
	56'		...PRONOUNCED VARVES	4		
				6		
	57'			7		
	58'					
	59'					
	60'		DARK GRAYISH/BROWN TO RED/BROWN, INTERBEDDED FINE SAND AND CLAYEY SILT; MOSTLY SAND AT BASE (SM)	4		24" RECOVERY
	61'			6		
				8		
	62'			9		
	63'					
	64'		(MH-CH)			
	65'		MOD-RED/BROWN TO BROWN/ GRAY, VARVED CLAYEY SILT AND CLAY WITH TRACE FINE SAND. CLAYEY SILT LAYERS ARE 2"-3", STIFF CLAY LAYERS ARE 0.5"-1" THICK	3		24" RECOVERY
	66'			4		
				4		
	67'			10		
	68'					
	69'					
	70'			2		24" RECOVERY
	71'		...WELL PRONOUNCED VARVES	3		

ENG FORM 1836A
(CADD Facsimilie)

PROJECT PASSAIC RIVER FLOOD PROTECTION, MAIN TUNNEL | HOLE NO. DC-5

Hole No. DC-5

DRILLING LOG	DIVISION NORTH ATLANTIC	INSTALLATION NEW YORK DISTRICT	SHEET 5 OF 5 SHEETS

ELEVATION a.	DEPTH b.	LEGEND c.	CLASSIFICATION OF MATERIALS (Description) d.	SPT BLOWS	SAMPLE/ BOX NO. f.	REMARKS (Drilling Time, water loss, etc.) g.
	72'			2		
				4		
	73'					
	74'					
	75'			8		20" RECOVERY
			MOSTLY SILT AT BASE	12		
	76'		WEATHERED ROCK: MOD-RED/ BROWN, SILTY, M-C SAND FINE GRAVEL (GM)	18		
				32		
	77'					
	78'					
	79'					
	80'			42		
			WEATHERED ROCK	145		
	81'		BEDROCK: SHALE (PASSAIC FORMATION)	100/1"		
	82'		ROCK DRILLING TO 510.2'			
	83'					
	84'					
	85'					
	86'					
	87'					
	88'					
	89'					
	90'					

ENG FORM 1836A
(CADD Facsimilie)

PROJECT PASSAIC RIVER FLOOD PROTECTION, MAIN TUNNEL | HOLE NO. DC-5

Hole No. HLD-1

DRILLING LOG	DIVISION NORTH ATLANTIC	INSTALLATION NEW YORK DISTRICT	SHEET 1 OF 4 SHEETS

1. PROJECT	PASSAIC RIVER FLOOD PROTECTION, MAIN TUNNEL	10. SIZE AND TYPE OF BIT	5" AUGUR & 4" ROCKBIT
2. LOCATION (Coordinates or Station)	DOREMUS AVE., NEWARK, N.J.	11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	NGVD
3. DRILLING AGENCY	MOBILE DIST.	12. MANUFACTURER'S DESIGNATION OF DRILL	F-314, CD-38
4. HOLE NO. (As shown on drawing title and file number)	HDL-1-94	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED 25 / UNDISTURBED
5. NAME OF DRILLER	C.MOON	14. TOTAL NUMBER CORE BOXES	
6. DIRECTION OF HOLE	☒ VERTICAL ☐ INCLINED _____ DEGREES FROM VERTICAL	15. ELEVATION GROUND WATER	0.5 ±
		16. DATE HOLE	STARTED 8-3-94 / COMPLETED 8-4-94
7. THICKNESS OF OVERBURDEN		17. ELEVATION TOP OF HOLE	5 ±
8. DEPTH DRILLED INTO ROCK		18. TOTAL CORE RECOVERY FOR BORING	
9. TOTAL DEPTH OF HOLE	56.5'	19. SIGNATURE OF INSPECTOR	B. BRYANT

ELEVATION a.	DEPTH b.	LEGEND c.	CLASSIFICATION OF MATERIALS (Description) d.	SPT BLOWS	SAMPLE/ BOX NO. f.	REMARKS (Drilling Time, water loss, etc.) g.
	1'		BROWN SILTY GRAVEL, 1/2" MAX., WITH SOME WOOD MOIST -FILL (GM)	2 5 50	1	
	2'		BLACK SILTY SAND, FINE GRAVEL, WITH SOME WOOD, MOIST -FILL (SM)	 	2	AUGURED SAMPLE FROM AUGUR
	3'		DARK GRAY SILTY SAND, MEDIUM GRAVEL, WITH SOME WOOD WET -FILL (SM)	11 2 3	3	
	4'			2 1 1	4	
	5'			wt/Hmr " "	5	
	6'					
	7'					
	8'		DARK GREY SILTY LEAN CLAY MOIST (CL)	wt/Hmr " 1	6	
	9'			wt/Hmr " "	7	
	10'					
	11'			1 1 2	8	
	12'			wt/Hmr 1 1	9	
	13'					
	14'			2	10	

ENG FORM 1836
(CADD Facsimilie)

PROJECT PASSAIC RIVER FLOOD PROTECTION, MAIN TUNNEL | HOLE NO. HDL-1-94

DRILLING LOG | DIVISION NORTH ATLANTIC | INSTALLATION NEW YORK DISTRICT | SHEET 2 OF 4 SHEETS

ELEVATION a.	DEPTH b.	LEGEND c.	CLASSIFICATION OF MATERIALS (Description) d.	SPT BLOWS	SAMPLE/ BOX NO. f.	REMARKS (Drilling Time, water loss, etc.) g.
	15'		SAME	1 2	10	
	16'			wt/Hmr " "	11	
	17'		DARK GREY SILTY SAND mEDIUM GRAVEL, MOIST (SM)	3 1 3	12	
	18'			1 2	13	
	19'			1		
	20'			2 2	14	
	21'			1 2	15	
	22'			2 1		
	23'		DARK BROWN ORGANIC CLAY, FINE GRAVEL MOIST (OH)	2 2	16	
	24'			2 3	17	
	25'		GREENISH-GRAY SILTY SAND, FINE GRAVEL MOIST (SM)	5 5		
	26'			4 4	18	
	27'		GRAY AND BROWN SILTY SAND MEDIUM GRAVEL	4 6 6	19	
	28'			8		
	29'		BROWN SAND (SW)	7 8	20	
	30'		ROCKBITTED: NO SAMPLE	8		
	31'					
	32'					
	33'					

ENG FORM 1836A
(CADD Facsimilie)

PROJECT PASSAIC RIVER FLOOD PROTECTION, MAIN TUNNEL | HOLE NO. HLD-1-94

DRILLING LOG	DIVISION NORTH ATLANTIC	INSTALLATION NEW YORK DISTRICT	SHEET 3 OF 4 SHEETS

ELEVATION a.	DEPTH b.	LEGEND c.	CLASSIFICATION OF MATERIALS (Description) d.	SPT BLOWS	SAMPLE/ BOX NO. f.	REMARKS (Drilling Time, water loss, etc.) g.
	33		ROCK BITTED: NO SAMPLE			
	34					
	35					
			BROWN WELL GRADED SAND COURSE GRAVEL MOIST (SW)	6 11 16	21	
	36					
	37		ROCK BITTED: NO SAMPLE			
	38					
	39					
	40					
			REDDISH BROWN SANDY INORGANIC SILT MOIST (ML)	23 11 11	22	
	41					
	42		ROCK BITTED: NO SAMPLE			
	43					
	44					
	45					
			REDDISH BROWN SILTY LEAN CLAY MOIST (CL)	6 8 8	23	
	46					
	47		ROCK BITTED: NO SAMPLE			
	48					
	49					
	50					
			REDDISH BROWN SILT MEDIUM GRAVEL, MOIST (ML)	21 28	24	
	51					

ENG FORM 1836A
(CADD Facsimilie)

PROJECT PASSAIC RIVER FLOOD PROTECTION. MAIN TUNNEL

HOLE NO. HLD-1-94

DRILLING LOG	DIVISION NORTH ATLANTIC	INSTALLATION NEW YORK DISTRICT	SHEET 4 OF 4 SHEETS

ELEVATION a.	DEPTH b.	LEGEND c.	CLASSIFICATION OF MATERIALS (Description) d.	SPT BLOWS	SAMPLE/ BOX NO. f.	REMARKS (Drilling Time, water loss, etc.) g.
			SAME	8	23	
	47		ROCK BITTED: NO SAMPLE			
	48					
	49					
	50		REDDISH BROWN SILT MEDIUM GRAVEL MOIST (ML)	21	24	
	51			28		
				15		
	52		ROCK BITTED: NO SAMPLE			
	53					
	54					
	55		REDDISH BROWN SILTY LEAN CLAY MOIST (CL)	17	25	
	56			10		
				8		
	57		BOTTOM OF HOLE			NOTE: WATER WAS ENCOUNTERED AT A DEPTH OF 4.5' NOTE: HOLE WAS GROUTED WITH FOUR BAGS OF CEMENT

ENG FORM 1836A
(CADD Facsimilie)

PROJECT PASSAIC RIVER FLOOD PROTECTION, MAIN TUNNEL

HOLE NO. HLD-1-94

Hole No. HLD-2-94

DRILLING LOG	DIVISION NORTH ATLANTIC	INSTALLATION NEW YORK DISTRICT	SHEET 1 OF 2 SHEETS
1. PROJECT PASSAIC RIVER FLOOD PROTECTION, MAIN TUNNEL		10. SIZE AND TYPE OF BIT 5" AUGUR&3-5/8" ROCKBIT	
2. LOCATION (Coordinates or Station) DOREMOS AVE., NEWARK, N.J.		11. DATUM FOR ELEVATION SHOWN (TBM or MSL) NGVD	
3. DRILLING AGENCY MOBILE DIST.		12. MANUFACTURER'S DESIGNATION OF DRILL F-314, CD-38	
4. HOLE NO. (As shown on drawing title and file number) HLD-2		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED 15 / UNDISTURBED
5. NAME OF DRILLER C. MOON		14. TOTAL NUMBER CORE BOXES	
6. DIRECTION OF HOLE [X] VERTICAL [ ] INCLINED _____ DEGREES FROM VERTICAL		15. ELEVATION GROUND WATER	
		16. DATE HOLE	STARTED 9-12-94 / COMPLETED 9-15-94
7. THICKNESS OF OVERBURDEN		17. ELEVATION TOP OF HOLE 12 ±	
8. DEPTH DRILLED INTO ROCK		18. TOTAL CORE RECOVERY FOR BORING	
9. TOTAL DEPTH OF HOLE 22.5'		19. SIGNATURE OF INSPECTOR	

ELEVATION a.	DEPTH b.	LEGEND c.	CLASSIFICATION OF MATERIALS (Description) d.	SPT BLOWS	SAMPLE/ BOX NO. f.	REMARKS (Drilling Time, water loss, etc.) g.
	1'		BLACK AND GRAY SILTY GRAVEL, 1" MAX, MOIST (GM)	8 11 6	1	
	2'			11 8 17	2	
	3'		BLACK SILTY SAND, COARSE GRAVEL, MOIST (SM)	30 50	3	
	4'		AUGURED: NO SAMPLE			
	5'		BLACK AND GRAY SANDY SILT W/ GRAVEL, 3/4" MAX MOIST (GM)	6 16 16	4	
	6'		1/2" MAX	5	5	
	7'			6 9		
	8'		AUGURED: NO SAMPLE	50	6	
	9'		NO RECOVERY	50	7	
	10'		AUGURED: NO SAMPLE			
	11'		BLACK&GRAY SILTY GRAVEL 1-1/4" MAX, MOIST (GM)	11 50	8	
			AUGURED: NO SAMPLE			
	12'		BLACK ORGANIC SILT, WITH ROCK FRAGMENTS, 3/4" MAX, WET (OH)	3 3 9	9	
	13'					
	14'		NO RECOVERY		10	

ENG FORM 1836

PROJECT PASSAIC RIVER FLOOD PROTECTION, MAIN TUNNEL | HOLE NO. HLD-2

Hole No. HLD-2-94

DRILLING LOG	DIVISION NORTH ATLANTIC	INSTALLATION NEW YORK DISTRICT	SHEET 2 OF 2 SHEETS

ELEVATION a.	DEPTH b.	LEGEND c.	CLASSIFICATION OF MATERIALS (Description) d.	SPT BLOWS	SAMPLE/ BOX NO. f.	REMARKS (Drilling Time, water loss, etc.) g.
	15'		NO RECOVERY	wt/hmr " " " "	10 11	
	16'					
	17'		BLACK ORGANIC SILT, WITH ROCK FRAGMENTS 1/2" MAX, WET (OH)	3 3 8	12	
	18'		BLACK SANDY SILTY GRAVEL, 1-1/4" MAX, MOIST (GM)	2 4 20	13	
	19'					
	20'			24 8 7	14	
	21'		NO RECOVERY		15	
	22'					
	23'		BOTTOM OF HOLE			NOTE: THE ABOVE MATERIAL IS INDUSTRIAL FILL
	24'					
	25'					
	26'					
	27'					
	28'					
	29'					
	30'					
	31'					
	32'					
	33'					

ENG FORM 1836A
(CADD Facsimilie)

PROJECT PASSAIC RIVER FLOOD PROTECTION, MAIN TUNNEL

HOLE NO. HLD-2-94

Hole No. HLL-1

DRILLING LOG	DIVISION NORTH ATLANTIC	INSTALLATION NEW YORK DISTRICT	SHEET 1 OF 4 SHEETS

1. PROJECT	PASSAIC RIVER FLOOD PROTECTION, MAIN TUNNEL	10. SIZE AND TYPE OF BIT	1-3/8" ID SPLITSPOON
2. LOCATION (Coordinates or Station)	LISTRER AVE., NEWARK, N.J.	11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	NGVD
3. DRILLING AGENCY	MOBILE DIST.	12. MANUFACTURER'S DESIGNATION OF DRILL	FAILING 314
4. HOLE NO. (As shown on drawing title and file number)	HLL-1 (DC-15)	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED 26 / UNDISTURBED
5. NAME OF DRILLER	BROWN / MOON	14. TOTAL NUMBER CORE BOXES	38
6. DIRECTION OF HOLE	[X] VERTICAL [ ] INCLINED _____ DEGREES FROM VERTICAL	15. ELEVATION GROUND WATER	1
		16. DATE HOLE	STARTED 10-31-94 / COMPLETED 11-22-94
7. THICKNESS OF OVERBURDEN	63.5'	17. ELEVATION TOP OF HOLE	7
8. DEPTH DRILLED INTO ROCK	438.6'	18. TOTAL CORE RECOVERY FOR BORING	97 %
9. TOTAL DEPTH OF HOLE	502.1'	19. SIGNATURE OF INSPECTOR	JAMES A. BIDDLE

ELEVATION a.	DEPTH b.	LEGEND c.	CLASSIFICATION OF MATERIALS (Description) d.	SPT BLOWS	SAMPLE/ BOX NO. f.	REMARKS (Drilling Time, water loss, etc.) g.
	1'		GRAY, BROW/BLACK COURSE TO FINE SILTY SAND, LITTLE FINE GRAVEL-FILL (SM)	36	1	NOTE: SPT VALUES ARE N VALUE IN BLOWS/FOOT
	2'		SAME WITH CINDERS AND ORGANIC MATERIAL -FILL	85	2	
	3'		SAME WITH ORGANIC SILT -FILL	16	3	
	4'					
	5'		DARK BROWNISH-GRAY ORGANIC CLAYEY SILT VERY SOFT (OH)	0	4	
	6'		SAME WITH SOME REDDISH-BROWN COURSE TO FINE SILTY SAND	2	5	
	7'		SAME GREENISH-GRAY WITH SOME FINE SILTY SAND	5	6	
	8'					
	9'			2	7	
	10'		DARK GRAYISH-BROWN PEAT WITH ORGANIC CLAYEY SILT (PT/OL)	2	8	
	11'					
	12'			4	9	
	13'					
	14'		(PT/OL)	4	10	

ENG FORM 1836

PROJECT PASSAIC RIVER FLOOD PROTECTION, MAIN TUNNEL | HOLE NO. HLL-1

Hole No. HLL-1

DRILLING LOG	DIVISION NORTH ATLANTIC	INSTALLATION NEW YORK DISTRICT	SHEET 2 OF 4 SHEETS

ELEVATION a.	DEPTH b.	LEGEND c.	CLASSIFICATION OF MATERIALS (Description) d.	SPT BLOWS	SAMPLE/ BOX NO. f.	REMARKS (Drilling Time, water loss, etc.) g.
	15'		GRAY/BLACK PEAT WITH ORGANIC CLAYEY SILT (PT/OL)	4	10	
	16'			6	11	
	17'		DARK GRAYISH/BROWN CLAYEY SILT (ML)	5	12	
	18'		GREENISH/GRAY CLAYEY SILT, (f-m) SAND (ML)	6	13	
	19'					
	20'		GRAY/BROWN CLAYEY SILT AND (f-m) SAND (ML/SM)	7	14	
	21'		GRAY SILTY (f-m) SAND TRACE ORGANIC MATTER WITH CLAYEY SILT LENSES (SM)	4	15	
	22'					
	23'			12	16	
	24'		GRAYISH/GREEN, MEDIUM TO FINE CLAYEY SAND (SC)	19	17	
	25'		REDDISH/BROWN, MEDIUM TO FINE POORLY GRADED SAND, SILT (SP)			
	26'			18	18	
	27'		VARIEGATED, TRACE OF COURSE SAND (SP)	21	19	
	28'					
	29'		BROWN (f-c) SAND, SILT, AND GRAVEL (SM)	28	20	
	30'					
	31'					
	32'					
	33'					

ENG FORM 1836A
(CADD Facsimilie)

PROJECT PASSAIC RIVER FLOOD PROTECTION, MAIN TUNNEL

HOLE NO. HLL-1

Hole No. HLL-1

DRILLING LOG | DIVISION NORTH ATLANTIC | INSTALLATION NEW YORK DISTRICT | SHEET 3 OF 4 SHEETS

ELEVATION a.	DEPTH b.	LEGEND c.	CLASSIFICATION OF MATERIALS (Description) d.	SPT BLOWS	SAMPLE/ BOX NO. f.	REMARKS (Drilling Time, water loss, etc.) g.
	34		SAME			
	35		RED BROWN (f-m) SAND TRACE OF GRAVEL (SM)	34	21	
	36					
	37					
	38					
	39					
	40		RED BROWN VERY FINE SAND, TRACE OF SILT (SP)	49	22	
	41					
	42					
	43					
	44					
	45		SAME	24	23	
	46					
	47					
	48					
	49					
	50		NO RECOVERY	29		
	51					
	52					

PROJECT PASSAIC RIVER FLOOD PROTECTION, MAIN TUNNEL | HOLE NO. HLL-1

ENG FORM 1836A
(CADD Facsimilie)

Hole No. HLL-1

DRILLING LOG	DIVISION NORTH ATLANTIC	INSTALLATION NEW YORK DISTRICT	SHEET 4 OF 4 SHEETS

ELEVATION a.	DEPTH b.	LEGEND c.	CLASSIFICATION OF MATERIALS (Description) d.	SPT BLOWS	SAMPLE/ BOX NO. f.	REMARKS (Drilling Time, water loss, etc.) g.
	53'					
	54'					
	55'		RED BROWN (f-m) SAND TRACE OF SILT (SP)	25	25	
	56'					
	57'					
	58'					
	59'					
	60'		REDDISH BROWN CLAYEY SILT, (f-c) SAND, GRAVEL (ML)	80	26	
	61'					
	62'					
	63'		TOP OF ROCK			
	64'		RED BROWN HIGHLY WEATHERED SHALE, FRACTURED			
	65'					
	66'		ROCK CORE DRILLING TO 502.1'			
	67'					
	68'					
	69'					
	70'					
	71'					

ENG FORM 1836A
(CADD Facsimilie)

PROJECT PASSAIC RIVER FLOOD PROTECTION, MAIN TUNNEL

HOLE NO. HLL-1

Hole No. HLS-1

DRILLING LOG	DIVISION NORTH ATLANTIC	INSTALLATION NEW YORK DISTRICT	SHEET 1 OF 4 SHEETS

1. PROJECT	PASSAIC RIVER FLOOD PROTECTION, MAIN TUNNEL
2. LOCATION (Coordinates or Station)	DEY ST. HARRISON, NJ
3. DRILLING AGENCY	USCE-C; MOBILE
4. HOLE NO. (As shown on drawing title and file number)	HLS-1
5. NAME OF DRILLER	JAMES KNOX
6. DIRECTION OF HOLE	☒ VERTICAL ☐ INCLINED _____ DEGREES FROM VERTICAL
7. THICKNESS OF OVERBURDEN	55.5
8. DEPTH DRILLED INTO ROCK	5.7
9. TOTAL DEPTH OF HOLE	61.2
10. SIZE AND TYPE OF BIT	2" SPTSPN W/3-1/4" ID
11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	NGVD
12. MANUFACTURER'S DESIGNATION OF DRILL	FAILING 314
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED 28 / UNDISTURBED
14. TOTAL NUMBER CORE BOXES	
15. ELEVATION GROUND WATER	1.5 ±
16. DATE HOLE	STARTED 11-14-94 / COMPLETED 11-18-94
17. ELEVATION TOP OF HOLE	6.5 ±
18. TOTAL CORE RECOVERY FOR BORING	
19. SIGNATURE OF INSPECTOR	LESLIE

ELEVATION a.	DEPTH b.	LEGEND c.	CLASSIFICATION OF MATERIALS (Description) d.	SPT BLOWS	SAMPLE/ BOX NO. f.	REMARKS (Drilling Time, water loss, etc.) g.
	1'		BLACK ORGANIC SILT WITH SAND, GLASS, CINDERS (OL) -FILL	8 28 26	1	1.5' RECOVERY
	2'		SAME BOULDER AT 1.8'	72	2	0.3' RECOVERY
	3'		BLACK SILT WITH SAND, CINDERS, BRICK (ML) -FILL	26 42 50	3	1.5' RECOVERY
	4'			16		GROUNDWATER AT 5.0'
	5'		RED/BROWN SILT, TRACE COURSE GRAVEL (ML)	16 8	4	0.4' RECOVERY
	6'		BROWN SAND, TRACE (m-f) GRAVEL, TRACE SILT (SM)	11 10 8	5	1.0' RECOVERY
	8'		RED BROWN SILT WITH SAND TRACE COURSE GRAVEL (ML)	8 5 5	6	0.1' RECOVERY
	9'		NO RECOVERY	5 4 4		0.0' RECOVERY
	11'		SAME	2 4 2	7	0.2' RECOVERY
	12'					DRILLER ACCIDENTILY CLEANED OUT TO 13.5'
	13'					
	14'		SAME	2	8	0.2' RECOVERY

ENG FORM 1836
(CADD Facsimilie)

PROJECT PASSAIC RIVER FLOOD PROTECTION, MAIN TUNNEL | HOLE NO. HLS-1

Hole No. HLS-1

DRILLING LOG	DIVISION NORTH ATLANTIC	INSTALLATION NEW YORK DISTRICT	SHEET 2 OF 4 SHEETS

ELEVATION a.	DEPTH b.	LEGEND c.	CLASSIFICATION OF MATERIALS (Description) d.	SPT BLOWS	SAMPLE/ BOX NO. f.	REMARKS (Drilling Time, water loss, etc.) g.
	15'		SAME	1 2	8	
	16'		RED BROWN SAND, TRACE (f-m) GRAVEL (SP)	5 7 12	9 10	1.3' RECOVERY
	17'		RED/BROWN SAND, SOME (f-m) GRAVEL, TRACE SILT (SM)	8 16 20	11	1.2' RECOVERY
	18'		SAME	14 18 30	12	1.0' RECOVERY
	19'		SAME	25 14 12	13	1.5' RECOVERY
	20'		RED/BROWN FINE SAND, TRACE SILT (SM-SP)	14 16 20	14	1.5' RECOVERY
	21'		RED BLACK (f-m) SAND, TRACE OF FINE GRAVEL, TRACE SILT (SM)	16 23 23	15	1.3' RECOVERY
	22'		SAME	25 16 19	16	1.0' RECOVERY
	23'		SAME	14 17 34	17	1.2' RECOVERY
	24'		RED/BROWN SILTY GRAVEL, TRACE SAND (GM)	15 22 19	18	1.0' RECOVERY
	25'		SAME	17 17 12	19	0.3' RECOVERY
	26'		SAME	12 12 22	20	1.0' RECOVERY
	27'					
	28'					
	29'					
	30'					
	31'					
	32'					
	33'					

ENG FORM 1836A
(CADD Facsimilie)

PROJECT PASSAIC RIVER FLOOD PREVENTION, MAIN TUNNEL | HOLE NO. HLS-1

Hole No. HLS-1

DRILLING LOG	DIVISION NORTH ATLANTIC	INSTALLATION NEW YORK DISTRICT	SHEET 3 OF 4 SHEETS

ELEVATION a.	DEPTH b.	LEGEND c.	CLASSIFICATION OF MATERIALS (Description) d.	SPT BLOWS	SAMPLE/ BOX NO. f.	REMARKS (Drilling Time, water loss, etc.) g.
	34					
	35		SAME	15		0.3' RECOVERY
	36			21 25	21	
	37					
	38					
	39					
	40		SAME	20		0.4' RECOVERY
	41			63 REFUS	22	
	42					
	43					
	44					
	45					
	46		RED/BROWN SILT, WITH (f-c) GRAVEL, TRACE SAND (ML-GM)	22		0.5' RECOVERY
	47			45 74	23	
	48					
	49					
	50		RED/BROWN SILTY SAND, WITH GRAVEL (SM)	25		1.5' RECOVERY
	51			20 51	24	
	52					

ENG FORM 1836A
(CADD Facsimilie)

PROJECT PASSAIC RIVER FLOOD PROTECTION, MAIN TUNNEL | HOLE NO. HLS-1

Hole No. HLS-1

DRILLING LOG	DIVISION NORTH ATLANTIC	INSTALLATION NEW YORK DISTRICT	SHEET 4 OF 4 SHEETS

ELEVATION a.	DEPTH b.	LEGEND c.	CLASSIFICATION OF MATERIALS (Description) d.	SPT BLOWS	SAMPLE/ BOX NO. f.	REMARKS (Drilling Time, water loss, etc.) g.
	53'					
	54'					
	55'		RED/BROWN SILTY SAND W/ SANDSTONE FRAGMENTS (SM)	90	26	0.5' RECOVERY
			TOP OF ROCK AT 55.5'	REFUS		
	56'		ROCKBIT DRILLING TO 60'			
	57'				27	
	58'					
	59'					
	60'		RED BROWN SHALE/ SANDSTONE FRAGMENTS	80		1.2' RECOVERY
				59	28	
	61'			103+		
			BOTTOM OF HOLE = 61.2'	REFUS		
	62'					
	63'					
	64'					
	65'					
	66'					
	67'					
	68'					
	69'					
	70'					
	71'					

ENG FORM 1836A
(CADD Facsimilie)

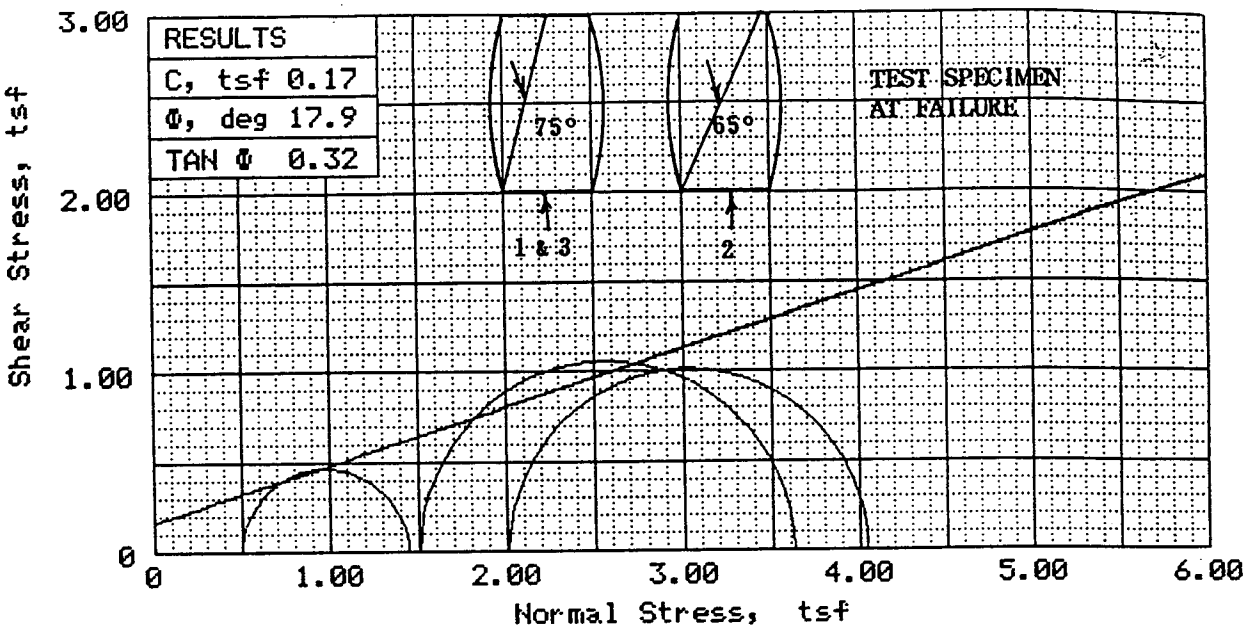
PROJECT PASSAIC RIVER FLOOD PROTECTION, MAIN TUNNEL | HOLE NO. HLS-1

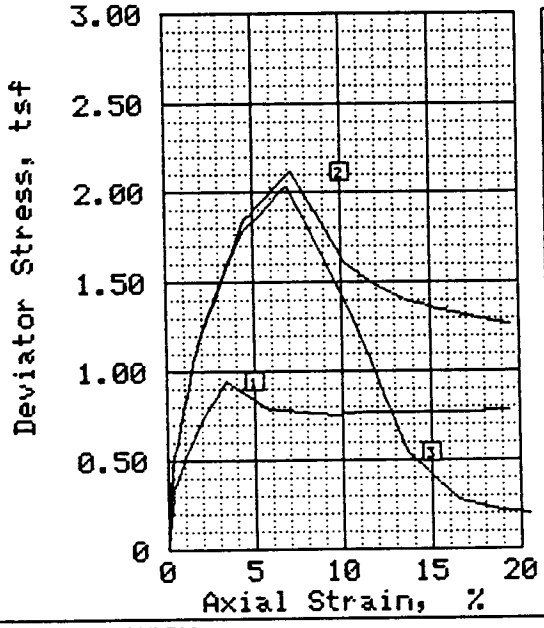
PASSAIC RIVER FLOOD DAMAGE REDUCTION PROJECT

SECTION 11
TIDAL AREA PROTECTION

ATTACHMENT E.11.2
LABORATORY TEST DATA

SOUTH ATLANTIC DIVISION LABORATORY, CORPS OF ENGINEERS - MARIETTA, GEORGIA
Requisition No. 92-0101 CH#5 Work Order No. 6788





SAMPLE NO.		1	2	3
INITIAL	WATER CONTENT, %	28.7	30.1	29.5
	DRY DENSITY, pcf	93.8	91.3	92.2
	SATURATION, %	97.2	95.9	96.2
	VOID RATIO	0.797	0.847	0.828
	DIAMETER, in	1.38	1.38	1.38
	HEIGHT, in	3.08	3.08	3.08
@ TESTING	WATER CONTENT, %	28.7	30.1	29.5
	DRY DENSITY, pcf	93.8	91.3	92.2
	SATURATION, %	97.3	95.8	96.2
	VOID RATIO	0.797	0.847	0.828
	DIAMETER, in	1.38	1.38	1.38
	HEIGHT, in	3.08	3.08	3.08
BACK PRESSURE, tsf		0.00	0.00	0.00
INIT. EFF. STR., tsf		0.50	1.51	2.02
MAX. DEV. STRESS, tsf		0.94	2.11	2.03
PORE PRESSURE, tsf				
TIME TO FAILURE, min.		6	9	10
RATE, %/min.		0.57	0.80	0.70
ULT. DEV. STRESS, tsf		0.76	1.36	0.42

DESCRIPTION (VISUAL) Brownish Gray Lean Clay (CL)

LL= 23	PL= 15	PI= 8	Gs= 2.70	CONTROLLED STRAIN TEST
TYPE OF SPECIMEN UNDISTURBED Assumed				TYPE OF TEST Q

REMARKS

PROJECT PASSAIC RIVER
HURRICANE LEVEE
AREA

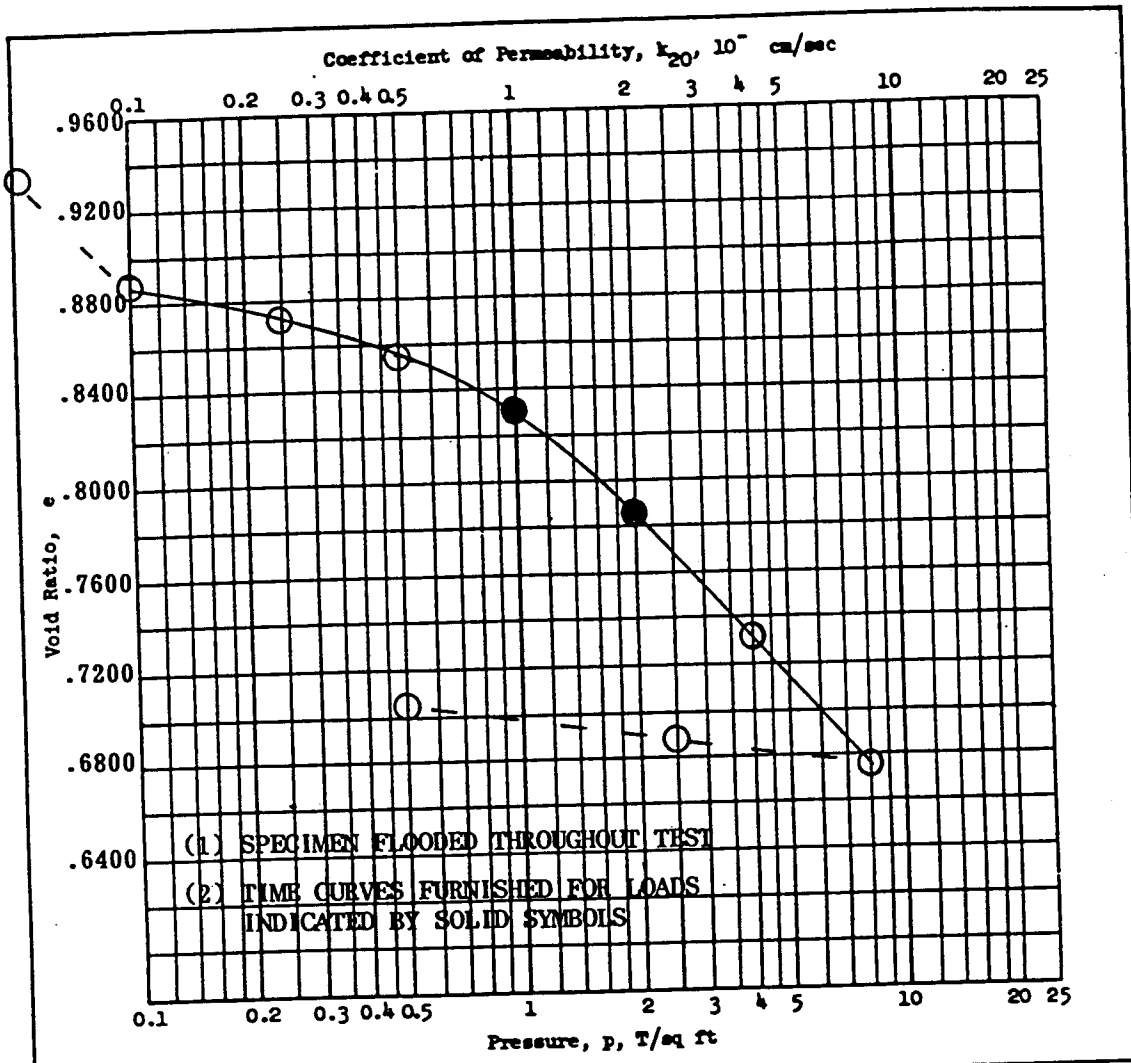
LAB NO. 264/714

BORING NO. HLK-1-94
SAMPLE NO. 1
DEPTH/~~ELEV~~ 21.0 -24.0'
LABORATORY CESAD-EN-FL DATE 4 NOV. 1994

TRIAXIAL COMPRESSION TEST

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE, MARIETTA, GA. 30061

WORK ORDER NO. 6788
REQ. NO. 92-0101 CH#5



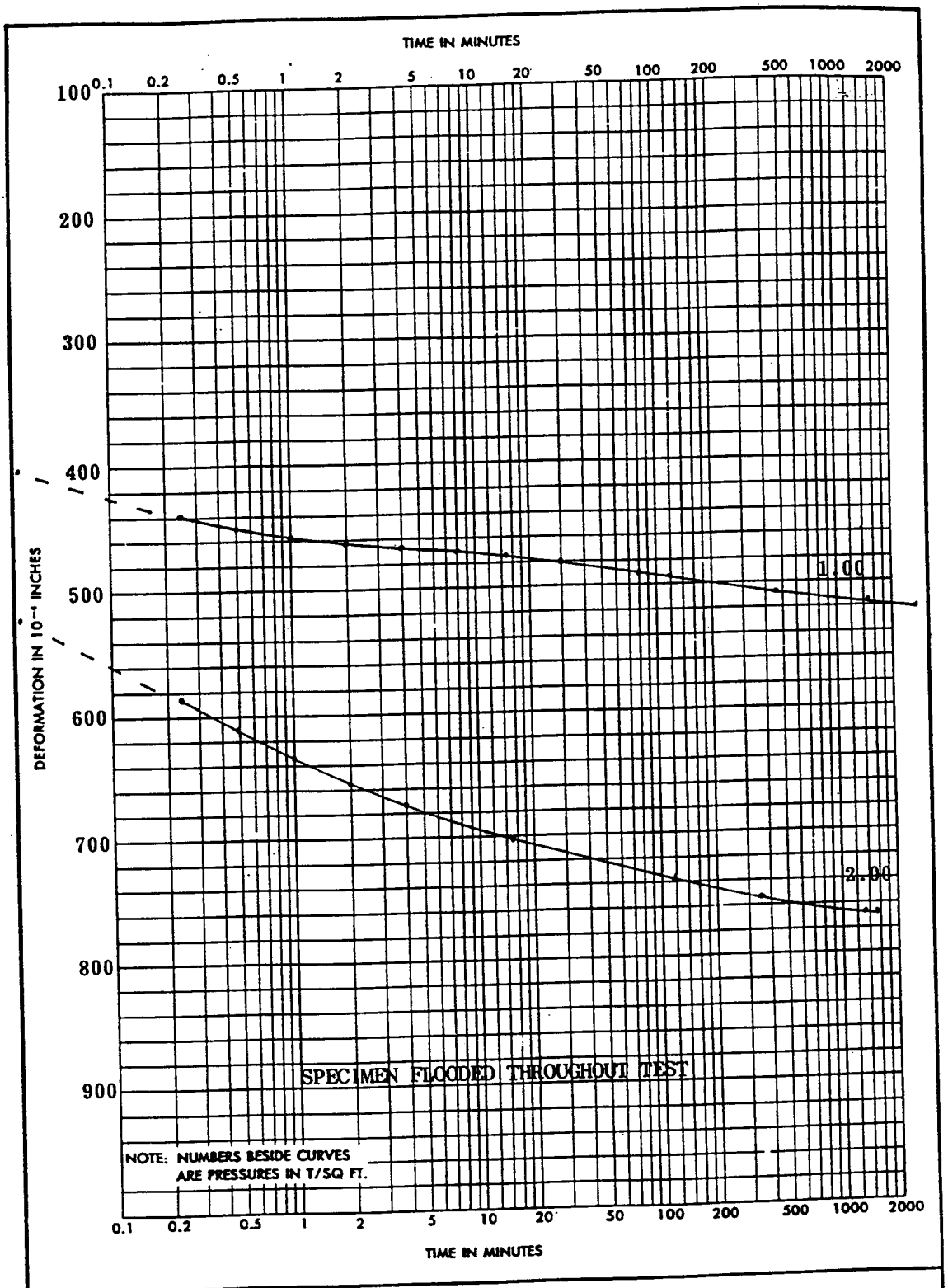
Type of Specimen Undisturbed		Before Test		After Test	
Diam 2.48 in.	Ht 1.00 in.	Water Content, w_o	34.8 %	w_f	26.2 %
Overburden Pressure, Po T/sq ft		Void Ratio, e_o	0.939	e_f	0.707
Preconsol. Pressure, Pc T/sq ft		Saturation, S_o	100.0 %	S_f	100.0 %
Compression Index, C_c		Dry Density, γ_d	86.91 lb/ft^3		
(VISUAL) Gray Lean Clay (CL) Classification		k_{20} at e_o =	x 10^{-} cm/sec		
LL 30	G_s Assumed 2.70	Project Passaic River			
PL 18	D_{10} -	Lab No. 264/715			
Remarks		Area Hurricane Levee			
		Boring No. HLK-1-94	Sample No. 2		
		Depth XX 28.0-31.0'	Date 12 Dec 94		

CONSOLIDATION TEST REPORT

ENG FORM 2090 1 MAY 63 PREVIOUS EDITIONS ARE OBSOLETE.

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE, MARIETTA, GA. 30060

WORK ORDER NO. 6788
Req. No. 92-0101 CH#5



PROJECT Passaic River

AREA Hurrican Levee — Lab No. 264-715

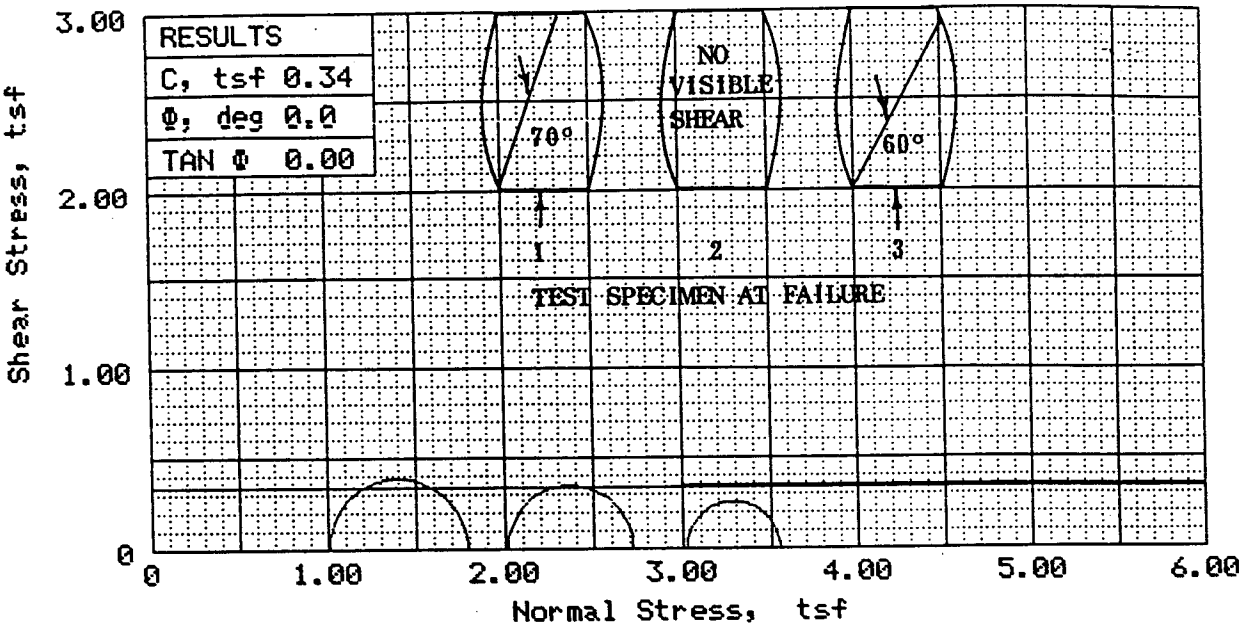
BORING NO. HLK-1-94 | SAMPLE NO. 2 | DEPTH REX 28.0-31.0' | DATE 12 Dec 94

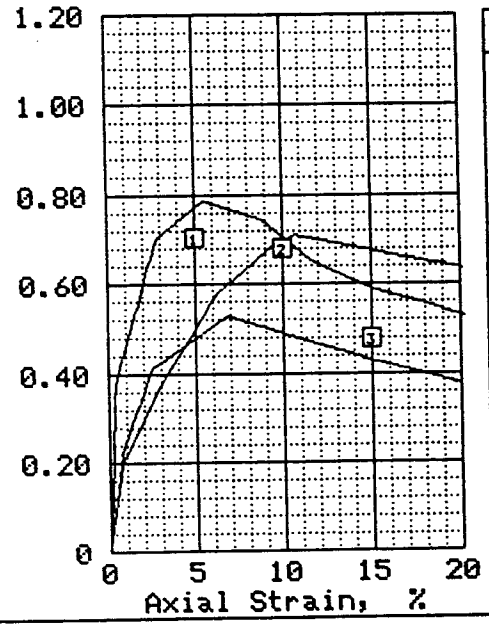
ENG FORM 2088 1 MAY 63 — PREVIOUS EDITIONS ARE OBSOLETE.

CONSOLIDATION TEST—TIME CURVES (TRANSLUCENT)

* GPO : 1964 OF—719-965

SOUTH ATLANTIC DIVISION LABORATORY, CORPS OF ENGINEERS - MARIETTA, GEORGIA
Requisition No. 92-0101 CH#5 Work Order No. 6788





SAMPLE NO.		1	2	3
INITIAL	WATER CONTENT, %	35.7	35.4	41.9
	DRY DENSITY, pcf	85.4	86.2	79.1
	SATURATION, %	99.0	100.0	100.0
	VOID RATIO	0.975	0.956	1.131
	DIAMETER, in	1.38	1.38	1.38
	HEIGHT, in	3.08	3.08	3.08
@ TESTING	WATER CONTENT, %	35.7	35.4	41.9
	DRY DENSITY, pcf	85.4	86.2	79.1
	SATURATION, %	99.0	100.0	100.0
	VOID RATIO	0.975	0.956	1.131
	DIAMETER, in	1.38	1.38	1.38
	HEIGHT, in	3.08	3.08	3.08
BACK PRESSURE, tsf		0.00	0.00	0.00
INIT. EFF. STR., tsf		1.01	2.02	3.02
MAX. DEV. STRESS, tsf		0.79	0.71	0.53
PORE PRESSURE, tsf				
TIME TO FAILURE, min.		7	15	9
RATE, %/min.		0.79	0.72	0.76
ULT. DEV. STRESS, tsf		0.59	0.67	0.43

DESCRIPTION (VISUAL) Gray Lean Clay (CL)

LL= 30	PL= 18	PI= 12	Gs= 2.70	CONTROLLED STRAIN TEST
TYPE OF SPECIMEN UNDISTURBED Assumed				TYPE OF TEST Q

REMARKS

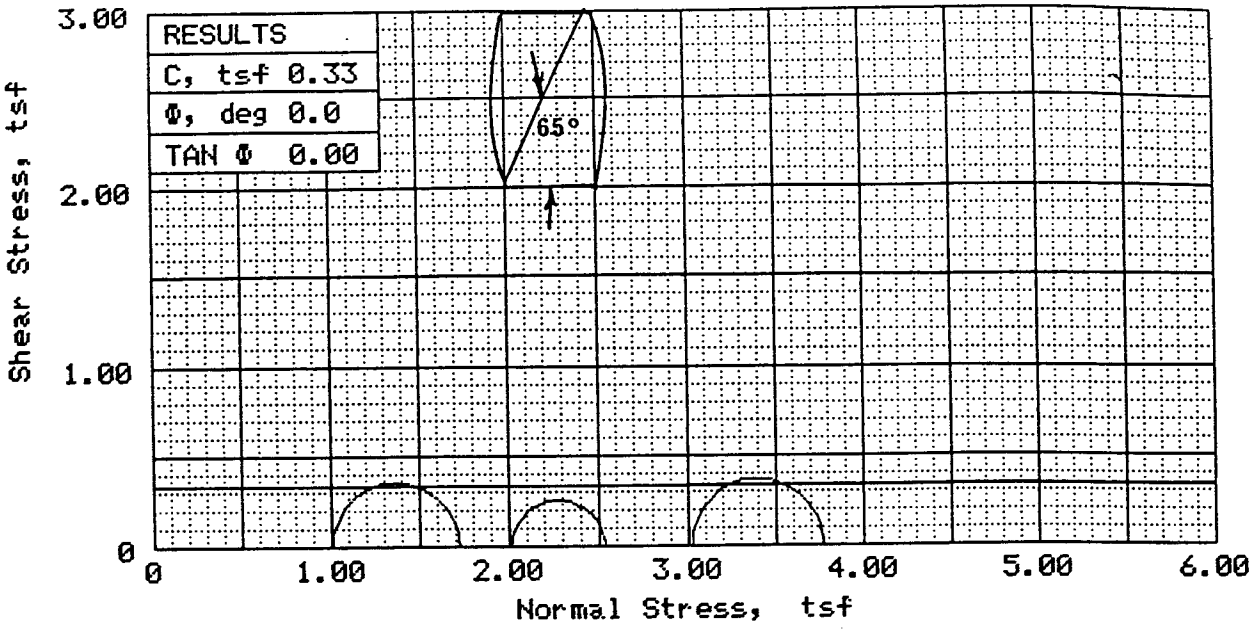
PROJECT PASSAIC RIVER
HURRICANE LEVEE
AREA

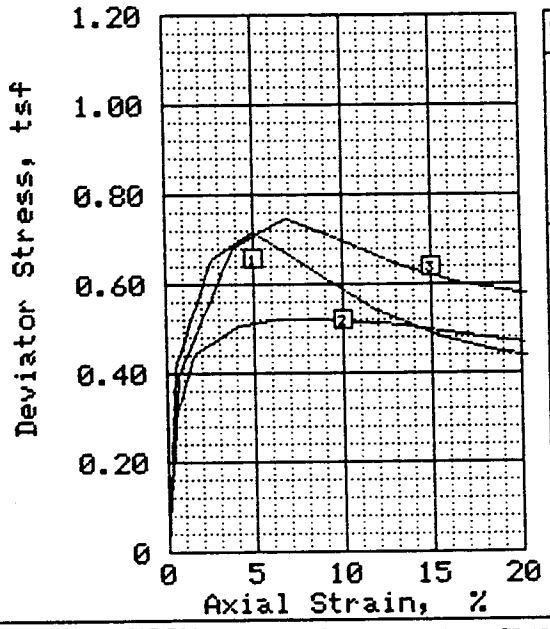
LAB NO. 264/715

BORING NO. HLK-1-94
SAMPLE NO. 2
DEPTH/~~ELEV~~ 28.0 - 31.0'
LABORATORY CESAD-EN-FL DATE 4 NOV. 1994

TRIAXIAL COMPRESSION TEST

SOUTH ATLANTIC DIVISION LABORATORY, CORPS OF ENGINEERS - MARIETTA, GEORGIA
Requisition No. 92®0101 Ch#5 Work Order No. 6788





SAMPLE NO.		1	2	3
INITIAL	WATER CONTENT, %	41.4	38.8	39.3
	DRY DENSITY, pcf	79.1	81.0	81.0
	SATURATION, %	99.0	96.9	98.1
	VOID RATIO	1.130	1.080	1.081
	DIAMETER, in	1.38	1.38	1.38
	HEIGHT, in	3.08	3.08	3.08
@ TESTING	WATER CONTENT, %	41.4	38.8	39.3
	DRY DENSITY, pcf	79.1	81.0	81.0
	SATURATION, %	99.0	96.9	98.1
	VOID RATIO	1.130	1.080	1.081
	DIAMETER, in	1.38	1.38	1.38
	HEIGHT, in	3.08	3.08	3.08
BACK PRESSURE, tsf		0.00	0.00	0.00
INIT. EFF. STR., tsf		1.01	2.02	3.02
MAX. DEV. STRESS, tsf		0.72	0.52	0.75
PORE PRESSURE, tsf				
TIME TO FAILURE, min.		7	9	9
RATE, %/min.		0.71	0.97	0.76
ULT. DEV. STRESS, tsf		0.49	0.50	0.62

DESCRIPTION (VISUAL) GRAY LEAN CLAY (CL)

LL= 34	PL= 19	PI= 15	Gs= 2.70	CONTROLLED STRAIN TEST
TYPE OF SPECIMEN UNDISTURBED		Assumed		TYPE OF TEST Q

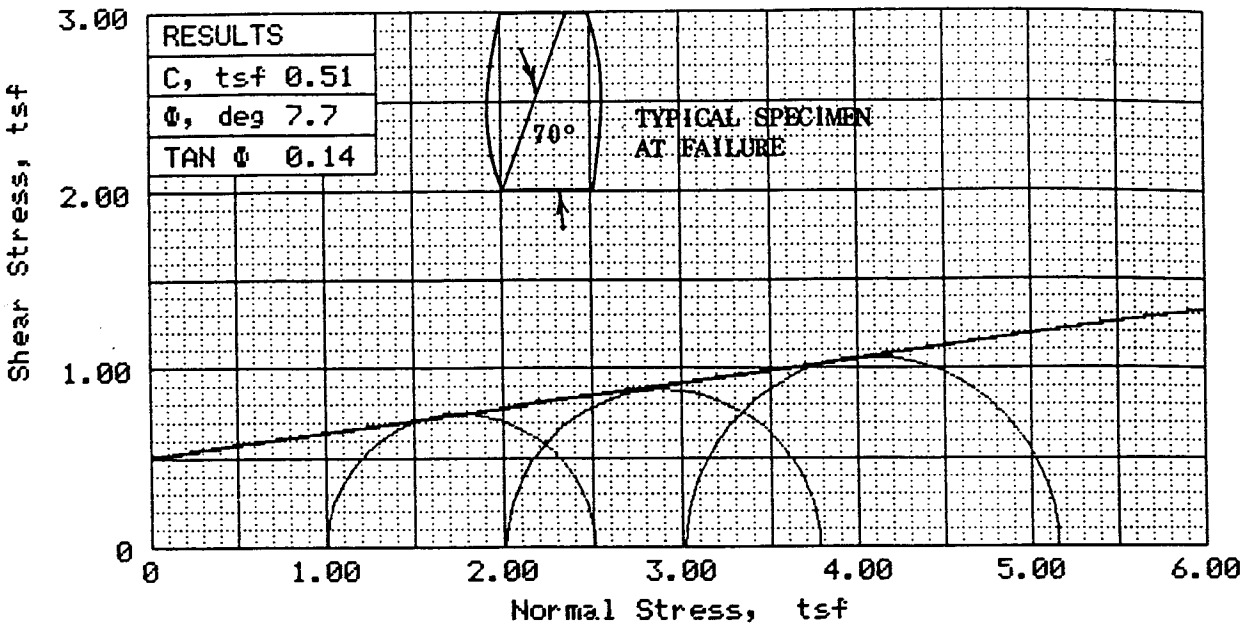
REMARKS

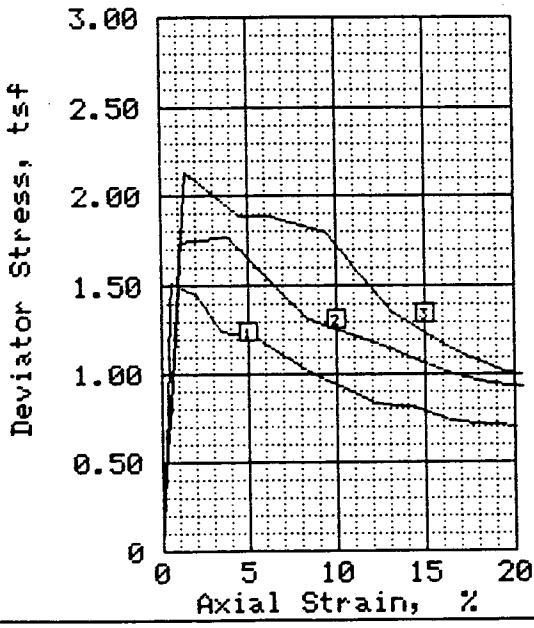
PROJECT PASSAIC RIVER
HURRICANE LEVEE
AREA
LAB NO. 264/716

BORING NO. HLK-1
SAMPLE NO. 3
DEPTH/ELEV 33.0 - 36.0'
LABORATORY CESAD-EN-FL DATE 4 NOV. 1994

TRIAXIAL COMPRESSION TEST

SOUTH ATLANTIC DIVISION LABORATORY, CORPS OF ENGINEERS - MARIETTA, GEORGIA
Requisition No. 92-0101 Ch #5 Work Order No. 6788





SAMPLE NO.		1	2	3
INITIAL	WATER CONTENT, %	41.1	38.8	38.4
	DRY DENSITY, pcf	79.9	81.8	82.6
	SATURATION, %	100.1	98.8	99.8
	VOID RATIO	1.109	1.060	1.040
	DIAMETER, in	1.38	1.38	1.38
	HEIGHT, in	3.08	3.08	3.08
@ TESTING	WATER CONTENT, %	34.7	26.9	31.0
	DRY DENSITY, pcf	87.0	97.6	91.7
	SATURATION, %	100.0	100.0	100.0
	VOID RATIO	0.937	0.727	0.837
	DIAMETER, in	1.34	1.30	1.33
	HEIGHT, in	2.99	2.91	2.97
BACK PRESSURE, tsf		5.04	5.04	5.04
INIT. EFF. STR., tsf		1.01	2.02	3.02
MAX. DEV. STRESS, tsf		1.51	1.76	2.13
PORE PRESSURE, tsf				
TIME TO FAILURE, min.		5	15	5
RATE, %/min.		0.12	0.26	0.29
ULT. DEV. STRESS, tsf		0.79	1.07	1.24

DESCRIPTION (VISUAL) GRAY LEAN CLAY (CL)

LL= 34	PL= 19	PI= 15	Gs= 2.70	CONTROLLED STRAIN TEST
TYPE OF SPECIMEN UNDISTURBED Assumed				TYPE OF TEST R

REMARKS

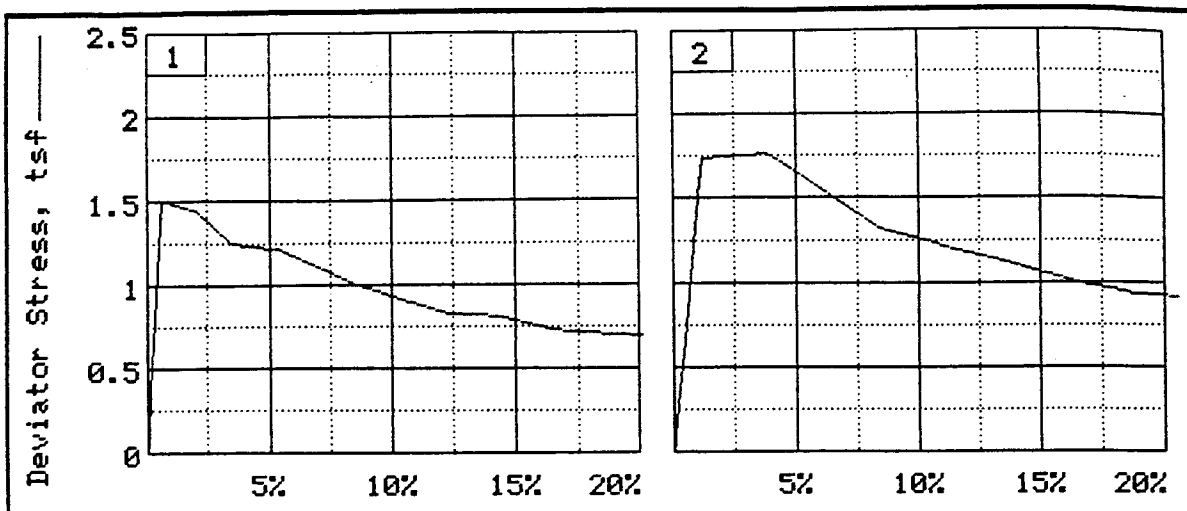
PROJECT PASSAIC RIVER
HURRICANE LEVEE
AREA

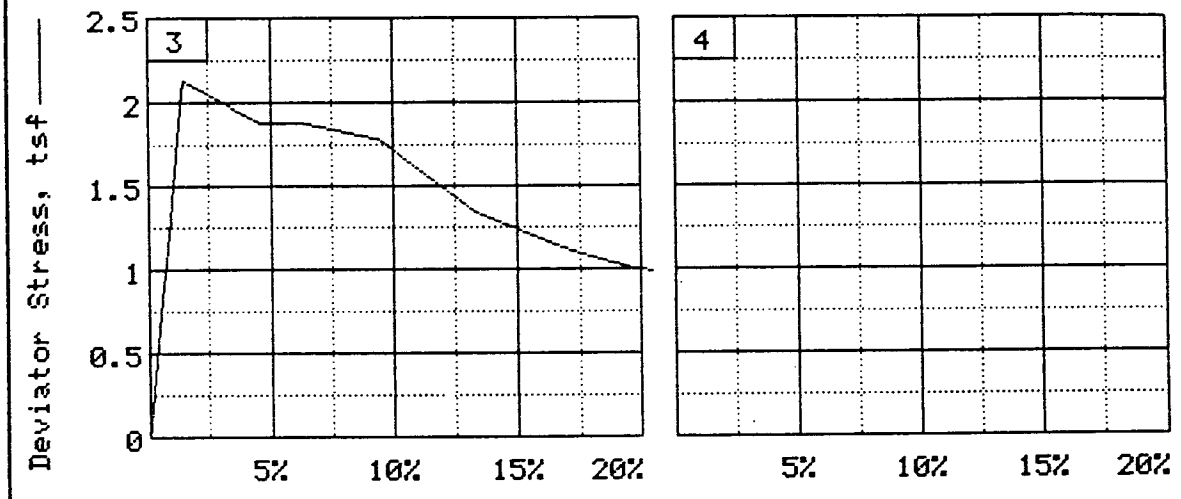
LAB NO. 264/716

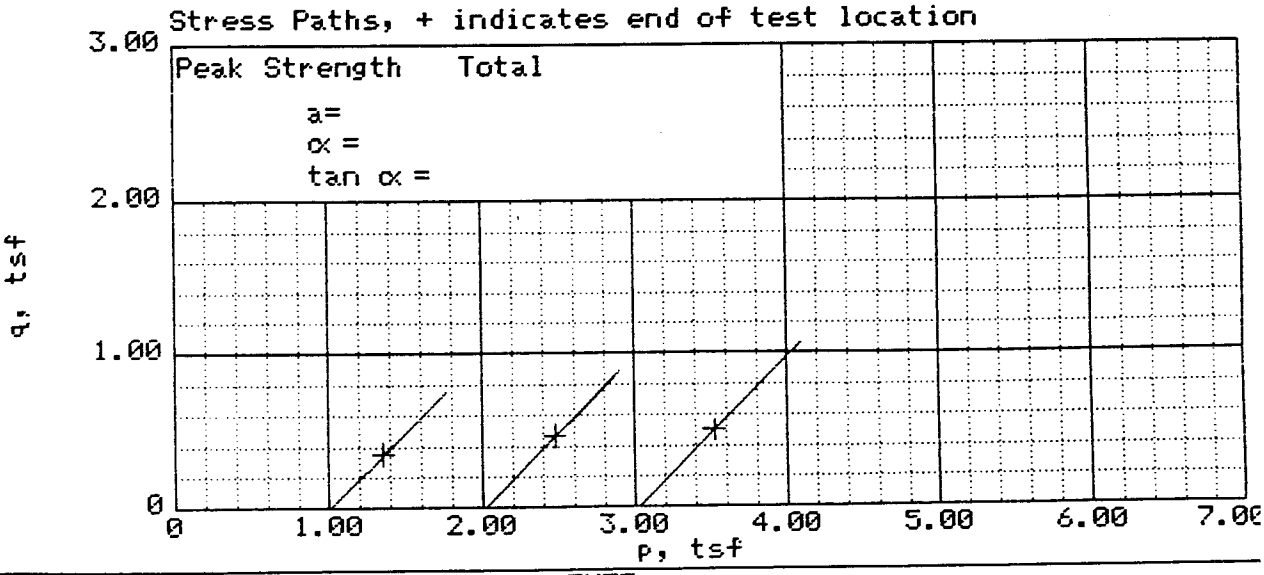
BORING NO. HLK-1
SAMPLE NO. 3
DEPTH/~~ELEV~~ 33.0 - 36.0'
LABORATORY CESAD-EN-FL DATE 4 NOV. 1994

Pg 1 of 2 TRIAXIAL COMPRESSION TEST

SOUTH ATLANTIC DIVISION LABORATORY, CORPS OF ENGINEERS - MARIETTA, GEORGIA
Requisition No. Work Order No.







PROJECT PASSAIC RIVER HURRICANE LEVEE
BORING HLK-1 SAMPLE 3 DEPTH/~~ELEV~~ 33.0 - 36.0'
TYPE OF TEST R LAB NO. 264/716
LABORATORY CESAD-EN-FL PAGE 2/2 DATE 4 NOV. 1994

APPENDIX E
SECTION 12
CENTRAL BASIN LEVEES

PASSAIC RIVER FLOOD DAMAGE
REDUCTION PROJECT

GEOTECHNICAL DESIGN
APPENDIX E

SECTION 12
CENTRAL BASIN PROTECTION

12.1 SCOPE

12.2 FEATURE DESCRIPTION
- 12.2.1 Pinch Brook
- 12.2.2 Rockaway No. 1
- 12.2.3 Rockaway No. 2
- 12.2.4 Rockaway No. 3
- 12.2.5 Passaic No. 2A
- 12.2.6 Deepavaal Channel

12.3 SUBSURFACE INVESTIGATION
- 12.3.1 Pinch Brook
- 12.3.2 Rockaway No. 1
- 12.3.3 Rockaway No. 2
- 12.3.4 Rockaway No. 3
- 12.3.5 Passaic No. 2A
- 12.3.6 Deepaval Channel

12.4 SITE GEOLOGY
- 12.4.1 General Geology
- 12.4.2 Pinch Brook
- 12.4.3 Rockaway No. 1
- 12.4.4 Rockaway No. 2
- 12.4.5 Rockaway No. 3
- 12.4.6 Passaic No. 2A
- 12.4.7 Deepavaal Channel

12.5 LABORATORY SOILS TESTING

12.6 DESIGN PARAMETERS
- 12.6.1 Pinch Brook
- 12.6.2 Rockaway No. 1
- 12.6.3 Rockaway No. 2
- 12.6.4 Rockaway No. 3
- 12.6.5 Passaic No. 2A
- 12.6.6 Deepavall Channel

12.7 DESIGN ALTERNATIVES
- 12.7.1 Levees
  - 12.7.1.1 Existing Embankments
- 12.7.2 I-Wall Floodwalls
- 12.7.3 Channel Modification

12.8 GEOTECHNICAL ANALYSIS
12.8.1 Pinch Brook
12.8.1.1 Levee Stability
12.8.1.2 Levee Settlement
12.8.1.3 Levee Underseepage
12.8.1.4 Floodwall Stability
12.8.2 Rockaway No. 1
12.8.2.1 Levee Stability
12.8.2.2 Levee Settlement
12.8.2.3 Levee Underseepage
12.8.2.4 Floodwall Stability
12.8.3 Rockaway No. 2
12.8.3.1 Levee Stability
12.8.3.2 Levee Settlement
12.8.3.3 Levee Underseepage
12.8.4 Rockaway No. 3
12.8.4.1 Levee Stability
12.8.4.2 Levee Settlement
12.8.4.3 Floodwall Stability
12.8.5 Passaic No. 2A
12.8.5.1 Levee Stability
12.8.5.2 Levee Settlement
12.8.5.3 Existing Embankment Stability and Underseepage
12.8.5.4 Floodwall Stability
12.8.6 Deepavaal Channel
12.8.6.1 Channel Modification Stability
12.8.6.2 Channel Erosion

12.9 DESIGN AND CONSTRUCTION CONSIDERATIONS
12.9.1 Levees
12.9.2 Levee Settlements
12.9.3 Additional Subsurface Investigation

PLATES

E.12.1 Pinch Brook/Levee Floodwall System

E.12.2-
E.12.3 Subsurface Profiles

E.12.4 Rockaway No.1 Levee/Floodwall System

E.12.5-
E.12.7 Subsurface Profiles

E.12.8 Rockaway No.2 Levee/Floodwall System

E.12.9-
E.12.10 Subsurface Profiles

E.12.11-
E.12.12 Rockaway No.3 Levee/Floodwall System

E.12.13-
E.12.17 Subsurface Profiles

E.12.18-
E.12.20 Passaic No.2A Levee/Floodwall System

E.12.21-
E.12.26 Subsurface Profiles

E.12.27-
E.12.28 Deepavaal Brook Channel Improvements

E.12.29-
E.12.33 Subsurface Profiles

E.12.34 Pinch Brook Levee Detail

E.12.35 Pinch Brook Floodwall Detail

E.12.36 Rockaway No.1 Levee Detail

E.12.37 Rockaway No.1 Floodwall Detail

E.12.38 Rockaway No.2 Levee Detail

E.12.39-
E.12.40 Rockaway No.3 Levee Details

E.12.41-
E.12.42 Rockaway No.3 Floodwall Details

E.12.43 Passaic No. 2A Levee Detail

E.12.44 Passaic No. 2A Floodwall Detail

E.12.45 Deepavaal Brook Channel Detail

APPENDIX E

SECTION 12

CENTRAL BASIN PROTECTION

12.1 SCOPE

The Central Basin Flood Protection System will consist of five seperate levee/floodwall systems and one area of river channel modification. The systems would be constructed slightly inland and along the banks of the Passaic River, Deepavaal Brook, Rockaway River and Pinch Brook. The individual levee/Floodwall and channel modification systems will be refered to as Pinch Brook; Rockaway Nos. 1, 2 and 3; Passaic No. 2A and Deepavaal Channel.

The goal of this effort is to present a feasible design for the flood protection systems from which a reasonable cost estimate for construction may be developed. A preliminary design with sufficient detail has been performed to achieve this goal. If order to arrive at this preliminary design, geotechnical analyses were performed utilizing a limited amount of subsurface information including previous test boring data from former flood protection soils investigations.

12.2 FEATURE DESCRIPTION

12.2.1 Pinch Brook The Pinch Brook Levee/Floodwall System is approximately 2,812' in length and consists of 2,397' of levee and 415' of floodwall. The northern levee starts at approximately Sta.26+90 and ends at Sta. 38+12 while the southern levee starts at Sta. 10+00 and ends at Sta.23+10. The floodwall, which overlaps into both sections of levee, starts at Sta. 22+75 and ends at Sta. 26+90. The proposed top of levee/floodwall is El. 184.8 along the entire levee system except 184.6 in the area of Sta. 18+50.

12.2.2 Rockaway No. 1 The Rockaway No. 1 Levee System includes two segments which are referred to as Upstream Rockaway No.1 and Downstream Rockaway No. 1. Upstream Rockaway No. 1 consists of 2,421' of levee. Downstream Rockaway No. 1 is approximately 1,339' in length and consists of 818' of levee and 521' of floodwall. The proposed top of levee/floodwall varies between El. 178.0 and El.179.2 at Downstream Rockaway No.1 and between El.182.6 and El. 183.2 at Upstream Rockaway No. 1.

12.2.3 Rockaway No. 2 The Rockaway No. 2 Levee System is approximately 3,172 feet in length. The levee starts at Sta. 0+00 and ends at Sta. 31+72 with the proposed top of levee

varying between El. 182.2 and El. 182.7 The Rockaway No. 2 Levee System will be located on the left bank of the Rockaway River in Montville Township. The proposed system is an open U-shaped system.

12.2.4 Rockaway No. 3

The Rockaway No. 3 Levee System will include sections of the existing Lake Hiawatha Flood Control Project which starts at Sta. 16+70 and ends at Sta. 78+00 of the proposed levee system baseline. The existing Lake Hiawatha Flood Control Project is approximately 6,130' in length and consists of approximately 2,295' of levee and approximately 3,835' of pre-cast concrete floodwall.

The new Rockaway No. 3 levee/floodwall system would consist of approximately 5,232' of floodwall, 1,850' of levee and 1,470' of floodwall on existing levee. This system will replace and augment the existing Lake Hiawatha levee/floodwall system. The average height of the existing levees will be increased by approximately 7' and the average base width increased by approximately 45'. The existing Lake Hiawatha Floodwall would be demolished, removed and replaced with a new floodwall. The average floodwall height will be approximately 5.1'. Levees were utilized wherever space was available to constuct a levee or to add onto an existing levee. Floodwalls were utilized wherever space was not available to expand a levee or where a floodwall presently exists.

12.2.5 Passaic No. 2A The levee/floodwall system consists of approximately 6,216' of earthen levee and 3,082' of floodwall for a total length of 9,298'. The Passaic No. 2A system is broken down into four segments which are referred to as Sections L1 through L4 looking south to north. Section L1 consists of 3,292' of levee. Section L2 is approximately 1,682' in length and consists entirely of floodwall. Section L3 is approximately 2,634' in length and consists of 1,400' of levee and 1,234' of floodwall. Section L4 consists of 1,690' of levee. Section L1 starts at Sta. 0+00 and ends at Sta. 32+92, Section L2 starts at Sta. 0+00 and ends at Sta. 16+82. Section L3 starts at Sta. 0+00, becomes a levee at Sta. 14+00 and ends at Sta. 29+08 with an unimproved section between Sta. 23+00 and Sta. 25+74. Section L4 starts at Sta. 0+00 and ends at Sta. 16+90.

12.2.6 Deepavaal Channel The Deepavaal Brook Channel Modification will cover approximately 7,660 feet of existing channel length from Sta. 60+50 to Sta. 137+10. The proposed channel invert elevations vary from El. 159.3± at the northern end of the project (Sta. 60+50) to El. 163.8± at the southern end of the project (Sta. 137+10). A channel invert slope of 0.061%

is maintained throughout the project length. The channel improvements are estimated to reduce the 100 year flood elevation by four feet (El. 172.8± to El. 168.8±) at Sta. 60+50 and three feet (El. 173.2± to El. 170.2±) at Sta. 137+10. Additional improvements will be required from Sta. 23+50 to 29+10 to alleviate backwater effects upstream of the existing Fairfield Office Center. A channel invert of El. 157± will be maintained below the office building.

12.3 SUBSURFACE INVESTIGATION

In general, very little subsurface information is available for the design of the subject levees/floodwalls and channel modification systems. The available data generally consists of test borings performed for previous flood protection projects within the vicinity of the proposed system. All borings were split spoon type borings ranging from 10 to 35 feet in depth. Additional borings will have to be made prior to final design for a more comprehensive assessment of the subsurface soil conditions and to verify or revise any initial design assumptions. The available boring data was also supplemented by Rutgers University Engineering Soil Surveys for Morris and Essex Counties. The available subsurface information for each system is summarized as follows.

12.3.1 Pinch Brook Five borings (B-2, B-3, B-4, B-5, and B-6) were available for this study from an earlier soils investigation performed by local interests for an earlier proposed levee system. These borings were located on or near the current proposed levee system alignment. See Plate 12-1 for boring locations and Plates 12-2 and 12-3 for borings in profile.

12.3.2 Rockaway No. 1 Only two borings were available for this study, Boring B-15 from the Lake Hiawatha Flood Control Project design report, and Boring 12-9 from the USACE feasibility report. See Plate 12-4 for boring locations and Plates 12-5 through 12-7 for borings in profile.

12.3.3 Rockaway No.2 The subsurface conditions for the project were inferred from two borings performed at adjacent flood control project sites. Boring B-15 from the existing Rockaway No. 3 Lake Hiawatha Flood Control Project design report and Boring 12-29 from the USACE Feasibility report. Refer to Plate 12-8 for the boring locations and Plates 12-9 and 12-10 for borings in profile.

12.3.4 Rockaway No. 3 The subsurface information available was from 15 borings performed for the design of the existing Lake Hiawatha Flood Control Project. See Plates 12-10 and 12-11 for boring locations and Plates 12-13 through 12-17 for borings in profile.

12.3.5 Passaic No. 2A No boring data was available for this levee/floodwall system within the immediate vicinity of the project area. Consequently, soil conditions were inferred from boring 12-29 performed about one mile west of the project area. See Plates 12-18 through 12-20 for a site plan of the levee/floodwall system and Plates 12-21 through 12-26 for profile drawings with the inferred subsurface conditions.

12.3.6 Deepavaal Brook Channel The subsurface information is derived from three borings (FL-7, FL-10, and FL-11) from the USACE feasibility study. See Plates 12-27 and 12-28 for boring locations and Plates 12-29 through 12-33 for borings in profile.

12.4 SITE GEOLOGY

12.4.1 General Geology The project area is within the Piedmont Plateau, also known as the Lowlands. During the Wisconsin glacial period, the Central Basin area was covered by glacial Lake Passaic. In this area, as the glacier melted, fine-textured materials, silts and clays, were deposited. As the lake drained, fluvial deposits of silts, sands, and gravels occurred. Kettles and basins with organic deposits also were formed. Up to approximately 90 feet of varved clay and silt were deposited over a thin layer of glacial ground moraine material, when Lake Passaic drained. In other areas, outside of Lake Passaic, the glacial soils are overlain by alluvial silts and sands. These alluvial soils vary in thickness in the project area from about 2 to 20ft and are generally thicker in the lower floodplain areas. The Central Basin area is generally underlain by a Triassic-age, soft red shale and/or siltstone, that is interbedded with sandstone. The entire area lies within a seismic 2 zone according to the seismic map in EM-1110-21902. Site specific soil conditions are discussed further below.

12.4.2 Pinch Brook In general, the soils within the explored depth throughout the project alignment consist of a surficial layer of organic silts and peat underlain by sands and gravels at the upstream portion of the project and varved silts and clays downstream. In addition, boring B-6 was performed in what appears to be the outer boundary of Horstmann Landfill. Miscellaneous trash and construction debris mixed with layers of clayey silt and peat to a depth of 18' below the ground surface were encountered in boring B-6. The proposed levee system

alignment was moved south of boring B-6 to avoid the landfill where possible. The surficial layer consists of dark gray to dark brown organic silt and dark brown to black peat. These materials varied in thickness from 3 to 5 feet and were typically very soft to medium in consistency. The underlying varved silts and clays were typically medium to very stiff in consistency and varied in thickness from about 6 to 21 feet. A thin stratum of granular materials was encountered in this clay layer. At the upstream end of the project, the granular deposits consisted of dense to very dense dark gray to reddish brown coarse to fine sand and coarse to fine gravel with little clayey silt. This layer varied in thickness from about 9 to 17 feet. Borings B-2, B-3, B-4 and B-6 were terminated within the granular deposits while boring B-5 was terminated within the varyed silt and clay layer.

12.4.3 Rockaway No.1 In general, the soils within the explored depth of Downstream Rockaway #1 are composed of two layers. The top layer at boring 12-9 consisted of an organic cohesive deposit with a depth of 2.5' while the underlying layer consisted of poorly graded sand mixed with silt to a depth of 18' from the existing ground surface. There was only one soil layer encountered in boring B-15 at Upstream Rockaway #1. In general, the soil consisted of a low plastic silt to a depth of 10' from the existing ground surface.

12.4.4 Rockaway No. 2 The subsurface conditions indicated by the available boring data can be summarized as a surficial layer of organic silts and clays subsequently underlain by alluvial deposits of low plasticity silts and clays. The organic soils generally varied from about 2 to 4 feet in thickness and were soft in consistency. The underlying silts and clays were generally stiff to very stiff in consistency and extended below the completion depth of the borings.

12.4.5 Rockaway No. 3 In general, the soils within the explored depth of Rockaway No. 3 are composed of three layers. Based on the subsurface information, it is believed that the top layer consists of loose borrowed fill material ranging in thickness from 2' to 10'. Underlying the fill materials are organic soil desposits over granular alluvial soils. The organic deposits can be described as peat and/or a clayey silt with fine sand. This layer ranged in thickness from 2' to 4' and is soft to medium in consistency. The underlying alluvial soils can be described as coarse to fine sand and silt with some medium to fine gravel. This layer was initially encountered from 5' to 10' below the ground surface and continued through the bottom of the borings. The density of this layer varied from medium to very dense.

12.4.6 Passaic #2A The subsurface profile for the entire Passaic No. 2A project area was assumed to have two layers. The top layer consists of 2' of organic silts and clays while the underlying layer consists of an alluvial deposit of low plastic silt with a thickness of greater than 20 feet.

12.4.7 Deepavaal Brook Channel In general, the soils within the explored depth of Deepavaal Brook are composed of four layers. Based on the subsurface information, it is believed that the top layer is a fill material consisting of soils varying from medium to fine sand with trace fine gravel (boring FL-11) to coarse to fine gravel and silt (borings FL-7 & FL-10). This layer ranged in thickness from two to four feet and was generally medium to very dense. Underlying the fill, the next layer consisted of either coarse to fine sand with some silt (borings FL-10 &FL-11) or clay with some coarse to fine gravel (boring FL-7). The noncohesive layer ranged in thickness from ten to sixteen feet and is very loose to medium in density. The cohesive layer was ten feet thick at boring FL-7 and can be considered as soft to stiff in consistency. A similar cohesive material consisting of predominantly lean clay was encountered underneath the noncohesive layer at borings FL-10 and FL-11. Both borings were terminated within the cohesive layer with thickness of six and eight feet. This cohesive layer can be considered as medium to stiff in consistency.

12.5 LABORATORY SOILS TESTING

Laboratory soils testing was not performed on any of the subsurface soils found within the Central Basin project area. However, laboratory test data on organic cohesive soils and low plasticity silts, similar to those encountered throughout the Central Basin area, was available from the USACE soils investigation performed for the proposed Passaic No. 10 Levee System. This data, where applicable, was used in developing preliminary estimate's of consolidation settlement for the levees throughout the Central Basin. A summary of this data is presented below within Table 12.5.

TABLE 12.5
CONSOLIDATION TEST DATA

Material	Coefficient of Consolidation C_v	Intial Void Ratio e_o	Compression Index C_c	Recompression Index C_r
Organic Cohesive Deposit	0.01	5.0	3.0	1.2
Low Plastic Silt	0.23	0.87	0.18	-

12.6 DESIGN PARAMETERS

The soils design parameters were derived by applying standard engineering correlations to the available boring data and by utilizing the Passaic No. 10 Levee System laboratory test data. The soil strengths, unit weights and appurtenant engineering properties for each flood system's soil stratigraphy are presented below in the following tables. The design analyses for the levee, floodwall and channel modification systems considered both the undrained and drained soil strength conditions.

12.6.1 Pinch Brook The soil strength parameters shown in the following tables were utilized for the design of the Pinch Brook levee and floodwall system.

TABLE 12.6.1
SOIL STRENGTH PARAMETERS

Material	Unit Weight γ (in pcf)	Effective γ' unit weight (pcf)	Friction Angle θ (in degrees)	Cohesion Value, C (in psf)
Levee Fill (Drained)	120	-	32	0
Levee Fill (Undrained)	120	-	30	0
Organic Silt & Peat (Drained)	75	-	20	0
Organic Silt & Peat (Undrained)	75	40	0	250
Varved Clay (Drained)	120	-	23	0
Varved Clay (Undrained)	120	65	0	500

TABLE 12.6.1.1
SITE SPECIFIC CONSOLIDATION DATA

Material	Coefficient of Consolidation Rate C_v (in Ft^2/day)	Initial Void Ratio e_o	Compression Index Cc	Recompression Index C_r
Organic Silt & Peat	0.01	5.0	3.0	1.2
Varved Clay	0.1	1.0	0.2	0.01
Landfill Material	0.05	5.0	1.5	0.25

Based on the available laboratory test results, the peat layer appeared to be normally to slightly overconsolidated, however, the clay can be assumed overconsolidated. These assumptions were used for settlement calculations.

12.6.2 Rockaway No. 1 The design soil strength parameters are shown in the following table. For underseepage estimates, the permeability of the granular subgrade soils at Downstream Rockaway No. 1 was assumed as 5 x 10^{-4}cm/sec.

TABLE 12.6.2
SOIL STRENGTH PARAMETERS

Material	Unit Weight, γ (in pcf)	Effective Unit Weight, γ' (in pcf)	Friction Angle, θ (in degrees)	Cohesion Value, C (in psf)
Levee Fill (Drained)	120	-	32	0
Levee Fill (Undrained)	120	-	30	0
Organic Cohesive Deposit (Drained)	75	-	20	0
Organic Cohesive Deposit (Undrained)	75	40	0	250
Low Plastic Silt (Drained)	115	-	28	0
Low Plastic Silt (Undrained)	115	55	0	400
Poorly Graded Sand (Drained)	120	-	30	0
Poorly Graded Sand (Undrained)	120	-	30	0

12.6.3 Rockaway No. 2 The design soil strength parameters are presented below in the following table.

TABLE 12.6.3
SOIL STRENGTH PARAMETERS

Material	Unit Weight, γ (in pcf)	Effective Unit Weight, γ' (in pcf)	Friction Angle, θ (in degrees)	Cohesion Value, C (in psf)
Levee Fill (Drained)	120	-	32	0
Levee Fill (Undrained)	120	-	30	0
Organic Cohesive Deposit (Drained)	75	-	20	0
Organic Cohesive Deposit (Undrained)	75	40	0	250
Low Plastic Silt (Drained)	115	-	28	0
Low Plastic Silt (Undrained)	115	55	0	400

12.6.4 Rockaway No. 3 The design soil strength parameters are presented in the following table.

TABLE 12.6.4
SOIL STRENGTH PARAMETERS

Material	Unit Weight, γ (in pcf)	Effective Unit Weight, γ' (in pcf)	Friction Angle, θ (in degrees)	Cohesion Value, C (in psf)
Levee Fill (Drained)	120	-	30	0
Existing Core Material Silty Clay (Drained)	115	65	20	250
Low Plastic Silt (Drained)	110	-	18	150
Silty Sand (Drained)	120	-	32	0
Silty Sand (Undrained)	120	-	30	0

12.6.5 Passaic No. 2A The design soil strength parameters are presented in the following table.

TABLE 12.6.5
SOIL STRENGTH PARAMETERS

Material	Unit Weight, γ (in pcf)	Effective Unit Weight, γ' (in pcf)	Friction Angle, θ (in degrees)	Cohesion Value, C (in psf)
Levee Fill (Drained)	120	-	32	0
Levee Fill (Undrained)	120	-	30	0
Organic Cohesive Deposit (Drained)	75	-	20	0
Organic Cohesive Deposit (Undrained)	75	40	0	250
Low Plastic Silt (Drained)	115	-	28	0
Low Plastic Silt (Undrained)	115	55	0	400

Based on available laboratory test results, both the organic cohesive soil deposit and the low plastic silt layer were assumed as normally consolidated. These assumptions were used for the project's settlement calculations. The estimated settlements were determined using the consolidation data in Table 12.5.

12.6.6 Deepavaal Brook Channel The soil strength parameters utilized in the channel modification analysis are presented in the table below.

TABLE 12.6.6
CHANNEL MODIFICATION
SOIL STRENGTH PARAMETERS

Material	Saturated Unit Weight γ (in pcf)	Friction Angle, θ (degrees)	Cohesion Value, C (in psf)
Fill and Noncohesive Materials combined (Sta. 77+80)	120	32	0
Fill and Noncohesive Materials combined (Sta. 123+30)	125	34	0
Cohesive Material (Undrained)	115	0	500
Cohesive Material (Drained)	115	26	0
Underlying Noncohesive Material	120	32	0

12.7 DESIGN ALTERNATIVES

The subsurface soil conditions throughout the Central Basin Protection system are generally favorable for the construction of levees. Occasional isolated areas of soft organic soils will require stripping or stabilization with geotextile fabrics prior to levee construction. Consequently, levees were chosen for most of the flood protection systems as the most economical means of protection. Floodwalls were only utilized in areas with inadequate space to accomodate levee construction. Other flood control measures utilized in the Central Basin system include channel improvements and the construction of sheet pile I-Walls on top of existing levees. Geotechnical design details of each flood control structure are discussed further below.

12.7.1 Levees

The typical levee will have a 10 feet wide crown with one vertical to three horizontal side slopes for maintenance and stability. The levee crown will also function as an access road for emergencies during flood events and as a recreational path for public use.

The entire area beneath the entire levee footprint will be cleared of trees and then stripped to a minimum depth of 6 inches to remove all vegetation and other objectional materials. After stripping, grubbing will be performed to a depth of 3ft to remove all tree roots and other large debris.

In areas with pervious foundation soils a toe drain will be utilized to control underseepage. During FDM studies, the use of an inspection trench will be considered as an alternative to of a toe drain and specified in areas without a toe drain.

The levees will be constructed with borrow fill material with a miniumum plasticity index (PI) of 7 and a minimum 25% fines by weight passing the number 200 sieve. If fill with suitable piping resistance is not available, a 3 feet thick riverside clay blanket will be placed on the levee surface to control through seepage. If tunnel muck is available, this material will be used for the levee core material in conjunction with the riverside clay blanket and topsoil cover. The levee should be constructed utilizing a maximum loose lift thickness of 12 inches with each lift compacted to at least 90 percent of the material's standard proctor density.

12.7.1.1 Existing Embankments

Two sections of existing roadway embankments will be utilized as part of the flood control system for the Pssaic No. 2A Levee/Floodwall System. An approximately 1300 foot stretch of Route 46 between Levee/Floodwall Sections L2 and L3 and the Route 80 embankment extending from the Passaic River northeast to Section L4 will both function as levees connecting adjacent levee/floodwall sections.

For this study, no subsurface information was vailable regarding the type of fill materials used to construct the embankments. However, New Jersey Department of Transportation (NJDOT) specifications require that embankment fill consist primarily of granular materials placed in controlled lifts and compacted to a minimum specified density. Consequently, it is anticipated that the embankment fill will have adequate resistance to piping and through seepage. Both stretches of

roadway embankment are several feet or more above the design flood level elevation for that reach of the river which also includes the required freeboard allowance established by the USACE.

12.7.2 I-Wall Floodwalls The floodwalls for the Central Basin Protection system will consist of continuous cantilever steel sheet piling with a cast-in-place reinforced concrete (I-Wall) cap. All piling would be corrosion protected with a zinc and coal tar epoxy coating. Based on the results of the sheet piling design analysis, a penetration depth to wall height ratio of approximately 2.4:1 is recommended for minimum pile penetration depths. All sheet piling should be driven to a minimum embeddment depth of 10 feet below the existing ground surface.

12.7.3 Channel Modification Based upon the results of the stability analyses, minimum channel bank cut slopes of 2.5 horizontal to 1 vertical will be used for the Deepavaal Brook channel modifications. Maximum river flow velocities following the channel modification will be low enough such that most of the modified alignment will not require rip rap for erosion control. Isolated areas of higher velocities and tributary confluence locations will require a 12 inch thick layer of stone rip rap. A six layer of graded crushed stone will initially be placed below the rip rap as a bedding material to control migration of soil fines into the rip rap. Refer to the Deepavaal Brook Channel Improvement site plans for the location of riprapped areas.

12.8 GEOTECHNICAL ANALYSIS

In general, the following analyses were performed for each of the proposed levee/floodwall systems:

1) Levee stability - After construction at maximum flood level and at sudden drawndown cases for the critical levee section.

2) Levee settlement and bearing capacity - In areas with soft organic soils consolidation settlements were estimated and geosynthetic reinforcement added where bearing capacity was inadequate.

3) Levee underseepage - Underseepage was evaluated in areas with granular foundation soils.

4) I-Wall sheetpile floodwall - Determined minimum penetration depths.

To provide adequate base reinforcement for global stability, it is recommended that a geotextile fabric with a minimum Long Term Allowable Design Load (LTADL) of 7,000 lb/ft (at allowed 10 percent strain) be utilized as base reinforcement between Sta. 14+00 and Sta. 22+75 and between Sta. 26+90 and Sta. 28+50. It is also recommended that prior to the geotextile fabric installation, a minimum of 6 inches of surface cover should be stripped from the levee foot print. This stripped material, if satisfactory, can be utilized on the levee slopes as topsoil. Refer to the Levee Detail drawing, Plate 12-34, for the typical levee section.

12.8.1.2 Levee Settlement In addition to slope stability, settlement of the critical section was also analyzed. A maximum estimated settlement of 18" is expected to occur south of the proposed floodwall in approximately 5 years. The maximum settlement north of the flood wall was estimated at 12" with a potential differential settlement of 5". The differential settlement would occur if part of the levee was located above the edge of the existing landfill area.

12.8.1.3 Levee Underseepage

A levee underseepage analysis was performed for the organic silt/peat layer at the southern levee portion to ensure that the landside gradient was not excessive. Based on this analysis, the landside gradient was found to be within tolerable limits.

The available boring data indicates the northern levee portion would be underlain by a variable layer of loose fill materials mixed with debris. Due to their variability, the fill materials are particularly susceptible to underseepage. Consequently, a 4 foot deep by 2 foot wide toe drain along the landside toe of the levee is recommended for safe exit of underseepage through the fill materials. The toe drain would consist of a trench lined with filter fabric and backfilled with graded filter material.

12.8.1.4 Floodwall Stability The conventional method of cantilever sheet pile analysis was used to design the floodwall section (Sta. 22+75 to Sta. 26+90) of the project. The floodwalls will consist of continuous cantilever, PZ-22 (regular carbon grade ASTM A328 steel) sheet piling with a cast-in-place reinforced concrete cap. Based on an average wall height of 9.3 feet, the sheet piling would be driven to a minimum penetration depth of 23 feet. The minimum penetration depth to wall height

ratio of 2.4:1 was developed based on the computed penetration depths for typical wall heights and various soil conditions. Refer to the Floodwall Detail drawing, Plate 12-35, for the typical floodwall section.

12.8.2 Rockaway No. 1 In order to design this system, the Upstream Roakaway No. 1 segment was broken into five sections and the Downstream Rockaway No. 1 segment was broken into seven sections. The sections were based on the existing ground surface, proposed top of levee/floodwall and the subsurface soils. Critical sections for both the levee and floodwall portions of the project were then chosen. The critical levee section was located between Sta. 0+00 and Sta. 4+00 of Upstream Rockaway #1 while the critical floodwall section was located between Sta. 1+00 and Sta. 5+21 of Downstream Rockaway No. 1.

12.8.2.1 Levee Stability One critical levee section, based on it height and subsurface soil conditions, was selected for the entire Rockaway No. 1 Levee System. It is assumed that the analyses performed for this section will be applicable for the entire levee system. Utilizing the soil parameters discussed earlier as well as a maximum slope of three horizontal to one vertical (3H:1V), slope stability analyses were performed for two critical conditions: levee at the end of construction during a maximum flood level and levee at the end of construction during a sudden drawdown. Stability on both sides of the levee was analyzed for these conditions. The following table summarizes the results of the slope stability analyses performed for the critical levee section. Global stability analyses indicated base reinforcement will not be required for the levees. Refer to the Levee Detail, Plate 12-36, for the typical levee section.

TABLE 12.8.2.1
LEVEE STABILITY FACTORS OF SAFETY

Case of Analysis	PCSTABL5M F.S. (without base reinforcement)
Sudden Drawdown Riverside Stability (G.W. up 1/2 of slope)	1.20
Sudden Drawdown Landside Stability (G.W. up 1/2 of slope)	1.39
Sudden Drawdown Riverside Stability (G.W. at toe of slope)	1.42
Maximum Flood Riverside Stability	1.92
Maximum Flood Landside Stability	1.24

12.8.2.2 Levee Settlement A detailed settlement analysis was not performed for the Rockaway No. 2 Levee System. Settlement estimates were based on the inferred soil conditions from the Passaic No. 2 Levee/Floodwall System. The preliminary settlement estimates indicate that up to approximately 9 inches of settlement may occur over 18 months following levee construction.

The settlement calculations included the overexcavation of an organic cohesive surface deposit. It is assumed that Downstream Rockaway No. 1 has an organic cohesive surface deposit. If encountered, the entire organic cohesive deposit (approximately 2 1/2' thick) should be overexcavated and backfilled with levee fill material. To help minimize the amount of differential settlement along the levee, stripping the top 6" of the existing ground surface and then grubbing to a maximum depth of 3' is recommended. Grubbing will consist of removing any objectionable and/or obstructional materials within 3' of the existing ground surface. The stripped and/or overexcavated materials, if satisfactory, can be utilized on the levee slopes as topsoil.

12.8.2.3 Levee Underseepage The levee section between Sta. 5+21 and Sta. 13+39 of Downstream Rockaway No. 1 was also analyzed for seepage underneath its base. The maximum underseepage was calculated to be 1 gallon/hour/foot of levee. Based on this rate, a toe drain along the entire landside length of Downstream Rockaway #1 is recommended. The toe drain would consist of a 2 foot x 4 foot trench backfilled with graded filter material encased with filter fabric. The toe drain is designed to relieve the build up of hydrostatic pressure under the levee foundation and to reduce the potential for piping. Underseepage of Upstream Rockaway No.1 was considered insignificant due to the presence of relatively low permeable silts below the base of this levee system. Landside drainage will not be required for this section of levees.

12.8.2.4 Floodwall Stability The floodwall stability analysis was based on the inferred soil conditions from the Passaic No. 2A Floodwall System. The conventional method of cantilever sheetpile analysis performed for the Passaic No 2A. system will be the basis for this system's recommendations. The floodwalls will consist of continuous cantilever, PZ-22 (regular carbon grade steel ASTM A328 grade with an allowable design stress of 19.25 KSI) sheet piling with a cast-in-place, reinforced concrete cap. The concrete should have a minimum compressive strength of 3,000 psi. Based on an average wall height of 4.5 feet, the sheet piling should be driven to a minimum depth of 10.5' below existing ground surface. This recommended penetration depth was based on the Passaic No. 2A sheet pile design which established a depth to height ratio of approximately 2.4:1. Refer to the Floodwall Detail, Plate 12-37, for construction and design details.

12.8.3 Rockaway No. 2 In order to design this system, the levee was broken into seven sections. The sections were based on the existing ground surface, proposed top of levee elevations and the available boring data from the southern end of the existing Rockaway No. 3 Levee/Floodwall System. The most critical levee section for this system is assumed to be located between Sta. 8+00 and Sta. 13+00.

12.8.3.1 Levee Stability

For the proposed levee system, the landside stability analysis is critical for the maximum flood condition. The Factor of Safety (F.S.) computed for this case was 1.23 which is slightly lower than the acceptable value (FS=1.3, or greater) as recommended by the Army Corps of Engineers Design Manual. Although this value is lower than the acceptable Factor of Safety, the stability of the levee is generally satisfactory

since the poorest subsurface conditions were assumed for this analysis and were based on boring data extrapolated from another site. It should be noted that additional test borings will be performed for the Final Design Memorandum and all levee design will be based on the actual subsurface conditions encountered at each site. Refer to the Levee Detail, Plate 12-38, for the typical levee section.

The following table lists the results of the slope stability analyses performed for the critical levee section between Sta. 8+00 and Sta. 13+00:

TABLE 12.8.3.1
LEVEE STABILITY FACTORS OF SAFETY

Case of Analysis	PCSTABL5M F.S. (without base reinforcement)
Sudden Drawdown Riverside Stability (G.W. up 1/2 of slope)	1.17
Sudden Drawdown Landside Stability (G.W. up 1/2 of slope)	1.42
Sudden Drawdown Riverside Stability (G.W. at toe of slope)	1.44
Maximum Flood Riverside Stability	1.90
Maximum Flood Landside Stability	1.23

12.8.3.2 Levee Settlement Settlement of the critical levee section was based on the inferred soil conditions from the Passaic No. 2A system. The maximum settlement for this project is estimated to be about 9 inches over 18 months. To help minimize the amount of differential settlement along the levee, stripping the top 6 inches of the existing ground surface and grubbing to a maximum depth of 3 feet is recommended. Grubbing

will consist of removing any objectionable and/or obstructional materials within 3 feet of the existing ground surface. The stripped material, if satisfactory, can be utilized on the levee slopes as topsoil.

12.8.3.3 Levee Underseepage Levee underseepage was investigated for the critical levee section. The available subsurface data indicate soils of low permeability are generally present below the proposed alignment of the levee system. Consequently, underseepage estimates for the critical section were (ie: silts and clays) are typically considered low with respect to their suceptability to piping.

12.8.4 Rockaway No. 3

In order to design this project, the levee system was broken into twelve sections. These sections were based on the existing type and height of flood control structure, proposed top of levee/floodwall elevations and the subsurface soil conditions. Critical sections for both the floodwall and levee portions of the project were then determined. Due to the existing flood control structures, this project requires several alternative floodwall and levee designs.

The first floodwall alternative consists of removing the existing pre-cast concrete wall sections; driving continuous cantilever sheet piling and constructing a cast-in-place, reinforced concrete cap. The second alternative consists of driving continuous cantilever sheet piling into the existing levee sections and constructing a cast-in-place, reinforced concrete cap. The critical section for the first alternative was between Sta. 40+50 and Sta. 59+50 and for the second alternative between Sta. 70+80 and Sta. 76+60. Modifying the existing floodwalls was not considered a viable alternative due to construction limitations imposed by the existing floodwall foundation, space constraints and constructability considerations.

The two levee alternatives consist of constructing a new levee on grade and constructing a levee on top of the existing levee sections with the additional levee height added on the landside. The critical section for the first alternative was between Sta. 0+00 and Sta. 10+25 and for the second alternative between Sta. 35+25 and Sta. 37+50.

12.8.4.1 Levee Stability One critical levee section was analyzed for the alternative where existing levees will be enlarged. It is assumed that the analysis performed for this section will be applicable for all existing levee sections which

are to be enlarged. Slope stability for the levee section between Sta. 0+00 to Sta. 10+25 which requires new levee construction was assumed to be satisfactory based on the stability analyses performed for the Rockaway No. 2 Levee System. Rockaway No. 2 is located near this project and possesses similar subsurface conditions. The following table summarizes the results of the slope stability analyses performed for the critical section. The shear strength properties of the existing levee fill and the core material were considered in the analyses. Refer to the Levee Detail drawings, Plates 12-39 and 12-40, for the typical levee sections.

TABLE 12.8.4.1
LEVEE STABILITY FACTORS OF SAFETY

Case of Analysis	PCSTABL5M F.S. (without base reinforcement)
Sudden Drawdown Riverside Stability (G.W. up 1/2 of slope)	1.67
Sudden Drawdown Landside Stability (G.W. up 1/2 of slope)	1.78
Sudden Drawdown Riverside Stability (G.W. at toe of slope)	1.88
Maximum Flood Riverside Stability	2.77
Maximum Flood Landside Stability	1.59

12.8.4.2 Levee Settlement Settlement of the critical levee section as well as the new levee section was based on the settlement calculations performed for the Passaic No. 2A Levee System. The maximum settlement of the levee constructed on top of the existing levee sections is estimated to be 6" over 18 months while the maximum settlement of the new levee section is estimated to be 9" over 18 months. These estimates consider the settlement that has already occurred for the existing sections of levee. To help minimize the amount of differential settlement

along the levee, stripping the top 6" of the existing ground surface and the top 4" of the existing levee crest and landside surfaces is recommended. Grubbing is also recommended to a maximum depth of 3' below the existing ground surface at tree stump locations. Grubbing will consist of removing any objectionable and/or obstructional materials within 3' of the existing ground surface. The stripped material, if satisfactory, can be utilized on the levee slopes as topsoil.

12.8.4.3 Floodwall Stability

The conventional method of cantilever sheet pile analysis was used to design the critical floodwall section to be constructed on top of the existing levee between Sta. 70+80 and Sta. 76+60. It is assumed that the analyses performed for this section will be applicable for the other proposed sections of floodwall which are to be driven into existing levees. The other sections are located between Sta. 59+50 and Sta. 68+40 and Sta. 70+80 and Sta. 76+60. Based on an average floodwall height of 5.2 feet the sheet piling should be driven to a minimum depth of 10.5 feet below the top of the levee surface. This recommended sheet pile penetration assumed a Factor of Safety 1.5.

For the other seven floodwall sections that are to be driven and constructed from the existing ground surface, a 2.4:1 penetration depth to wall height ratio was used for determining minimum penetration depth requirements for the sheet piling. This depth to height ratio was developed based on the Passaic No. 2A sheet pile analysis. Based on an average Floodwall height of 8.5', the sheet piling should be driven to a minimum depth of 20.5' below the existing ground surface. The seven floodwall sections that pertain to this design criteria are as follows: STA.15+30 to Sta. 16+70, Sta. 16+70 to Sta. 20+30, Sta. 26+30 to Sta. 37+50, Sta. 59+50, Sta. 68+40 to Sta. 70+80, Sta. 76+60 to Sta. 78+00 and Sta. 78+00 to Sta. 80+32. The second through to the sixth sections will require the demolition and removal of the existing concrete floodwall prior to driving and constructing the new floodwall while the first and last sections (Sta. 15+30 to Sta. 16+70 and Sta. 78+00 to Sta. 80+32) have no existing flood control structures. The new floodwall will consist of continuous PZ-22 (regular carbon steel ASTM A328 grade with an allowable design stress of 19.25 KSI) sheet piling with a cast-in-place, reinforced concrete cap. Refer to the typical Floodwall Details, Plates 12-41 and 12-42, for construction and design details.

12.8.5 Passaic No. 2A The Passaic No. 2A Levee/Floodwall System includes four segments which are referred to as Sections L1 through L4 looking south to north. In order to design this project, Sections L1, L2 and L4 were each broken into three

subsections and Section L3 was broken into five sub-sections. The sections were based on the existing ground surface, proposed top of levee/floodwall and the subsurface soil conditions. Critical sections for both the levee and floodwall portions of the project were then chosen. The critical levee section was located between Sta. 0+00 and Sta. 8+40 of Section L4 which is surrounded by a 4 foot deep pond (approximate El. 166.2), while the critical floodwall section was located between Sta. 9+50 and Sta. 14+00 on Section L2.

12.8.5.1 Levee Stability One critical levee section (Sta. 0+00 to Sta. 8+40) was selected for the entire Passaic No. 2A levee system. It is assumed that the analyses performed for this section will be applicable for the other proposed sections of levee. The critical section is located adjacent to an existing pond area; consequently, soil conditions landside of the levee were assumed as saturated and undrained in the stability analyses. Based on the inferred soil conditions from the available boring data, global stability analyses indicated base reinforcement was not required. Utilizing the soil strength parameters discussed earlier, slope stability analyses were performed for two critical conditions at the end of construction: maximum flood level and sudden drawdown. The following table summarizes the results of these analyses. Refer to the Levee Detail, Plate 12-43, for the typical levee section.

TABLE 12.8.5.1
LEVEE STABILITY FACTORS OF SAFETY

Case of Analysis	PCSTABL5M F.S (without base reinforcement)
Sudden Drawdown Riverside Stability (G.W. up 1/2 of slope)	1.17
Sudden Drawdown Landside Stability (G.W. up 1/2 of slope)	1.51
Sudden Drawdown Riverside Stability (G.W. at toe of slope)	1.51
Maximum Flood Riverside Stability	1.93

12.8.5.2 Levee Settlement. Settlement analyses were performed for the critical levee section. The estimated maximum settlements for this section range from approximatel 9 to 12 inches over roughly 2 1/2 years following levee construction. These estimates include the overexcavation of the 2 foot organic cohesive surface deposit. If encountered, the entire organic deposit should be overexcavated and backfilled with levee fill. To help minimize the amount of differential settlement along the levee, stripping the top 6" of the existing ground surface and then grubbing to a maximum depth of 3 feet is recommended. Grubbing will consist of removing any objectionable and/or obstructional materials within 3' of the existing ground surface. The stripped and/or overexcavated materials, if satisfactory, can be utilized on the levee slopes as topsoil.

12.8.5.3 Existing Embankment Stability and Underseepage Since both existing embankments support active roadways, it is assumed the embankments were constructed in a controlled, engineered manner (according to NJDOT specifications) and are inherently stable. The width of the embankments,

generally 100 to 300 feet, are greater than the proposed levees which results in extended seepage paths and landside exit gradients within the acceptable limits established by the USACE. Consequently, underseepage of the existing embankments is anticipated to be negligable. Erosion of these embankments during flood periods is also anticipated to be minimal since they are inland from the river and generally protect against ponded floodwaters and from flanking of the system.

12.8.5.4 Floodwall Stability The conventional method of cantilever sheet pile analysis was used to design the critical floodwall Section L2 between Sta. 9+50 and Sta. 14+00. Based on the average floodwall height of 8.5 feet the sheet piling should be driven to a minimum depth of approximately 20.5 feet below the existing ground surface. This recommended sheet pile penetration assumed a factor of safety 1.5 and an established depth to height ratio of 2.4:1. The proposed floodwalls will consist of continuous PZ-22 cantilever steel sheet piling (regular carbon ASTM A328 steel) with a cast-in-place, reinforced concrete cap. Refer to the Floodwall Detail, Plate 12-44, for construction and design details of the proposed floodwall.

12.8.6 Deepavaal Channel In order to design this project, the channel was broken into seventeen cross sections. The left and right banks of each cross section were evaluated by reviewing the proposed channel bank slope, proposed channel bank height and inferred subsurface profile. Based on this evaluation two critical cross sections were then determined. The right bank of the cross section at Sta. 77+80 and the left bank of the cross section at Sta. 123+30 were considered as critical for the project.

12.8.6.1 Channel Modification Stability Two critical channel sections were selected for the entire channel modification project. It is assumed that the analyses performed on these sections will be applicable for the entire project. Utilizing the soil parameters discussed earlier with three different channel bank slopes and two different channel bank heights, slope stability analyses were performed for two critical conditions: a channel bank slope at the end of construction during a maximum flood level and channel bank slope at the end of construction during a sudden drawndown. For simplicity in analysis of the maximum flood condition, it is assumed that the phreatic line is level with the maximum flood elevation. Consolidated drained shear strength properties were utilized for this analysis. An acceptable Factor of Safety (F.S.) for this case should be equal to or greater than 1.3. The sudden drawdown condition assumes that the brook quickly draws down from the maximum flood level to the channel invert elevation. The

phreatic line runs along the channel invert and then up the channel bank to halfway between the channel invert and the maximum flood level where it enters the channel bank at a slope equal to one-half of the channel bank slope until it reaches the maximum flood level elevation. For this condition, the shear strength properties of the channel bank are assumed to be undrained. Therefore, consolidated undrained shear strength properties were used for these analyses. An acceptable F.S. for this case should be equal to or greater than 1.0. The stability analyses indicated that a new channel bank slope cut steeper than 2.5:1 would yield an unstable condition. Although some of the existing bank slopes are of this magnitude or steeper and appeared to be stable; the existing banks are probably stabilized by heavy vegetation and plant growth. Consequently, all of the existing channel banks should be cut to a slope of 2.5:1 or flatter for adequate stability. The following table lists the results of the slope stability analyses performed for the critical channel bank sections at Sta. 77+80 (Right Bank) and Sta. 123+30 (Left Bank). Refer to the Channel Detail, Plate 12-45, for the typical channel improvement section.

TABLE 12.8.6.1
CHANNEL MODIFICATION STABILITY
FACTORS OF SAFETY

Case of Analysis	F.S.
Sta. 77+80 Sudden Drawdown 2.9:1 slope to 1.85:1 slope	0.88
Sta. 77+80 Maximum Flood 2.9:1 slope to 1.85:1 slope	1.13
Sta. 77+80 Sudden Drawdown Hypothetical 2.5:1 slope	1.02
Sta. 77+80 Maximum Drawdown Hypothetical 2.5:1 slope	1.50
Sta. 123+30 Sudden Drawdown Proposed 2.85:1 slope	1.28
Sta. 123+30 Maximum Flood Proposed 2.85:1 slope	1.78

12.8.6.2 Channel Erosion

An analysis to determine erosion control requirements was performed for the proposed modified channel. The maximum water velocity expected within the project limits was assumed to be 2.5 feet/second with the exception of the Fairfield Office Center location where the expected velocity was assumed to be 4.5 feet/second. These values were obtained from a hydrological study plot of the proposed Deepavaal Brook Channel Modification.

The following is a list of recommendations for erosion control within the channel:

o All channel banks should have a slope of 2.5:1 or flatter.

o A 12" thick layer of 4" to 8" size rip rap should be provided at tributary confluence locations for erosion control regardless of their slopes.

o A 12" thick layer of 4" to 8" size should be provided in the area of the existing Fairfield Office Center for erosion control regardless of bank slopes.

o The right banks in the area of Sta. 69+30± and Sta. 80+50± cannot be cut due to their close proximity to the Jersey City watermain right-of-way. Therefore, they will require backfilling with a minimum 12" thick layer of 4" to 8" size rip rap to maintain a minimum slope of 2.5:1 which provides protection for slope stability and erosion control.

o It is recommended that approximately two-thirds of the rip rap have a minimum size of 6"

o The rip rap should be constructed on a six inch (minimum) thick layer of graded crushed stone to provide a bed for the rip rap and to control migration of the underlying soils into the rip rap.

Refer to the end of this section for construction and design detail of the proposed channel modification and inferred subsurface profiles.

12.9 DESIGN AND CONSTRUCTION CONSIDERATIONS

12.9.1 Levees It is planned to utilize offsite borrow sources for all of the Central Basin levees. Since availability of suitable borrow sources in the future is difficult to predict, this is a critical item. If suitable quantities of relatively impervious levee fill cannot be found, two options exist. One option is to construct the main portion of the levees using tunnel muck and then add a 3 foot thick riverside clay blanket to control through seepage. Alternatively, if only granular and relatively previous commercial fill materials are available, these also may be satisfactorily used with the addition of a riverside clay blanket.

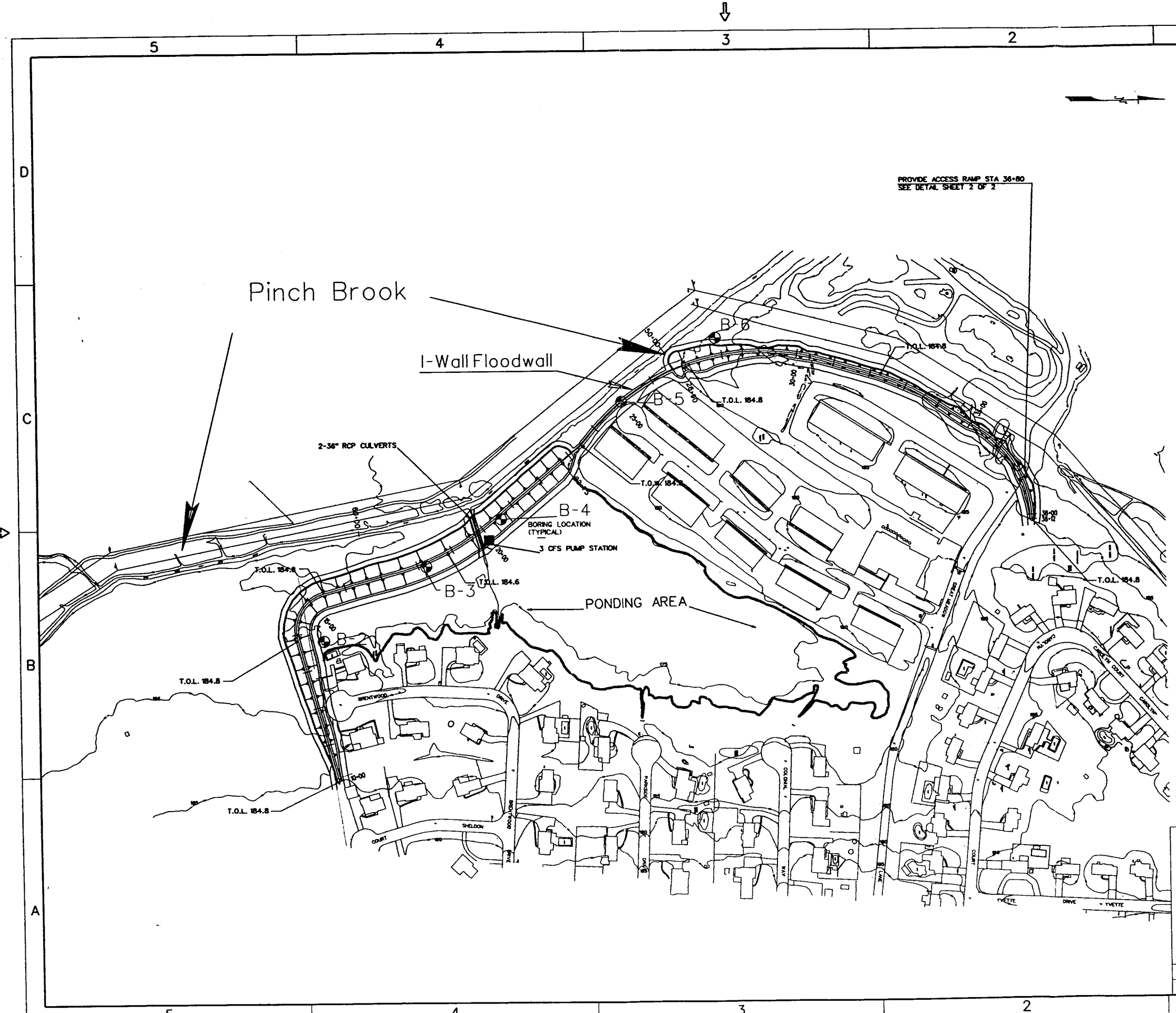
12.9.2 Levee Settlements As previously discussed, all levee systems for the Central Basin will experience some degree of post construction settlement. Settlement of the levee systems may be monitored by a system of conventional settlement plates installed at regular intervals near the crown of the levees. Periodic survey of the settlement plate elevations would provide a reasonable estimate of the levee settlement in that area. Additional fill materials should be placed on top of the levees as soon as measured settlements exceed several inches. It should be noted that the cost of an additional lift of fill material required to maintain the design top of levee elevation has been included in the cost estimate for the Central Basin levees.

12.9.3 Additional Subsurface Investigation The design of the Central Basin Levees and Floodwalls for this GDM is based on widely spaced and limited soil boring data. It is recommended for the FDM that additional borings be performed along the proposed flood protection system alignment to verify the initial design assumptions and also to check for unknown or unanticipated problematic soil conditions. Approximately 30 to 50 additional shallow (20-30 feet in depth) borings are recommended for final design purposes.

PASSAIC RIVER FLOOD DAMAGE REDUCTION PROJECT

SECTION 12
CENTRAL BASIN PROTECTION

PLATES



SHEET LEGEND

- BUILDINGS
- BUILDING UNDER CONSTRUCTION
- ROADS/PARKING AREAS
- DRIVES
- DIRT ROADS
- RAILROAD
- FENCE
- WATERS EDGE AND SWAMP OUTLINE
- DENSE WOODS LINE
- SWAMP SYMBOL
- WOODED AREA
- TOWER
- COUNTY BOUNDARY
- BOROUGH AND TOWNSHIP BOUNDARY
- U.S. ROAD SHIELD
- INTERSTATE ROAD SHIELD
- STATE ROADSHIELD
- PERMANENT EASEMENT
- TEMPORARY EASEMENT
- WETLAND AND VEGETATION LIMITS
- STUDY AREA BOUNDARY
- KNOWN HTRW SITES
- HIGH POTENTIAL HTRW SITES
- LOW POTENTIAL HTRW SITES
- (16) HTRW SITES
- STANDARD LEVEE
- STANDARD FLOOD WALL
- B-1 BORING LOCATION AND NUMBER

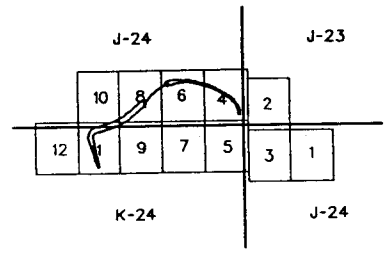
WETLAND LEGEND

PF - PALUSTRINE FORESTED

PSS - PALUSTRINE SCRUB/SCHRUB

EM - PALUSTRINE EMERGENT
CAT - CATTAIL
3SQ - 3-SQUARE

KEY TO MATCHING SHEETS



SCALE IN FEET

100 0 100 200 300

U.S. ARMY ENGINEER DISTRICT, NEW YORK
PASSAIC RIVER DIVISION
CORPS OF ENGINEERS

Passaic River Flood Damage Reduction Project

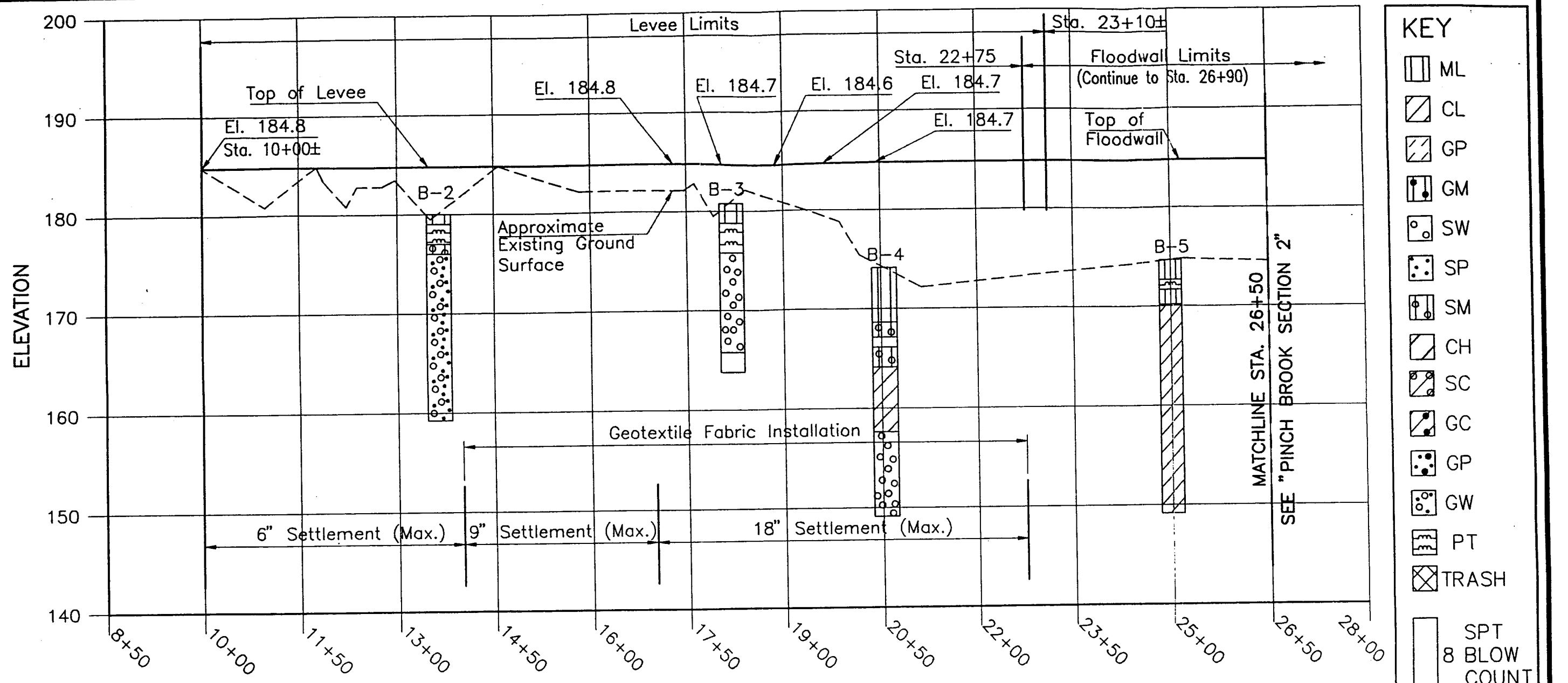
GENERAL DESIGN MEMORANDUM

PINCH BROOK LEVEE/FLOOD WALL SYSTEM

REVISED:

DATE: OCTOBER 1994 | PREPARED BY: MRW | SHEET 1 OF 2

PLATE E-12.1



Note:

1. Subsurface soil classification is inferred from Borings B-2 through B-6 located along the proposed Levee System, respectively.
2. The Ground Surface Profile is approximate and was developed from the plans provided by CENAN-PR/RBA.

10' 5' 0 10' 20'
1" = 10'-0"

150' 0 150' 300'
1" = 150'-0"

PINCH BROOK SECTION 1
PROPOSED LEVEE PROFILE

SCALE: Vert.: 1" = 10'
Horiz.: 1" = 150'

DWN. BY: JSL
CHK'D BY: UK
ARORA and ASSOCIATES, P.C.
CONSULTING ENGINEERS

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PASSAIC RIVER DIVISION
CORPS OF ENGINEERS

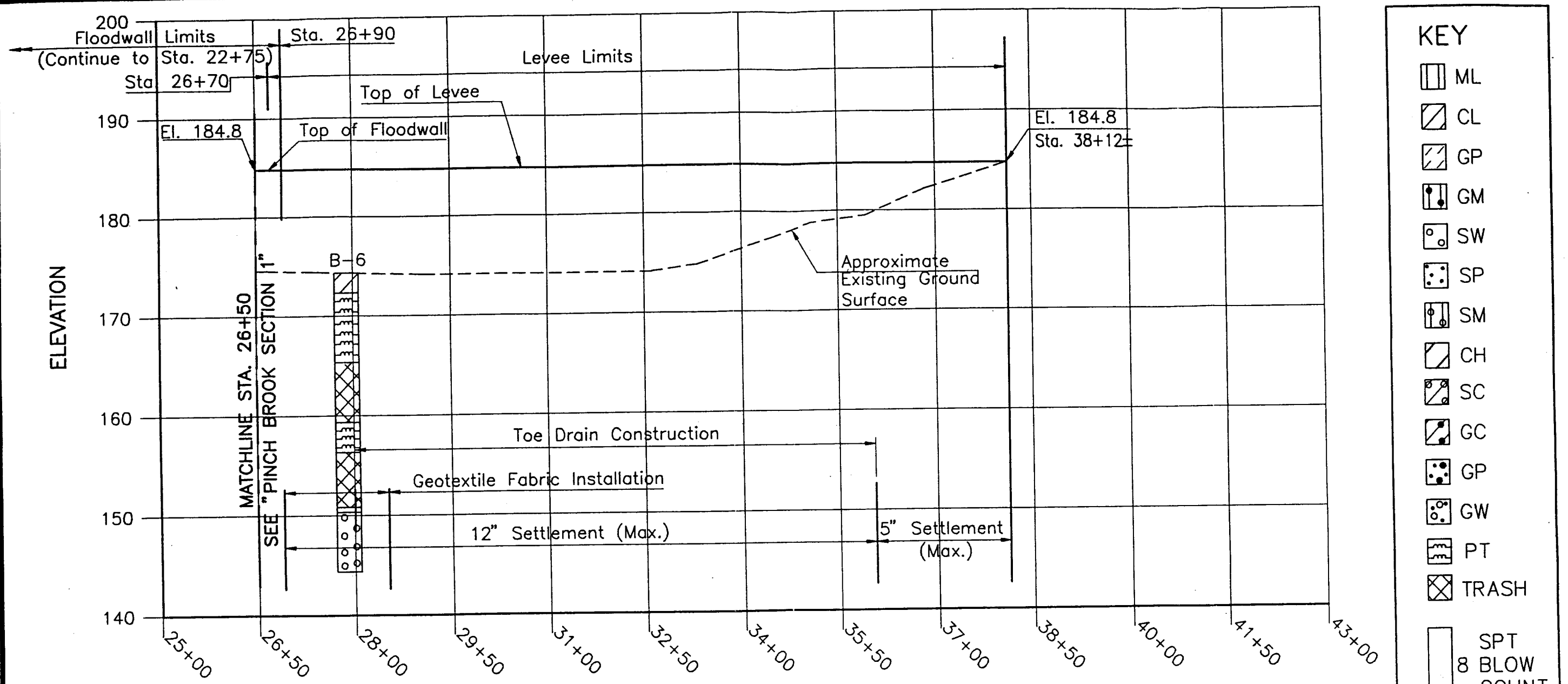
PASSAIC RIVER FLOOD DAMAGE REDUCTION PROJECT

SUBSURFACE PROFILE

PINCH BROOK
LEVEE/FLOODWALL SYSTEM

PLATE E-12.2

CAD A&A 1218 PINCHPRO.DWG 02/02/95 MSB



Note:

1. Subsurface soil classification is inferred from Borings B-2 through B-6 located along the proposed Levee System, respectively.
2. The Ground Surface Profile is approximate and was developed from the plans provided by CENAN-PR/RBA.

10' 5' 0 10' 20'
1" = 10'-0"

150' 0 150' 300'
1" = 150'-0"

PINCH BROOK SECTION 2
PROPOSED LEVEE PROFILE

SCALE: Vert.: 1" = 10'
Horiz.: 1" = 150'

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CHK'D BY: UK
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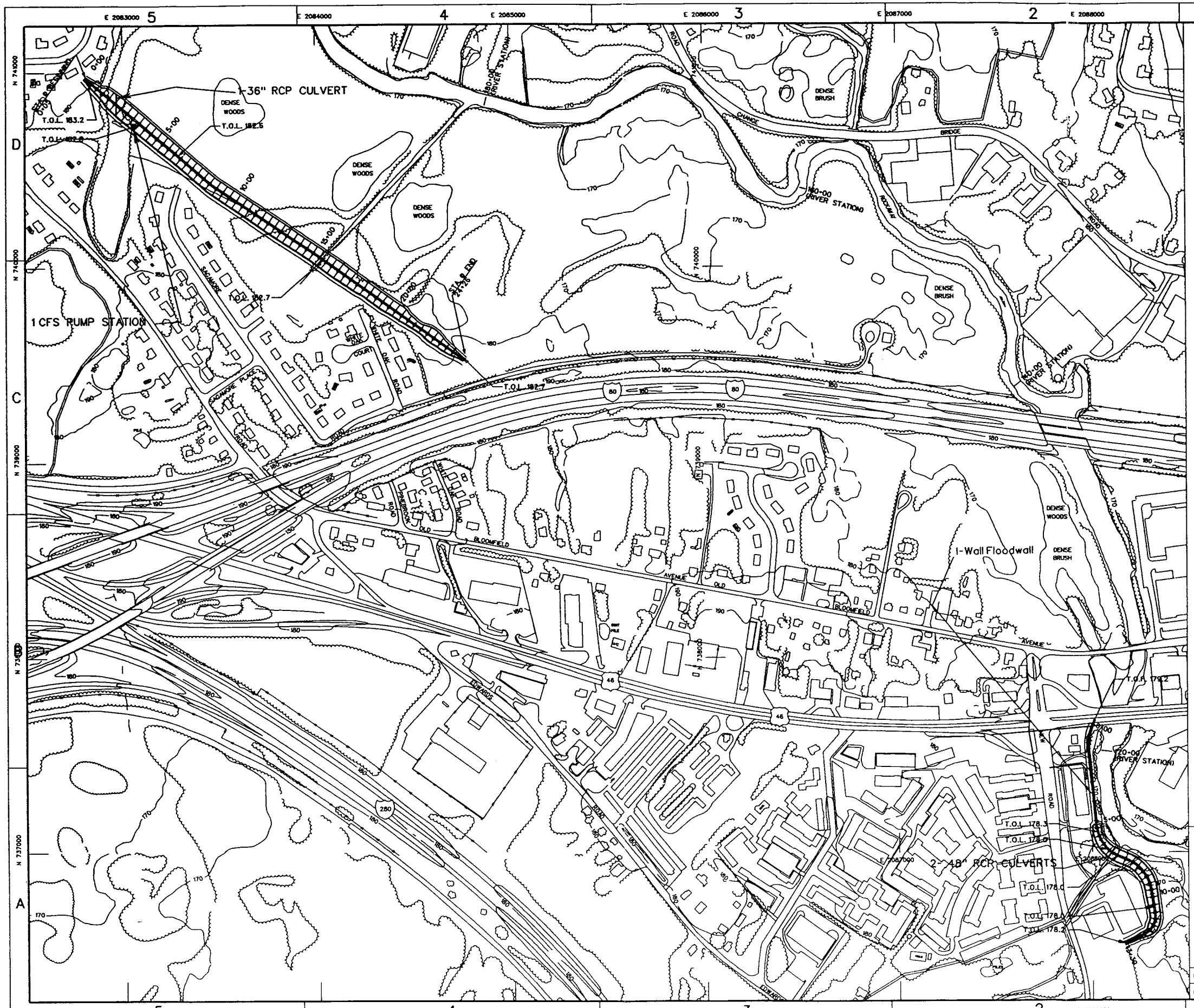
PASSAIC RIVER FLOOD DAMAGE REDUCTION PROJECT

SUBSURFACE PROFILE

PINCH BROOK
LEVEE/FLOODWALL SYSTEM

PLATE E-12.3

02/02/95 MSB
PINCHPRO.DWG
1218
CAD A&A



SHEET LEGEND

- BUILDINGS
- BUILDING UNDER CONSTRUCTION
- ROADS/PARKING AREAS
- DRIVES
- DIRT ROADS
- RAILROAD
- FENCE
- WATERS EDGE AND SWAMP OUTLINE
- DENSE WOODS LINE
- SWAMP SYMBOL
- WOODED AREA
- TOWER
- COUNTY BOUNDARY
- BOROUGH AND TOWNSHIP BOUNDARY
- U.S. ROAD SHIELD
- INTERSTATE ROAD SHIELD
- STATE ROADSHIELD
- PERMANENT EASEMENT
- TEMPORARY EASEMENT
- WETLAND AND VEGETATION LIMITS
- STUDY AREA BOUNDARY
- KNOWN HTRW SITES
- HIGH POTENTIAL HTRW SITES
- LOW POTENTIAL HTRW SITES
- HTRW SITES (15)
- STANDARD LEVEE
- STANDARD FLOOD WALL

WETLAND LEGEND

PF - PALUSTRINE FORESTED

PSS - PALUSTRINE SCRUB/SCRUB

EM - PALUSTRINE EMERGENT
CAT - CATTAIL
3SQ - 3-SQUARE

L-19	M-19
L-20	M-20

DATE OF PHOTOGRAPHY
JANUARY 27, 1990 (MAPS L-19, L-20, M-19)
ORIGINAL MAP PRODUCED FROM PHOTOGRAPHY DATED APRIL 9, 1978.
UPDATED FROM PHOTOGRAPHY DATED JANUARY 27, 1990 (MAP M-20)

SCALE IN FEET
200 0 200 400 600

U.S. ARMY ENGINEER DISTRICT, NEW YORK
PASSAIC RIVER DIVISION
CORPS OF ENGINEERS

Passaic River Flood Damage Reduction Project

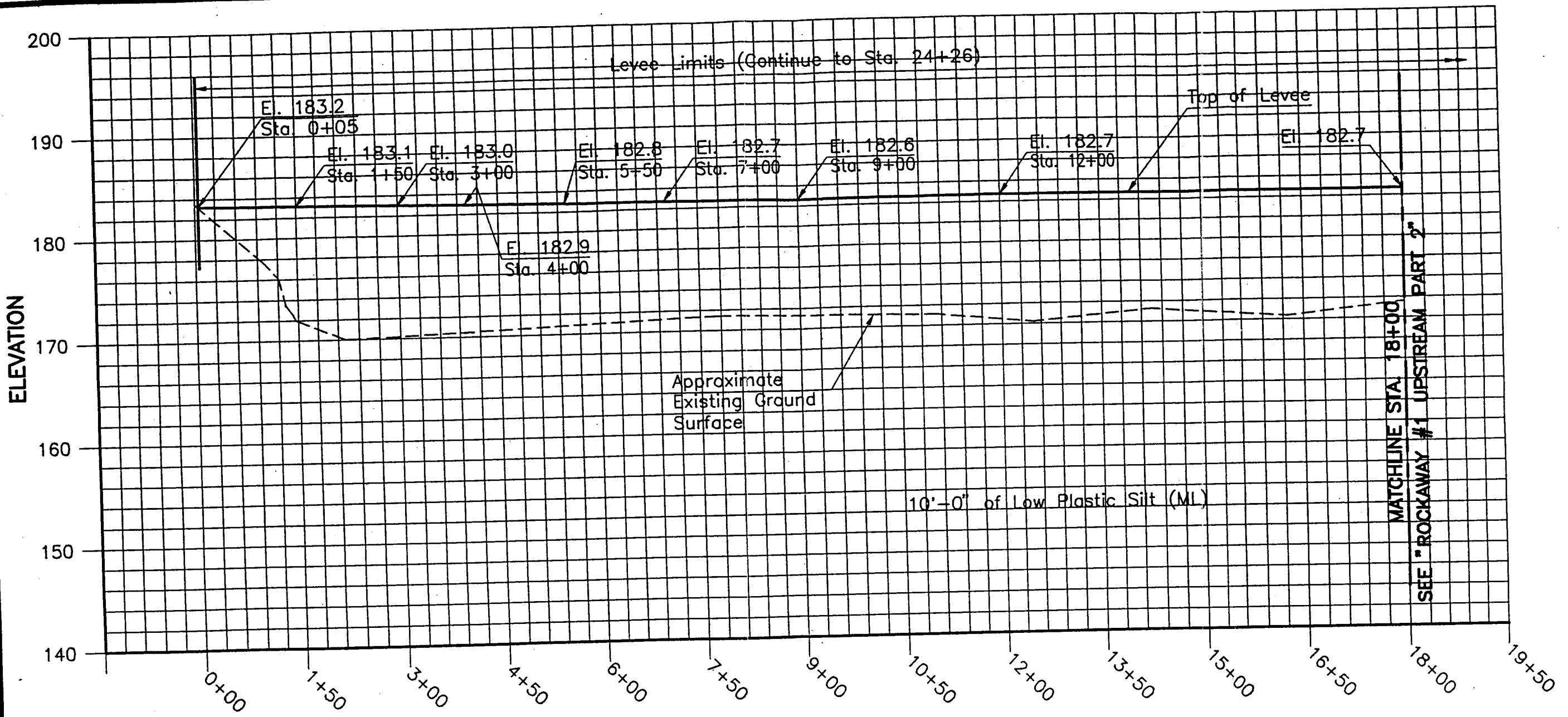
GENERAL DESIGN MEMORANDUM

ROCKAWAY 1 LEVEE/FLOODWALL SYSTEM

REVISED:

DATE: NOVEMBER 1994 | PREPARED BY: MRV | SHEET 1 of 3

PLATE E-12.4



Note:

1. Subsurface soil classification is inferred from Boring B-15 located North of Proposed Levee System
2. The Ground Surface Profile is approximate and was developed from the plans provided by CENAN-PR/RBA.

10' 5' 0 10' 20'
1" = 10'-0"

150' 0 150' 300'
1" = 150'-0"

ROCKAWAY #1 UPSTREAM SHEET 1 OF 2
PROPOSED LEVEE PROFILE

SCALE: Vert.: 1" = 10'
Horiz.: 1" = 150'

DWN. BY: JSL
CHK'D BY: UK
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PASSAIC RIVER DIVISION
CORPS OF ENGINEERS

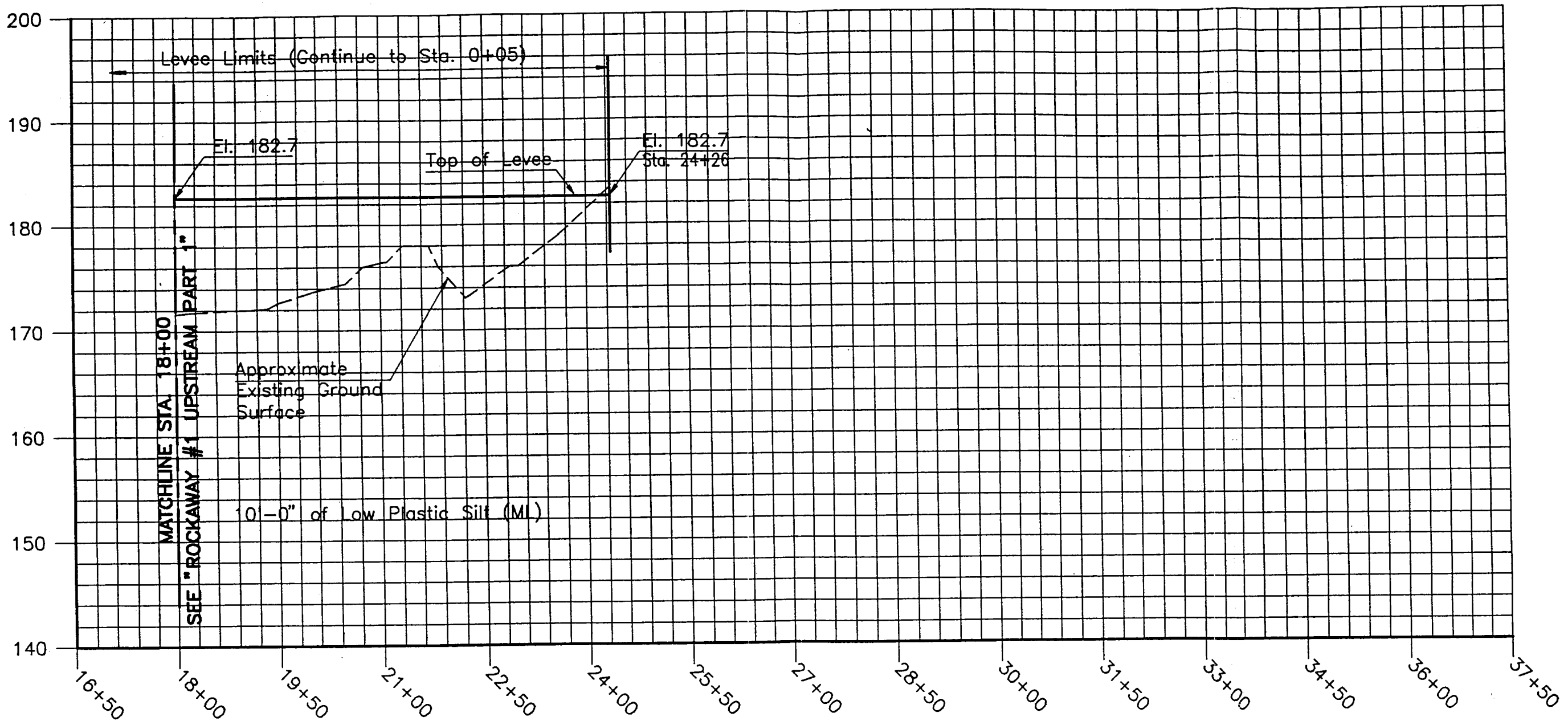
PASSAIC RIVER FLOOD DAMAGE REDUCTION PROJECT

SUBSURFACE PROFILE

ROCKAWAY #1 UPSTREAM LEVEE SYSTEM

PLATE E-12.5

CAD A&A 1218 ROCK1PRO.DWG 4/10/95 JSL



Note:

1. Subsurface soil classification is inferred from Boring B-15 located North of Proposed Levee System
2. The Ground Surface Profile is approximate and was developed from the plans provided by CENAN-PR/RBA.

10' 5' 0 10' 20'
1" = 10'-0"

150' 0 150' 300'
1" = 150'-0"

ROCKAWAY #1 UPSTREAM SHEET 2 OF 2
PROPOSED LEVEE PROFILE

SCALE: Vert.: 1" = 10'
Horiz.: 1" = 150'

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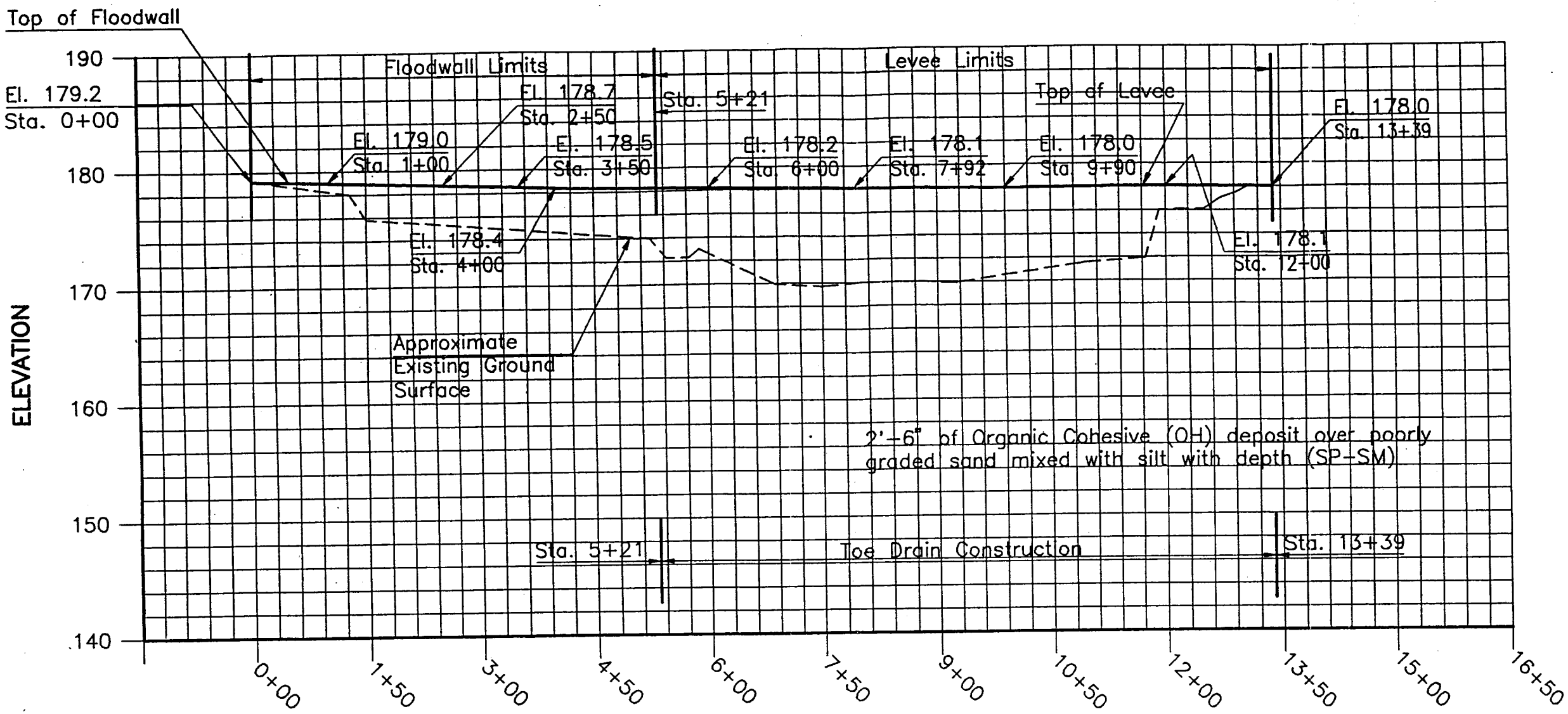
PASSAIC RIVER DIVISION
CORPS OF ENGINEERS

PASSAIC RIVER FLOOD DAMAGE REDUCTION PROJECT

SUBSURFACE PROFILE

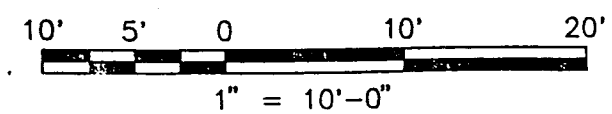
ROCKAWAY #1 UPSTREAM LEVEE SYSTEM

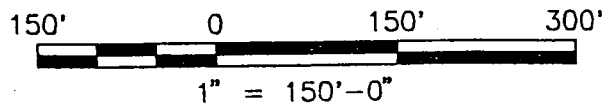
CAD A&A 1218 ROCK1PRO.DWG 4/10/95 JSL



Note:

1. Subsurface soil classification is inferred from Boring 12–9 located South of Proposed Levee/Floodwall System
2. The Ground Surface Profile is approximate and was developed from the plans provided by CENAN–PR/RBA.
3. If the Organic Cohesive material is encountered, it should be overexcavated before placing the Levee foundation.





ROCKAWAY #1 DOWNSTREAM PROPOSED LEVEE PROFILE

SCALE: Vert.: 1" = 10'
Horiz.: 1" = 150'

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PASSAIC RIVER DIVISION
CORPS OF ENGINEERS

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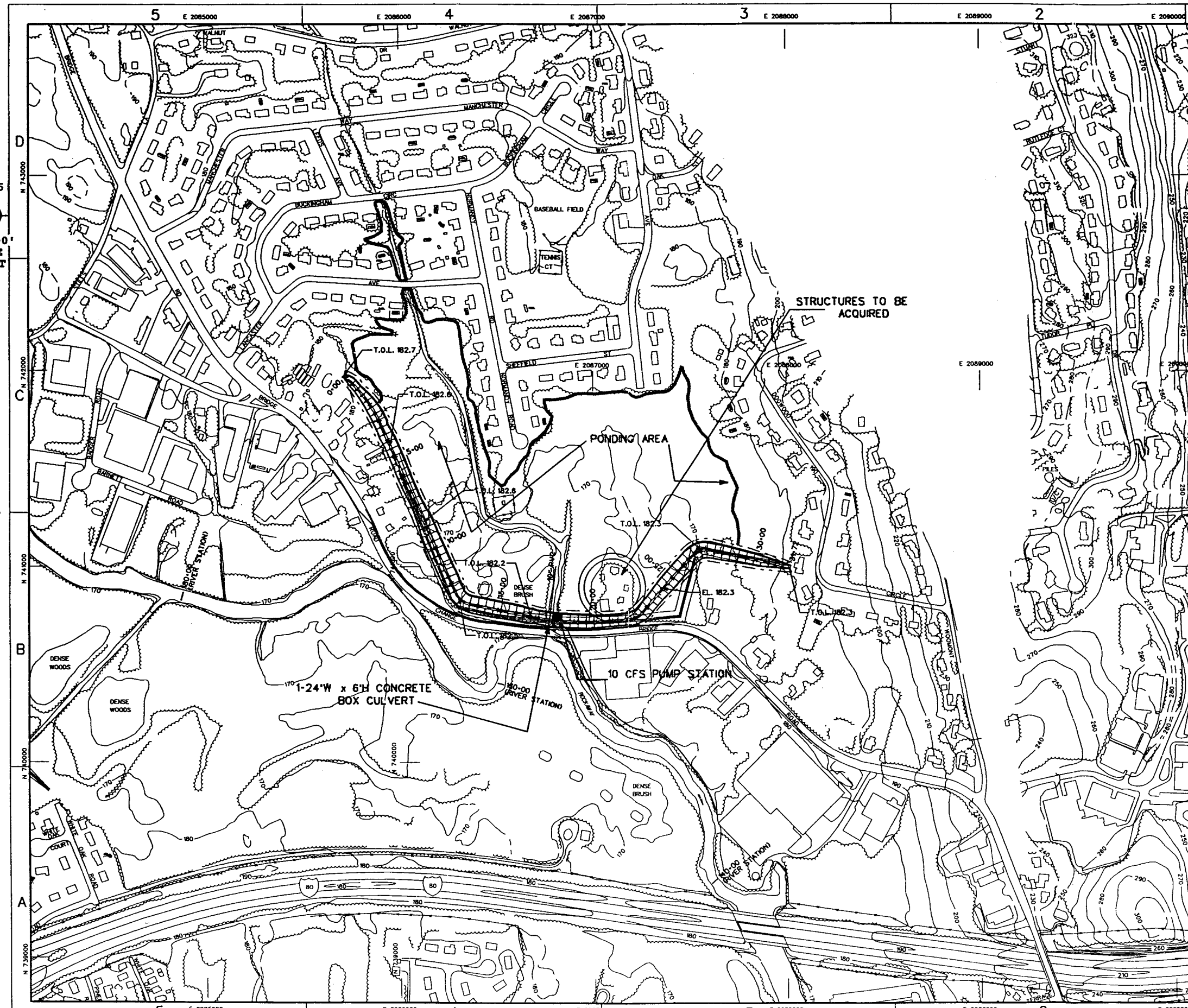
PASSAIC RIVER FLOOD DAMAGE REDUCTION PROJECT

SUBSURFACE PROFILE

ROCKAWAY #1 DOWNSTREAM LEVEE/FLOODWALL SYSTEM

PLATE E-12.7

CAD A&A 1218 ROCK1PRO.DWG 4/10/95 JSL



SHEET LEGEND

BUILDINGS
BUILDING UNDER CONSTRUCTION
ROADS/PARKING AREAS
DRIVES
DIRT ROADS
RAILROAD
FENCE
WATERS EDGE AND SWAMP OUTLINE
DENSE WOODS LINE
SWAMP SYMBOL
WOODED AREA
TOWER
COUNTY BOUNDARY
BOROUGH AND TOWNSHIP BOUNDARY
U.S. ROAD SHIELD
INTERSTATE ROAD SHIELD
STATE ROADSHIELD
PERMANENT EASEMENT
TEMPORARY EASEMENT
WETLAND AND VEGATATION LIMITS
STUDY AREA BOUNDARY
KNOWN HTRW SITES
HIGH POTENTIAL HTRW SITES
LOW POTENTIAL HTRW SITES
HTRW SITES
STANDARD LEVEE
STANDARD FLOOD WALL

B-1 BORING LOCATION AND NUMBER

WETLAND LEGEND

PF - PALUSTRINE FORESTED
PSS - PALUSTRINE SCRUB/SCHRUB
EM - PALUSTRINE EMERGENT
CAT - CATTAIL
3SQ - 3-SQUARE

KEY TO MATCHING SHEETS

L-18 M-18
SHEET 1
L-19 M-19

DATE OF PHOTOGRAPHY JANUARY 27, 1990

SCALE IN FEET
200 0 200 400 600

U.S. ARMY ENGINEER DISTRICT, NEW YORK
PASSAIC RIVER DIVISION
CORPS OF ENGINEERS

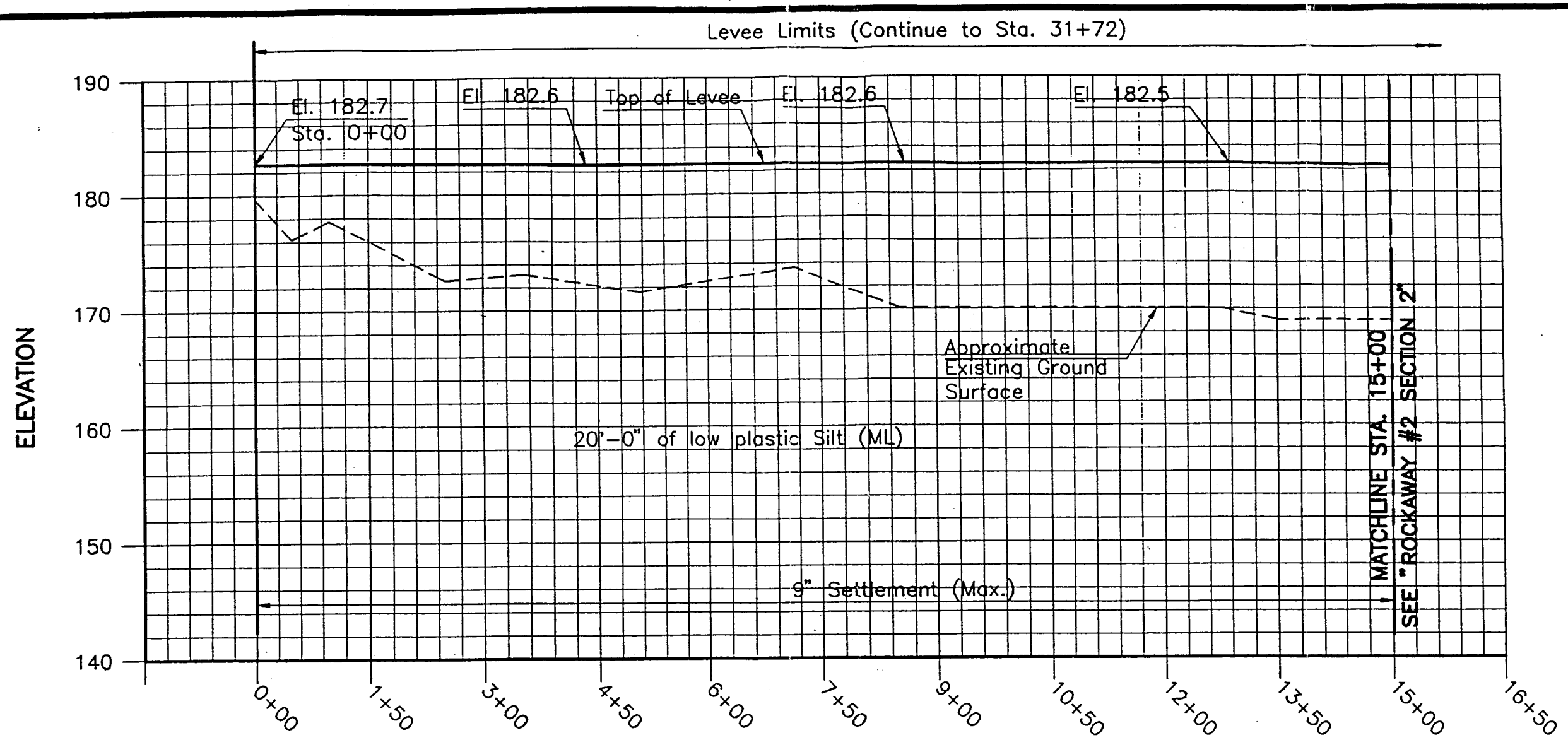
Passaic River Flood Damage Reduction Project

GENERAL DESIGN MEMORANDUM

ROCKAWAY 2 LEVEE SYSTEM

REVISED:
DATE: NOVEMBER 1994 | PREPARED BY: MRW | SHEET 1 of 3

PLATE E-12.8



Note:

1. Subsurface soil classification is inferred from Borings B-15 and 12-29 located West and South of the proposed Levee System, respectively.
2. The Ground Surface Profile is approximate and was developed from the plans provided by CENAN-PR/RBA.

ROCKAWAY #2 SECTION 1
PROPOSED LEVEE PROFILE

SCALE: Vert.: 1" = 10'
Horiz.: 1" = 150'

10' 5' 0 10' 20'
1" = 10'-0"

150' 0 150' 300'
1" = 150'-0"

U.S. ARMY ENGINEER DISTRICT, NEW YORK
PASSAIC RIVER DIVISION
CORPS OF ENGINEERS

DWN. BY: JSL
CHK'D BY: UK
ARORA and ASSOCIATES, P.C.
CONSULTING ENGINEERS

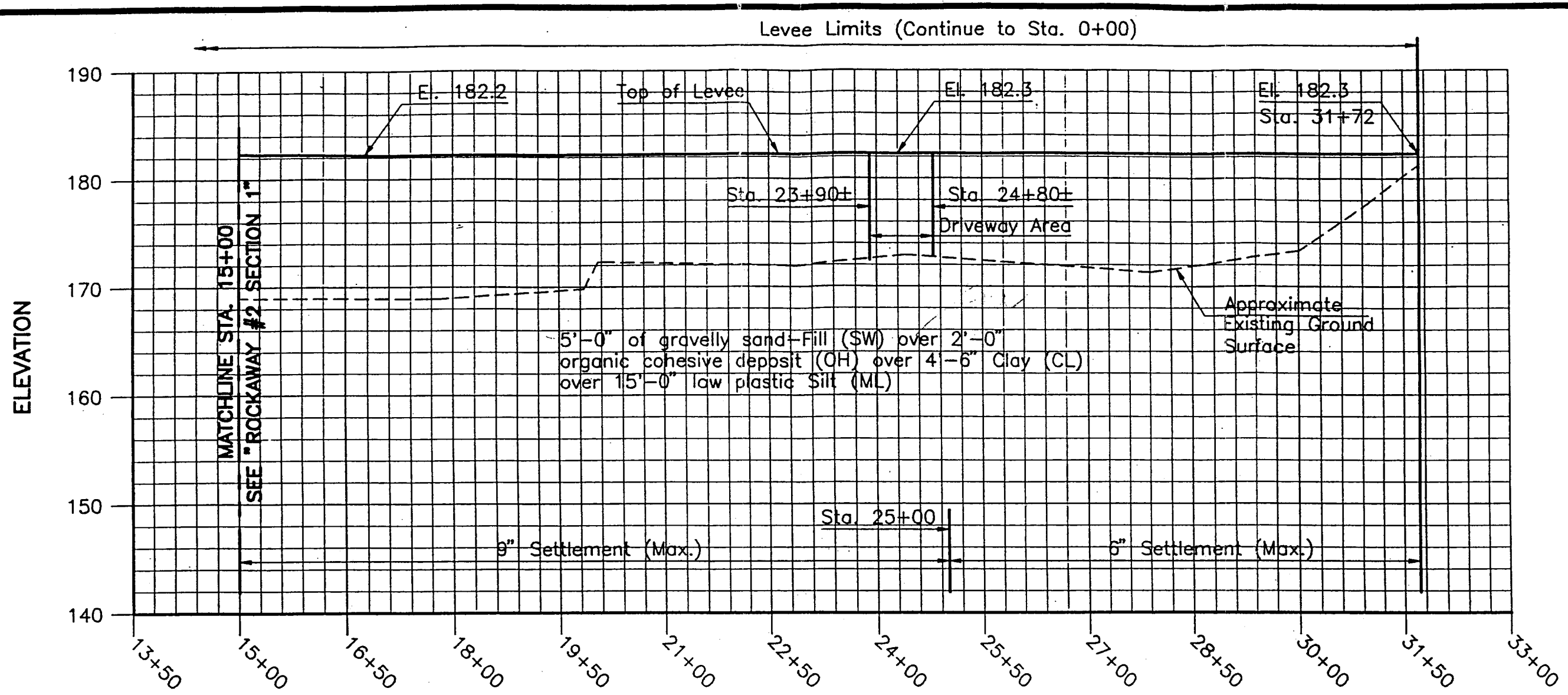
PASSAIC RIVER FLOOD DAMAGE REDUCTION PROJECT

SUBSURFACE PROFILE

ROCKAWAY #2
LEVEE SYSTEM

PLATE E-12.9

CAD A&A 1218 ROCK2PRO.DWG 3/6/95 JSL



Note:

1. Subsurface soil classification is inferred from Borings B-15 and 12-29 located West and South of the proposed Levee System, respectively.
2. The Ground Surface Profile is approximate and was developed from the plans provided by CENAN-PR/RBA.

ROCKAWAY #2 SECTION 2
PROPOSED LEVEE PROFILE

SCALE: Vert.: 1" = 10'
Horiz.: 1" = 150'

10' 5' 0 10' 20'
1" = 10'-0"

150' 0 150' 300'
1" = 150'-0"

U.S. ARMY ENGINEER DISTRICT, NEW YORK
PASSAIC RIVER DIVISION
CORPS OF ENGINEERS

DWN. BY: JSL
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ARORA and ASSOCIATES, P.C.
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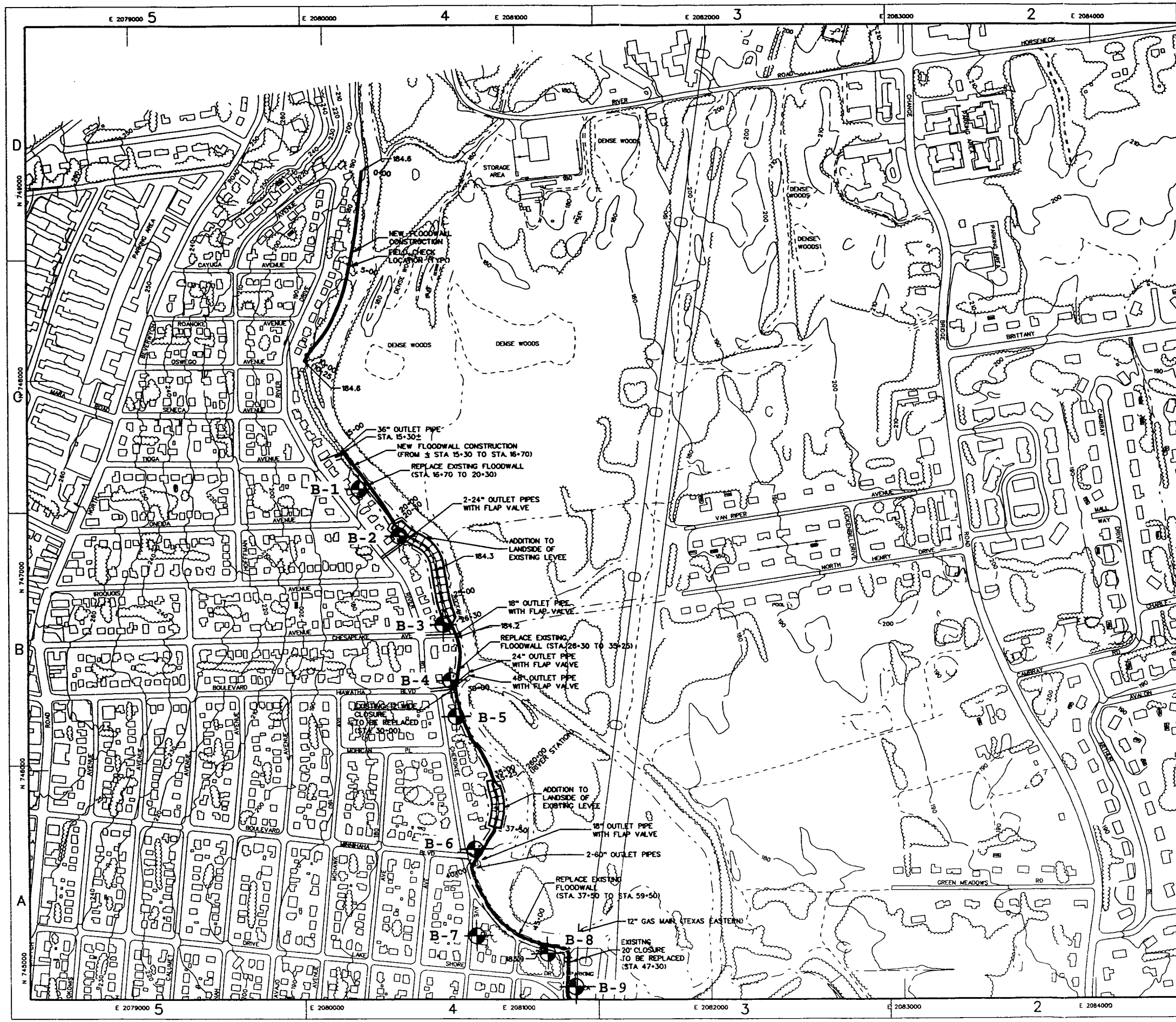
PASSAIC RIVER FLOOD DAMAGE REDUCTION PROJECT

SUBSURFACE PROFILE

ROCKAWAY #2
LEVEE SYSTEM

CAD A&A 1218 ROCK2PRO.DWG 3/6/95 JSL

PLATE E-12.10



SHEET LEGEND

- BUILDINGS
- BUILDING UNDER CONSTRUCTION
- ROADS/PARKING AREAS
- DRIVES
- DIRT ROADS
- RAILROAD
- FENCE
- WATERS EDGE AND SWAMP OUTLINE
- DENSE WOODS LINE
- SWAMP SYMBOL
- WOODED AREA
- TOWER
- COUNTY BOUNDARY
- BOROUGH AND TOWNSHIP BOUNDARY
- U.S. ROAD SHIELD
- INTERSTATE ROAD SHIELD
- STATE ROADSHIELD
- PERMANENT EASEMENT
- TEMPORARY EASEMENT
- WETLAND AND VEGATATION LIMITS
- STUDY AREA BOUNDARY
- KNOWN HTRW SITES
- HIGH POTENTIAL HTRW SITES
- LOW POTENTIAL HTRW SITES
- 15 HTRW SITES
- STANDARD LEVEE
- STANDARD FLOOD WALL
- B-1 BORING LOCATION AND NUMBER

WETLAND LEGEND

PF - PALUSTRINE FORESTED

PSS - PALUSTRINE SCRUB/SCHRUB

EM - PALUSTRINE EMERGENT
CAT - CATTAIL
3SQ - 3-SQUARE

KEY TO MATCHING SHEETS

K-17	L-17
SHEET	
K-18	L-18

PHOTOGRAMMETRY MAPPING ORIGINALY PRODUCED FROM PHOTOGRAPHY DATED APRIL 9, 1978 PHOTOGRAMMETRICAL UPDATE PRODUCED FROM PHOTOGRAPHY DATED JANUARY 27, 1990 (K-17) DATE OF PHOTOGRAPHY JANUARY 27, 1990 (K-18, L-17, L-18)

SCALE IN FEET

200 0 200 400 600

U.S. ARMY ENGINEER DISTRICT, NEW YORK
PASSAIC RIVER DIVISION
CORPS OF ENGINEERS

Passaic River Flood Damage Reduction Project

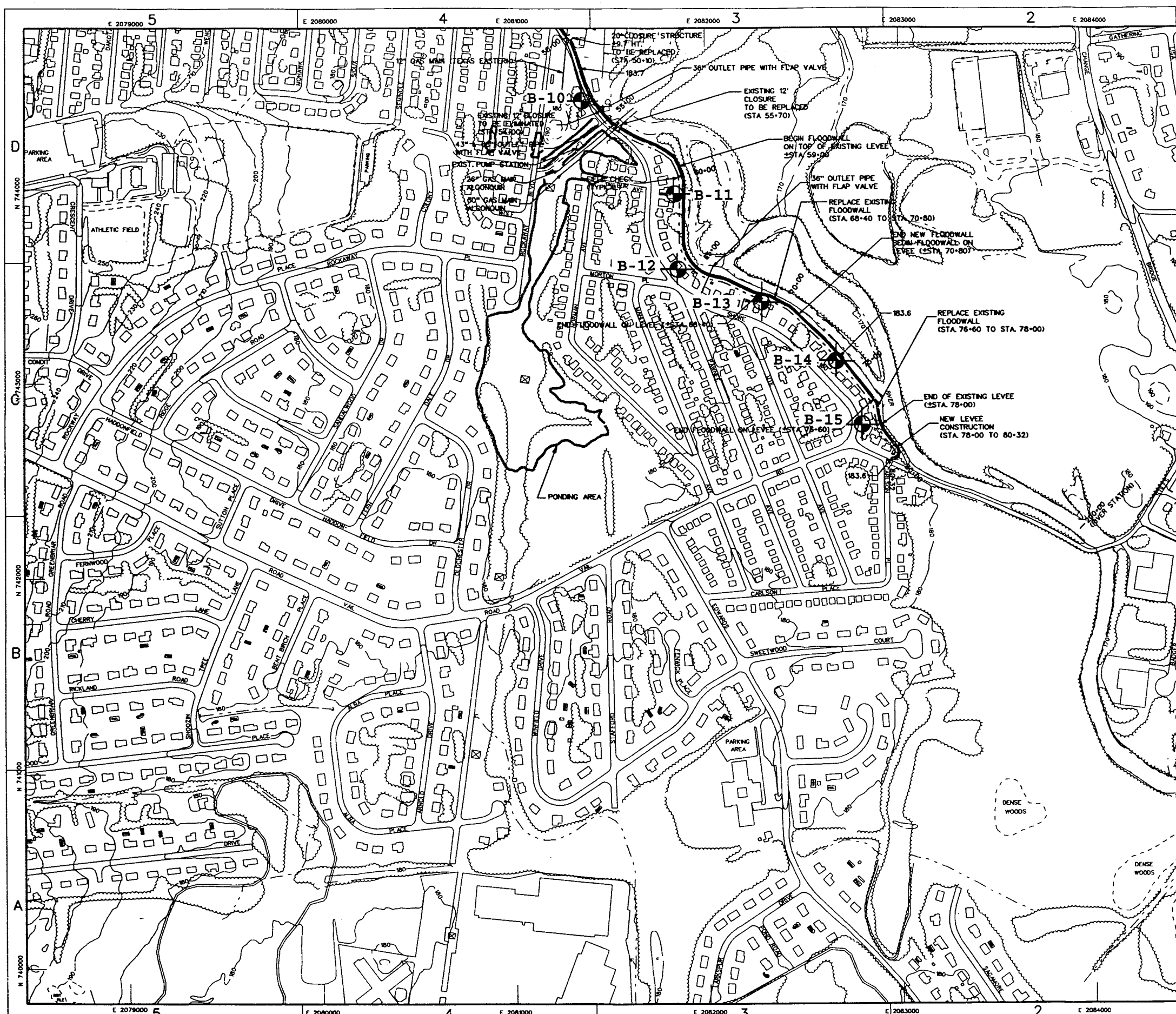
GENERAL DESIGN MEMORANDUM

ROCKAWAY 3 LEVEE / FLOODWALL SYSTEM

REVISED:

DATE: DECEMBER 1994 | PREPARED BY: MRW | SHEET 1 of 6

PLATE E-12.11



U.S. ARMY ENGINEER DISTRICT, NEW YORK
PASSAIC RIVER DIVISION
CORPS OF ENGINEERS

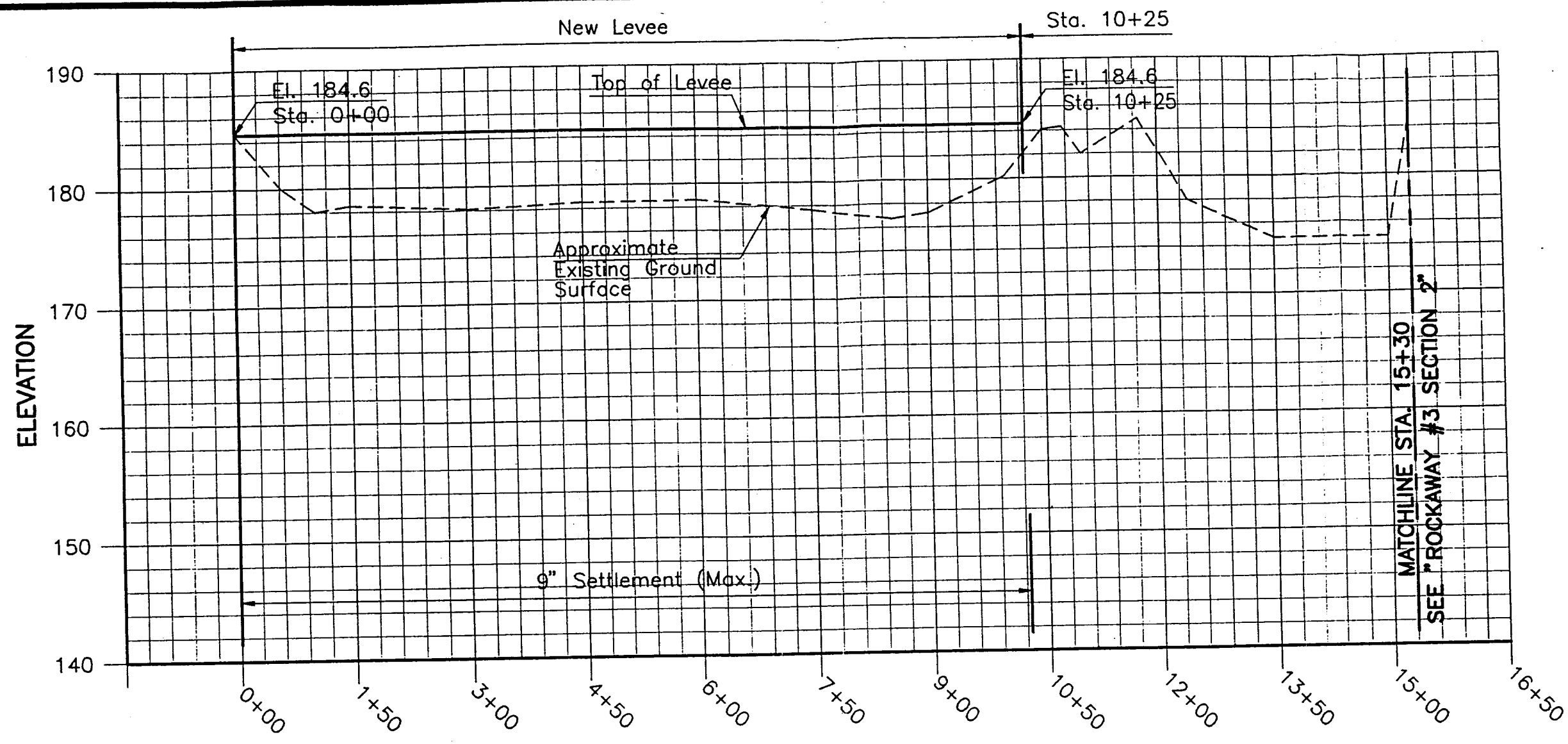
Passaic River Flood Damage Reduction Project

GENERAL DESIGN MEMORANDUM

ROCKAWAY 3 LEVEE / FLOODWALL SYSTEM

REVISED:		
DATE: DECEMBER 1994	PREPARED BY: MRV	SHEET 2 of 6

PLATE E-12.12



Note:

1. The Ground Surface Profile is approximate and was developed from the plans provided by CENAN-PR/RBA.
2. Subsurface drainage systems are provided along the proposed levees. The drainage systems shall have the same design as the existing drainage systems.

ROCKAWAY #3 SECTION 1
PROPOSED PROFILE

SCALE: Vert.: 1" = 10'
Horiz.: 1" = 150'

10' 5' 0 10' 20'
1" = 10'-0"

150' 0 150' 300'
1" = 150'-0"

DWN. BY: JSL
CHK'D BY: UK
ARORA and ASSOCIATES, P.C.
CONSULTING ENGINEERS

U.S. ARMY ENGINEER DISTRICT, NEW YORK
PASSAIC RIVER DIVISION
CORPS OF ENGINEERS

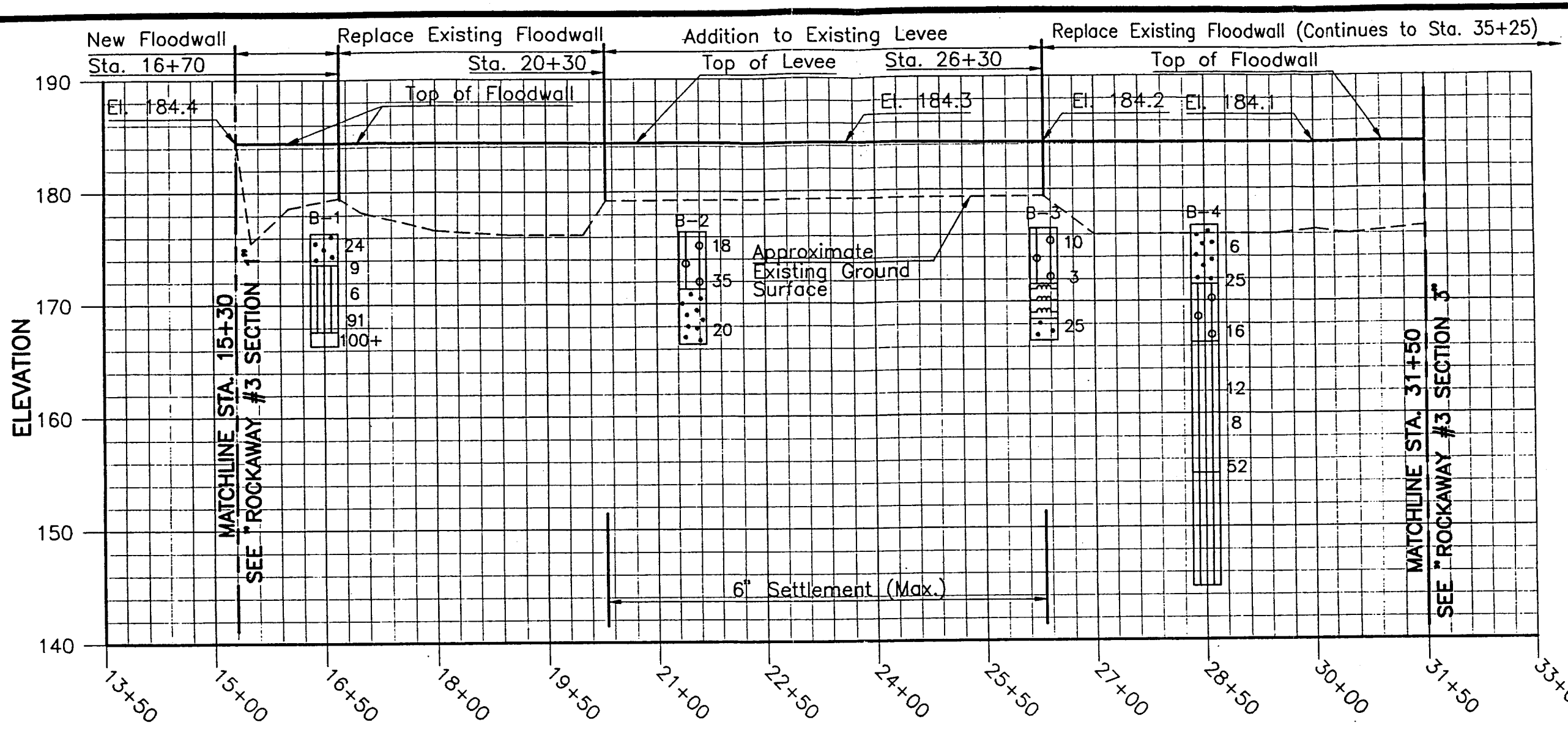
PASSAIC RIVER FLOOD DAMAGE REDUCTION PROJECT

SUBSURFACE PROFILE

ROCKAWAY #3
LEVEE/FLOODWALL SYSTEM

PLATE E-12.13

CAD A&A 1218 ROCK3PRO.DWG 3/2/95 JSL



Note:

1. The Ground Surface Profile is approximate and was developed from the plans provided by CENAN-PR/RBA.
2. Subsurface drainage systems are provided along the proposed levees. The drainage systems shall have the same design as the existing drainage systems.

ROCKAWAY #3 SECTION 2
PROPOSED PROFILE

SCALE: Vert.: 1" = 10'
Horiz.: 1" = 150'

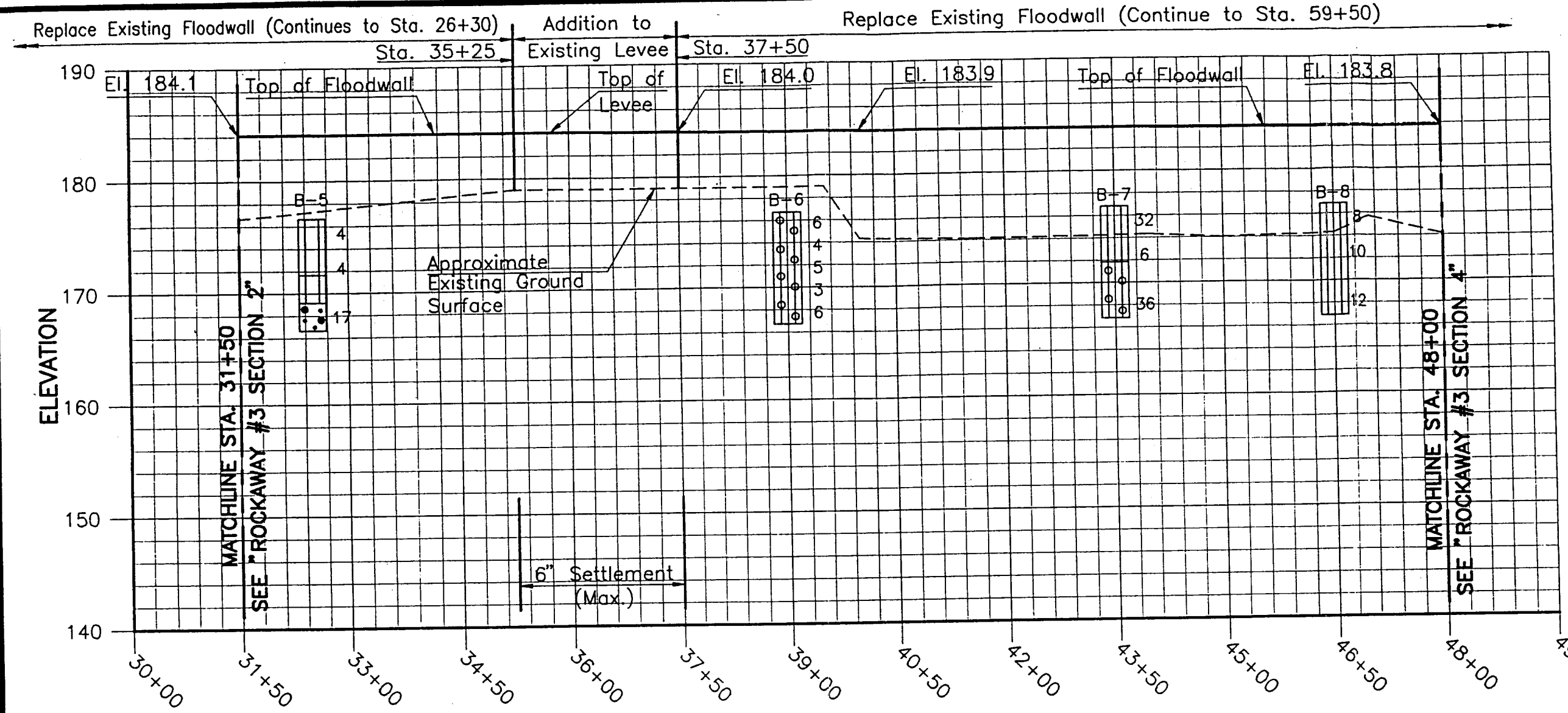
10' 5' 0 10' 20'
1" = 10'-0"

150' 0 150' 300'
1" = 150'-0"

DWN. BY: JSL	U.S. ARMY ENGINEER DISTRICT, NEW YORK PASSAIC RIVER DIVISION CORPS OF ENGINEERS
CHK'D BY: UK	PASSAIC RIVER FLOOD DAMAGE REDUCTION PROJECT
ARORA and ASSOCIATES, P.C. CONSULTING ENGINEERS	SUBSURFACE PROFILE ROCKAWAY #3 LEVEE/FLOODWALL SYSTEM

PLATE E-12.14

CAD A&A 1218 ROCK3PRO.DWG 3/2/95 JSL



Note:

1. The Ground Surface Profile is approximate and was developed from the plans provided by CENAN-PR/RBA.
2. Subsurface drainage systems are provided along the proposed levees. The drainage systems shall have the same design as the existing drainage systems.

ROCKAWAY #3 SECTION 3
PROPOSED PROFILE

SCALE: Vert.: 1" = 10'
Horiz.: 1" = 150'

10' 5' 0 10' 20'
1" = 10'-0"

150' 0 150' 300'
1" = 150'-0"

U.S. ARMY ENGINEER DISTRICT, NEW YORK
PASSAIC RIVER DIVISION
CORPS OF ENGINEERS

DWN. BY: JSL
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CONSULTING ENGINEERS

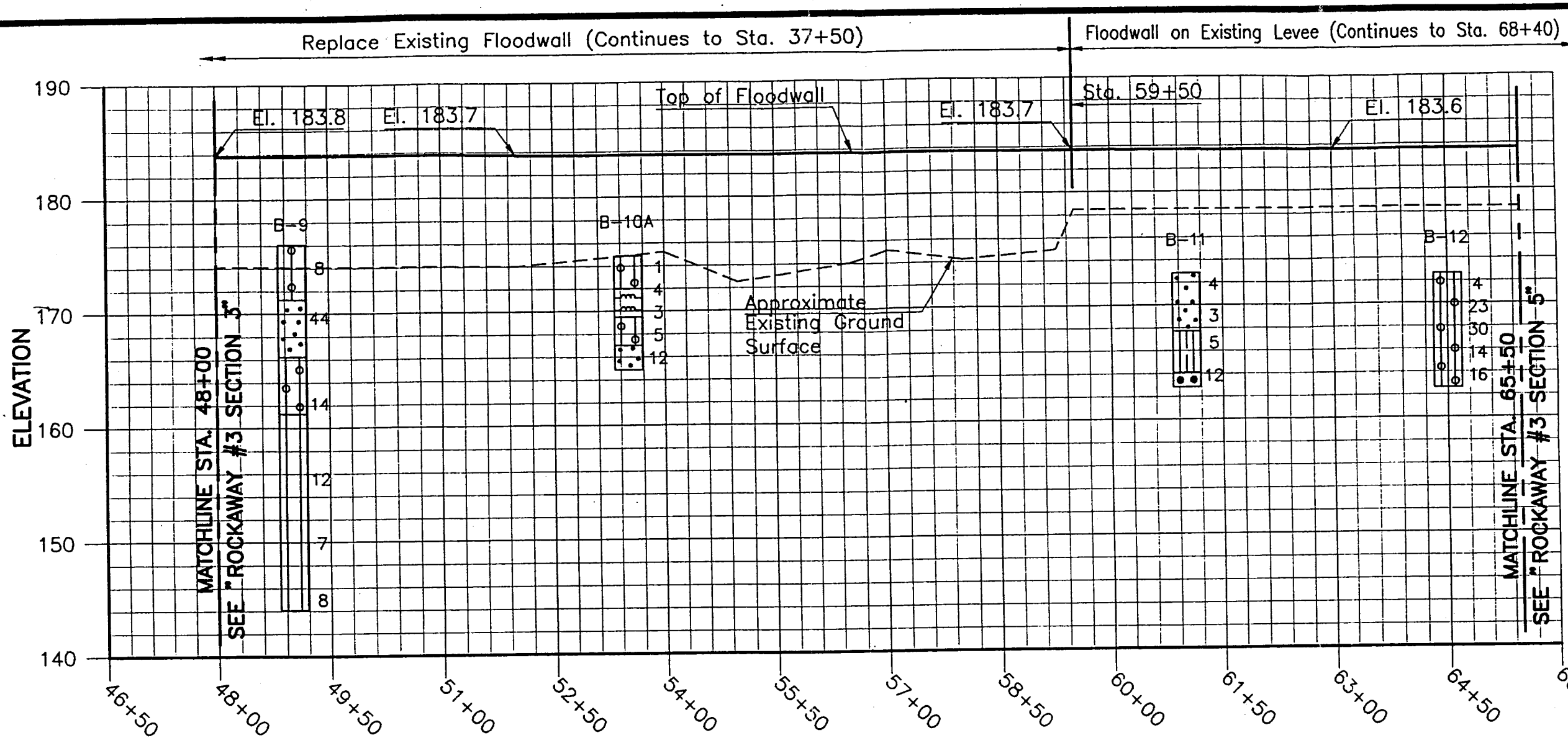
PASSAIC RIVER FLOOD DAMAGE REDUCTION PROJECT

SUBSURFACE PROFILE

ROCKAWAY #3
LEVEE/FLOODWALL SYSTEM

PLATE E-12.15

CAD A&A 1218 ROCK3PRO.DWG 3/2/95 JSL



Note:

1. The Ground Surface Profile is approximate and was developed from the plans provided by CENAN-PR/RBA.
2. Subsurface drainage systems are provided along the proposed levees. The drainage systems shall have the same design as the existing drainage systems.

ROCKAWAY #3 SECTION 4
PROPOSED PROFILE

SCALE: Vert.: 1" = 10'
Horiz.: 1" = 150'

10' 5' 0 10' 20'
1" = 10'-0"

150' 0 150' 300'
1" = 150'-0"

U.S. ARMY ENGINEER DISTRICT, NEW YORK
PASSAIC RIVER DIVISION
CORPS OF ENGINEERS

DWN. BY: JSL
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ARORA and ASSOCIATES, P.C.
CONSULTING ENGINEERS

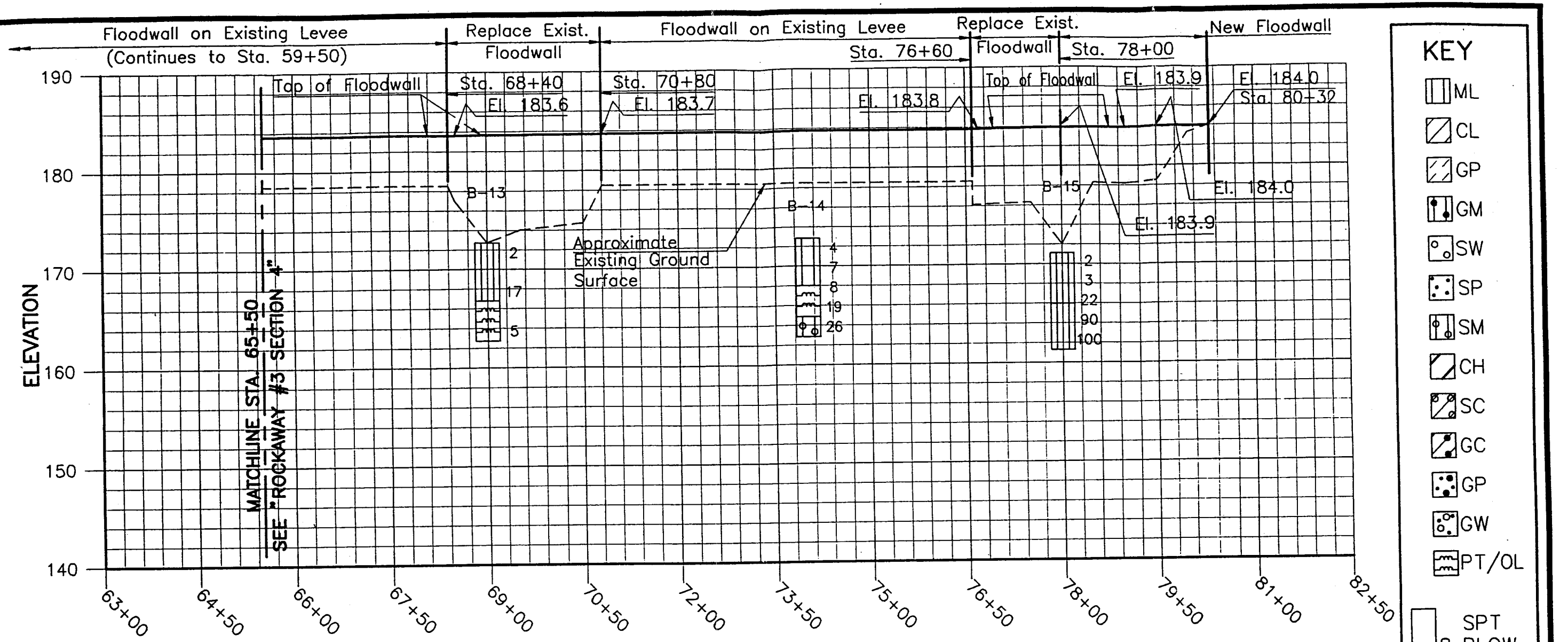
PASSAIC RIVER FLOOD DAMAGE REDUCTION PROJECT

SUBSURFACE PROFILE

ROCKAWAY #3
LEVEE/FLOODWALL SYSTEM

PLATE E-12.16

CAD A&A 1218 ROCK3PRO.DWG 3/2/95 JSL



Note:

1. The Ground Surface Profile is approximate and was developed from the plans provided by CENAN-PR/RBA.
2. Subsurface drainage systems are provided along the proposed levees. The drainage systems shall have the same design as the existing drainage systems.

ROCKAWAY #3 SECTION 5
PROPOSED PROFILE

SCALE: Vert.: 1" = 10'
Horiz.: 1" = 150'

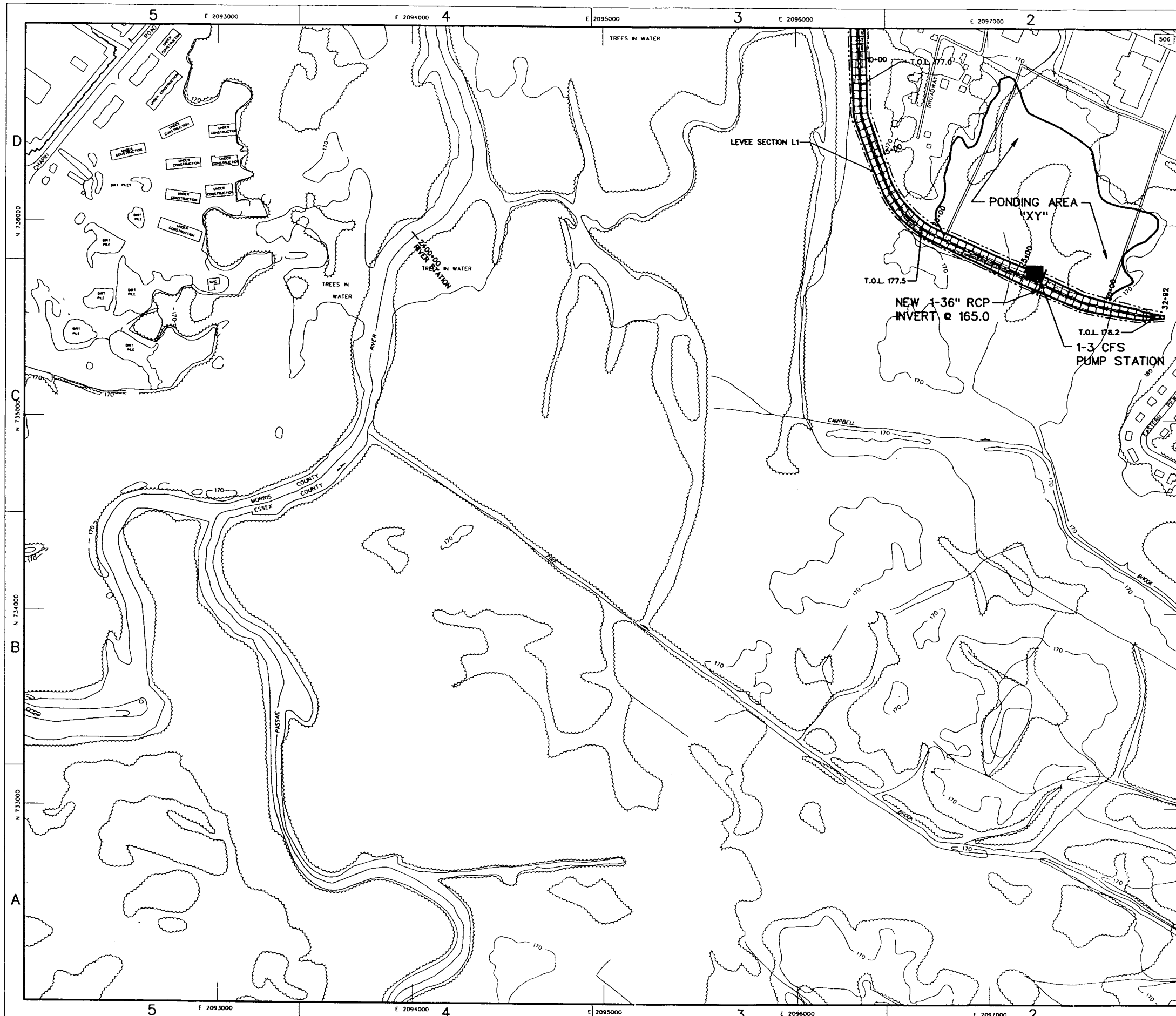
10' 5' 0 10' 20'
1" = 10'-0"

150' 0 150' 300'
1" = 150'-0"

DWN. BY: JSL	U.S. ARMY ENGINEER DISTRICT, NEW YORK PASSAIC RIVER DIVISION CORPS OF ENGINEERS
CHK'D BY: UK	PASSAIC RIVER FLOOD DAMAGE REDUCTION PROJECT
ARORA and ASSOCIATES, P.C. CONSULTING ENGINEERS	SUBSURFACE PROFILE ROCKAWAY #3 LEVEE/FLOODWALL SYSTEM

PLATE E-12.17

CAD A&A 1218 ROCK3PRO.DWG 3/3/95 JSL



SHEET LEGEND

- BUILDINGS
- BUILDING UNDER CONSTRUCTION
- ROADS, PARKING AREAS
- DRIVES
- DIRT ROADS
- RAILROAD
- FENCE
- WATERS EDGE AND SWAMP OUTLINE
- DENSE WOODS LINE
- SWAMP SYMBOL
- WOODED AREA
- TOWER
- COUNTY BOUNDARY
- BOROUGH AND TOWNSHIP BOUNDARY
- U.S. ROAD SHIELD
- INTERSTATE ROAD SHIELD
- STATE ROADSHIELD
- PERMANENT EASEMENT
- TEMPORARY EASEMENT
- WETLAND AND VEGATATION LIMITS
- STUDY AREA BOUNDARY
- KNOWN HTRW SITES
- HIGH POTENTIAL HTRW SITES
- LOW POTENTIAL HTRW SITES
- 15 HTRW SITES
- STANDARD LEVEE
- STANDARD FLOOD WALL

WETLAND LEGEND

PF - PALUSTRINE FORESTED

PSS - PALUSTRINE SCRUB/SCHRUB

EM - PALUSTRINE EMERGENT
CAT - CATTAIL
3SQ - 3-SQUARE

KEY TO MATCHING SHEETS

M-19	N-19	O-19
M-20	N-20	O-20
M-21	N-21	O-21

DATE OF PHOTOGRAPHY JANUARY 27, 1990

SCALE IN FEET

200 0 200 400 600

U.S. ARMY ENGINEER DISTRICT, NEW YORK
PASSAIC RIVER DIVISION
CORPS OF ENGINEERS

Passaic River Flood Damage Reduction Project

GENERAL DESIGN MEMORANDUM

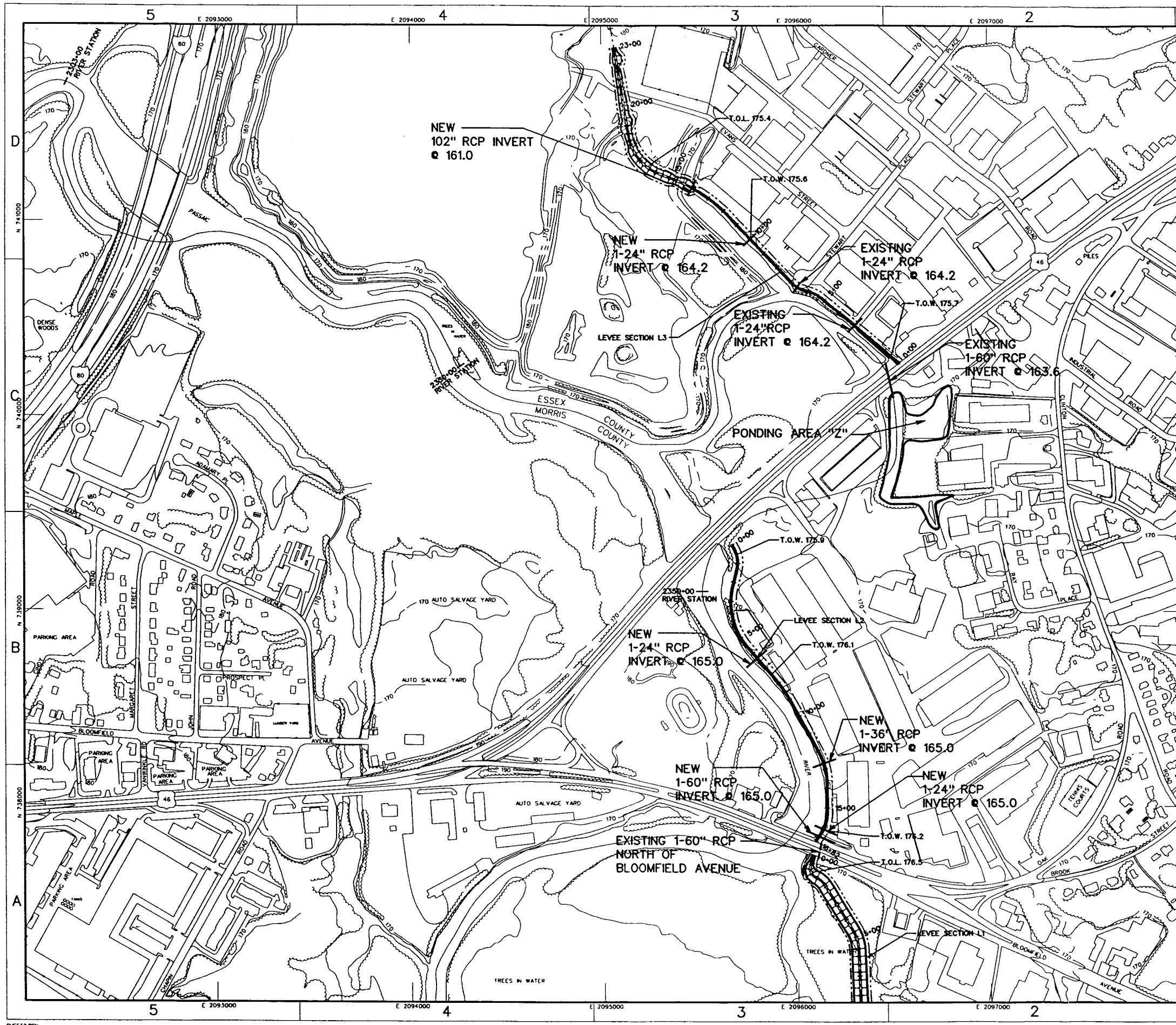
PASSAIC 2A LEVEE/FLOOD WALL SYSTEM

REVISED:

DATE: NOVEMBER 1994 | PREPARED BY: MRW | SHEET 1 of 13

PLATE E-12.18

SHEET1.DGN



SHEET LEGEND

- BUILDINGS
- BUILDING UNDER CONSTRUCTION
- ROADS,PARKING AREAS
- DRIVES
- DIRT ROADS
- RAILROAD
- FENCE
- WATERS EDGE AND SWAMP OUTLINE
- DENSE WOODS LINE
- SWAMP SYMBOL
- WOODED AREA
- TOWER
- COUNTY BOUNDARY
- BOROUGH AND TOWNSHIP BOUNDARY
- U.S. ROAD SHIELD
- INTERSTATE ROAD SHIELD
- STATE ROADSHIELD
- PERMANENT EASEMENT
- TEMPORARY EASEMENT
- WETLAND AND VEGATATION LIMITS
- STUDY AREA BOUNDARY
- KNOWN HTRW SITES
- HIGH POTENTIAL HTRW SITES
- LOW POTENTIAL HTRW SITES
- HTRW SITES
- STANDARD LEVEE
- STANDARD FLOOD WALL

WETLAND LEGEND

PF - PALUSTRINE FORESTED

PSS - PALUSTRINE SCRUB/SCHRUB

EM - PALUSTRINE EMERGENT
CAT - CATTAIL
3SQ - 3-SQUARE

KEY TO MATCHING SHEETS

M-18	N-18	O-18
M-19	N-19	O-19
M-20	N-20	O-20

DATE OF PHOTOGRAPHY JANUARY 27, 1990

SCALE IN FEET

200 0 200 400 600

U.S. ARMY ENGINEER DISTRICT, NEW YORK
PASSAIC RIVER DIVISION
CORPS OF ENGINEERS

Passaic River Flood Damage Reduction Project

GENERAL DESIGN MEMORANDUM

PASSAIC 2A LEVEE/FLOOD WALL SYSTEM

REVISED:

DATE: NOVEMBER 1994 | PREPARED BY: MRW | SHEET 2 of 13

PLATE E-12.19

SHEET2.DGN

EXISTING
1-84" RCP
INVERT @ 162.8

PONDING AREA
"E-Fnew"

FLOW

INSTALL SLUICE & FLAP
GATES

PROVIDE
110' EARTH
LEVEE CLOSURE

110 L.F.
CLOSURE ±5.5 HT.

FLOW

EXISTING
1-36" RCP
INVERT @ 161.8

PONDING AREA
"ABC"

LEVEE SECTION L4

INSTALL SLUICE & FLAP
GATES

FLOW

T.O.L. 174.9

T.O.L. 174.4

T.O.L. 175.2

EXISTING
1-48" RCP
INVERT @ 160.6

NEW
1-48" RCP
INVERT @ 160.2

T.O.L. 175.2

LEVEE SECTION L3

BASEBALL FIELD

PARKING AREA

COMMERCE

SHEET LEGEND

- BUILDINGS
- BUILDING UNDER CONSTRUCTION
- ROADS, PARKING AREAS
- DRIVES
- DIRT ROADS
- RAILROAD
- FENCE
- WATERS EDGE AND SWAMP OUTLINE
- DENSE WOODS LINE
- SWAMP SYMBOL
- WOODED AREA
- TOWER
- COUNTY BOUNDARY
- BOROUGH AND TOWNSHIP BOUNDARY
- U.S. ROAD SHIELD
- INTERSTATE ROAD SHIELD
- STATE ROADSHIELD
- PERMANENT EASEMENT
- TEMPORARY EASEMENT
- WETLAND AND VEGETATION LIMITS
- STUDY AREA BOUNDARY
- KNOWN HTRW SITES
- HIGH POTENTIAL HTRW SITES
- LOW POTENTIAL HTRW SITES
- HTRW SITES (15)
- STANDARD LEVEE
- STANDARD FLOOD WALL

WETLAND LEGEND

PF - PALUSTRINE FORESTED

PSS - PALUSTRINE SCRUB/SCRUB

EM - PALUSTRINE EMERGENT
CAT - CATTAIL
3SQ - 3-SQUARE

KEY TO MATCHING SHEETS

M-17	N-17	O-17
M-18	N-18	O-18
M-19	N-19	O-19

DATE OF PHOTOGRAPHY JANUARY 27, 1990

SCALE IN FEET
200 0 200 400 800

U.S. ARMY ENGINEER DISTRICT, NEW YORK
PASSAIC RIVER DIVISION
CORPS OF ENGINEERS

Passaic River Flood Damage Reduction Project

GENERAL DESIGN MEMORANDUM

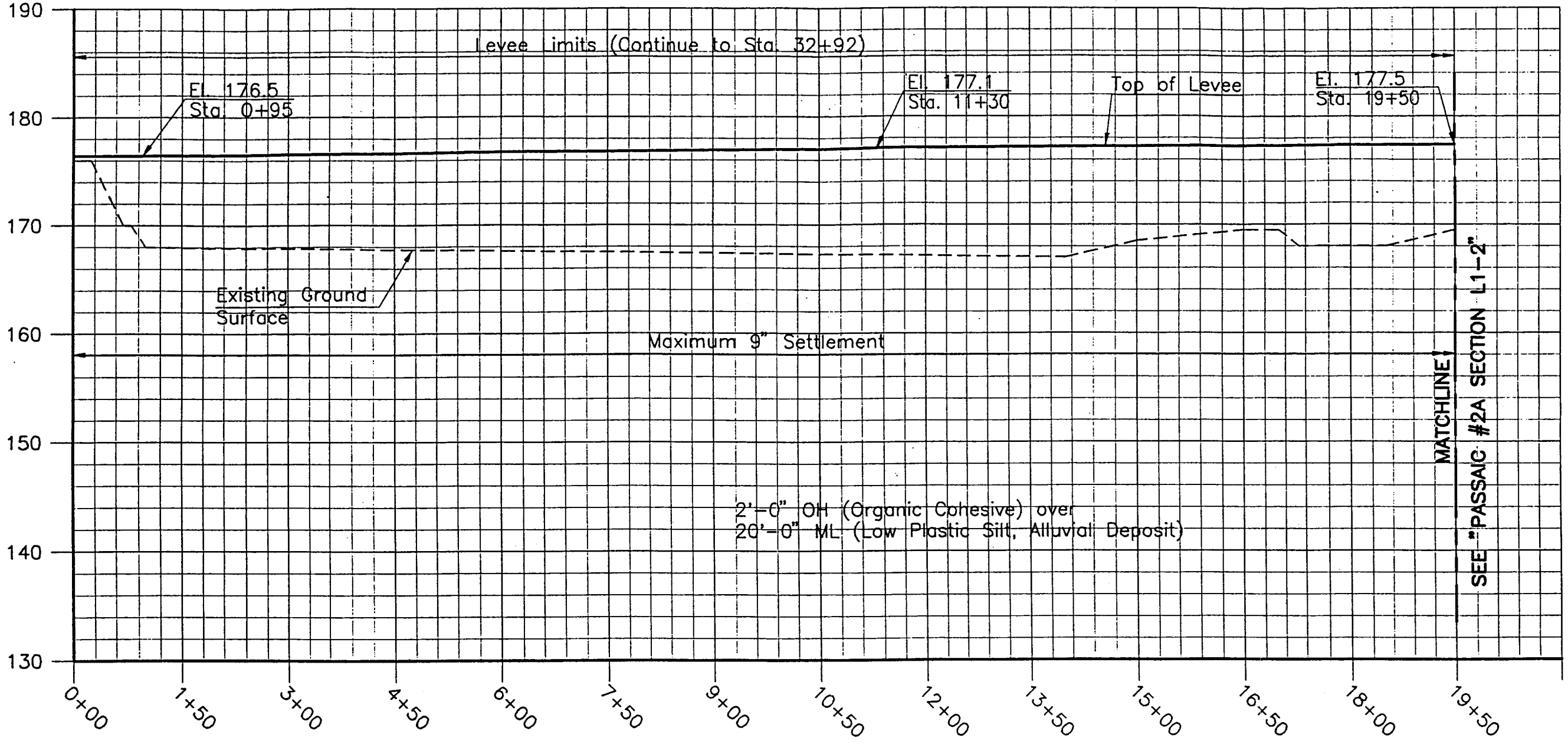
PASSAIC 2A LEVEE/FLOOD WALL SYSTEM

REVISED:

DATE: NOVEMBER 1994 | PREPARED BY: MRW | SHEET 3 of 13

PLATE E-12.20

SHEET3.DGN



Notes:

1. Subsurface soil classification is inferred from Boring 12-29 located West of Proposed Levee System
2. The Ground Surface Profile is approximate and was developed from the plans provided by CENAN-PR/RBA.

10' 5' 0 10' 20'
1" = 10'-0"

150' 0 150' 300'
1" = 150'-0"

STATION

PASSAIC #2A SECTION L1-1
PROPOSED LEVEE PROFILE

SCALE: Vert.: 1" = 10'
Horiz.: 1" = 150'

DWN. BY: JR

CHK'D BY: UK

ARORA and ASSOCIATES, P.C.
CONSULTING ENGINEERS

U.S. ARMY ENGINEER DISTRICT, NEW YORK
PASSAIC RIVER DIVISION
CORPS OF ENGINEERS

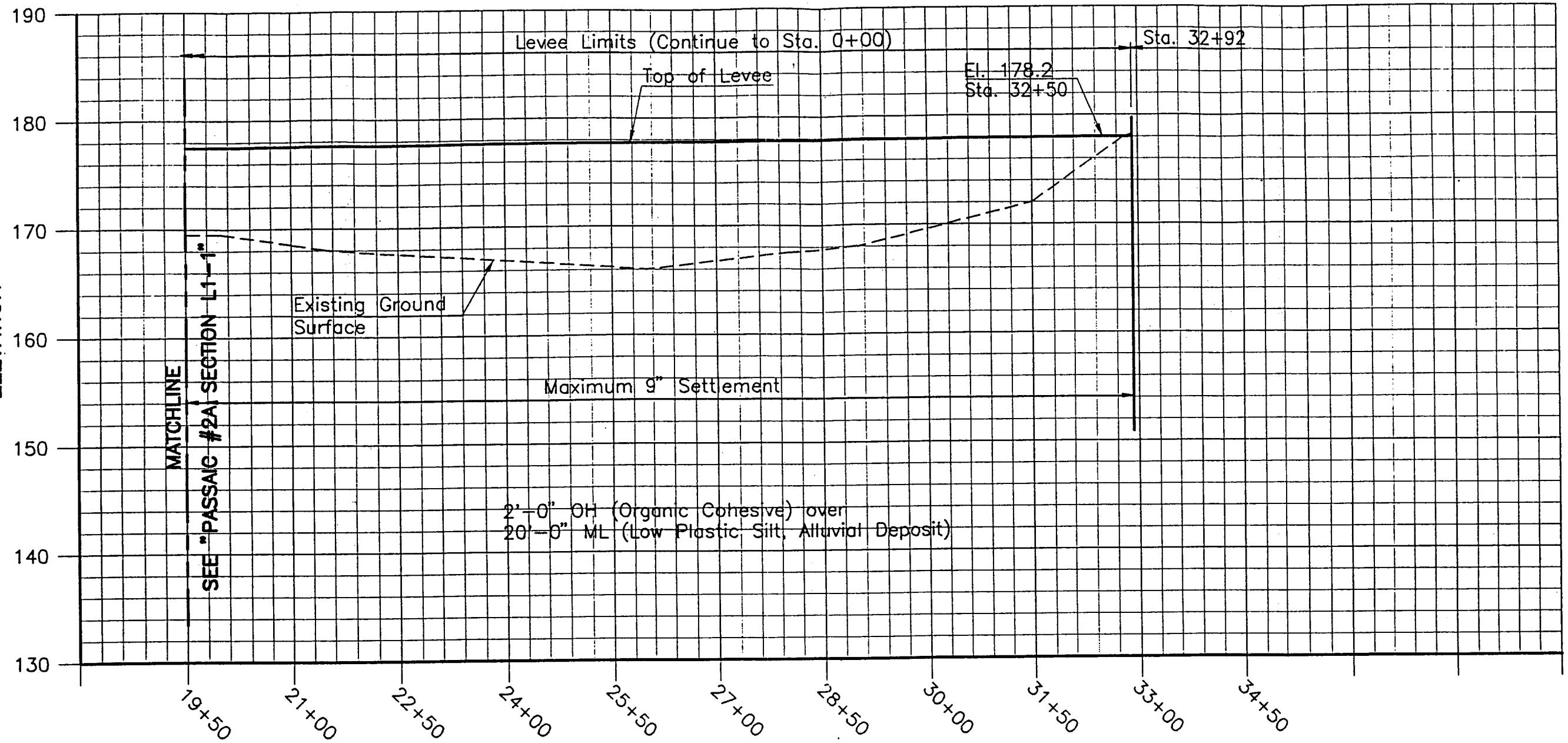
PASSAIC RIVER FLOOD DAMAGE REDUCTION PROJECT

SUBSURFACE PROFILE

PASSAIC #2A
LEVEE/FLOODWALL SYSTEM

PLATE E-12.21

CAD A&A 1218 PAS2APRO.DWG JSL 3/9/95



Notes:

1. Subsurface soil classification is inferred from Boring 12-29 located West of Proposed levee System.
2. The Ground Surface Profile is approximate and was developed from the plans provided by CENAN-PR/RBA.

10' 5' 0 10' 20'
1" = 10'-0"

150' 0 150' 300'
1" = 150'-0"

PASSAIC #2A SECTION L1-2
PROPOSED LEVEE PROFILE

SCALE: Vert.: 1" = 10'
Horiz.: 1" = 150'

DWN. BY: JR
CHK'D BY: UK
ARORA and ASSOCIATES, P.C.
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U.S. ARMY ENGINEER DISTRICT, NEW YORK
PASSAIC RIVER DIVISION
CORPS OF ENGINEERS

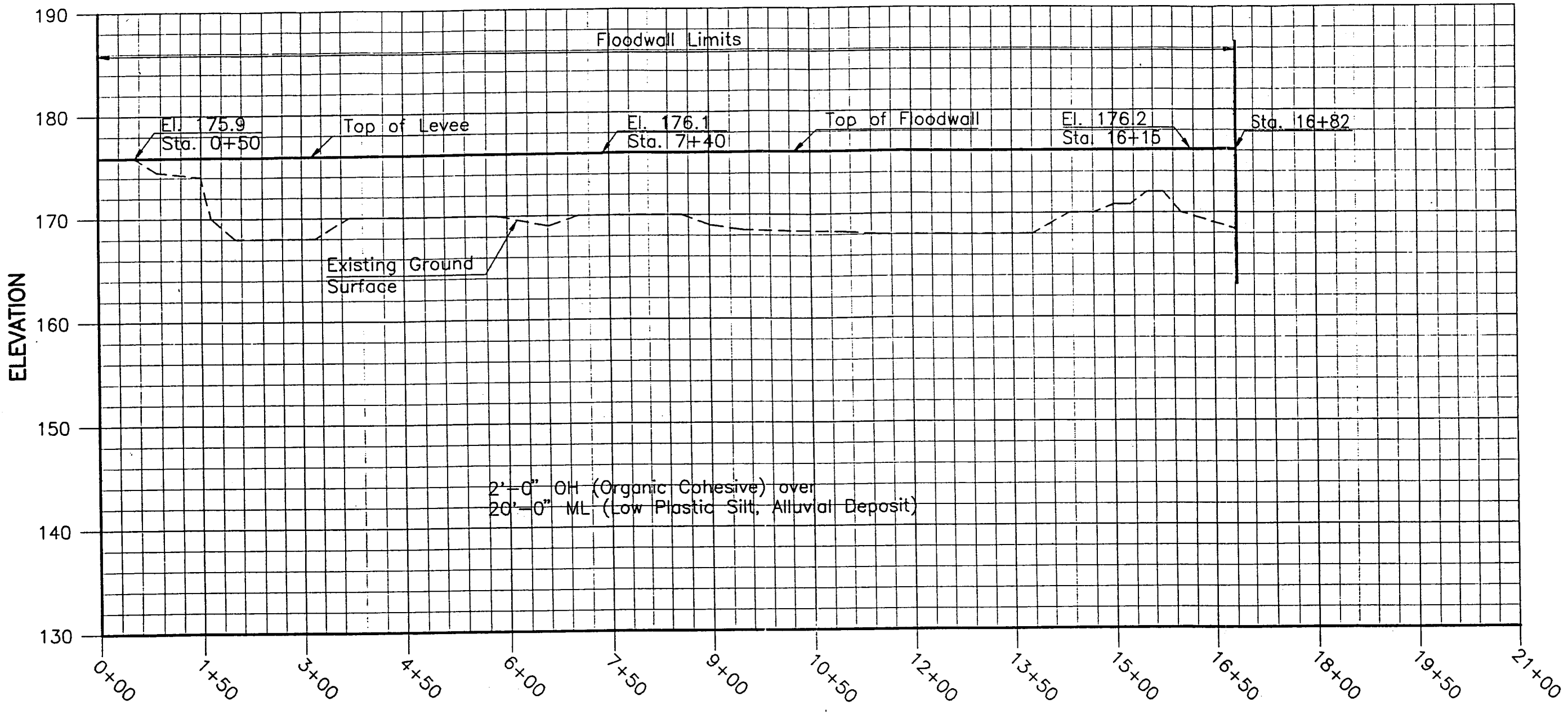
PASSAIC RIVER FLOOD DAMAGE REDUCTION PROJECT

SUBSURFACE PROFILE

PASSAIC #2A
LEVEE/FLOODWALL SYSTEM

PLATE E-12.22

3/9/95 JSL
PAS2APRO.DWG
CAD A&A 1218



Notes:

1. Subsurface soil classification is inferred from Boring 12-29 located West of Proposed Levee System
2. The Ground Surface Profile is approximate and was developed from the plans provided by CENAN-PR/RBA.

10' 5' 0 10' 20'
1" = 10'-0"

150' 0 150' 300'
1" = 150'-0"

STATION

PASSAIC #2A SECTION L2
PROPOSED LEVEE PROFILE

SCALE: Vert.: 1" = 10'
Horiz.: 1" = 150'

DWN. BY: JR
CHK'D BY: UK
ARORA and ASSOCIATES, P.C.
CONSULTING ENGINEERS

U.S. ARMY ENGINEER DISTRICT, NEW YORK
PASSAIC RIVER DIVISION
CORPS OF ENGINEERS

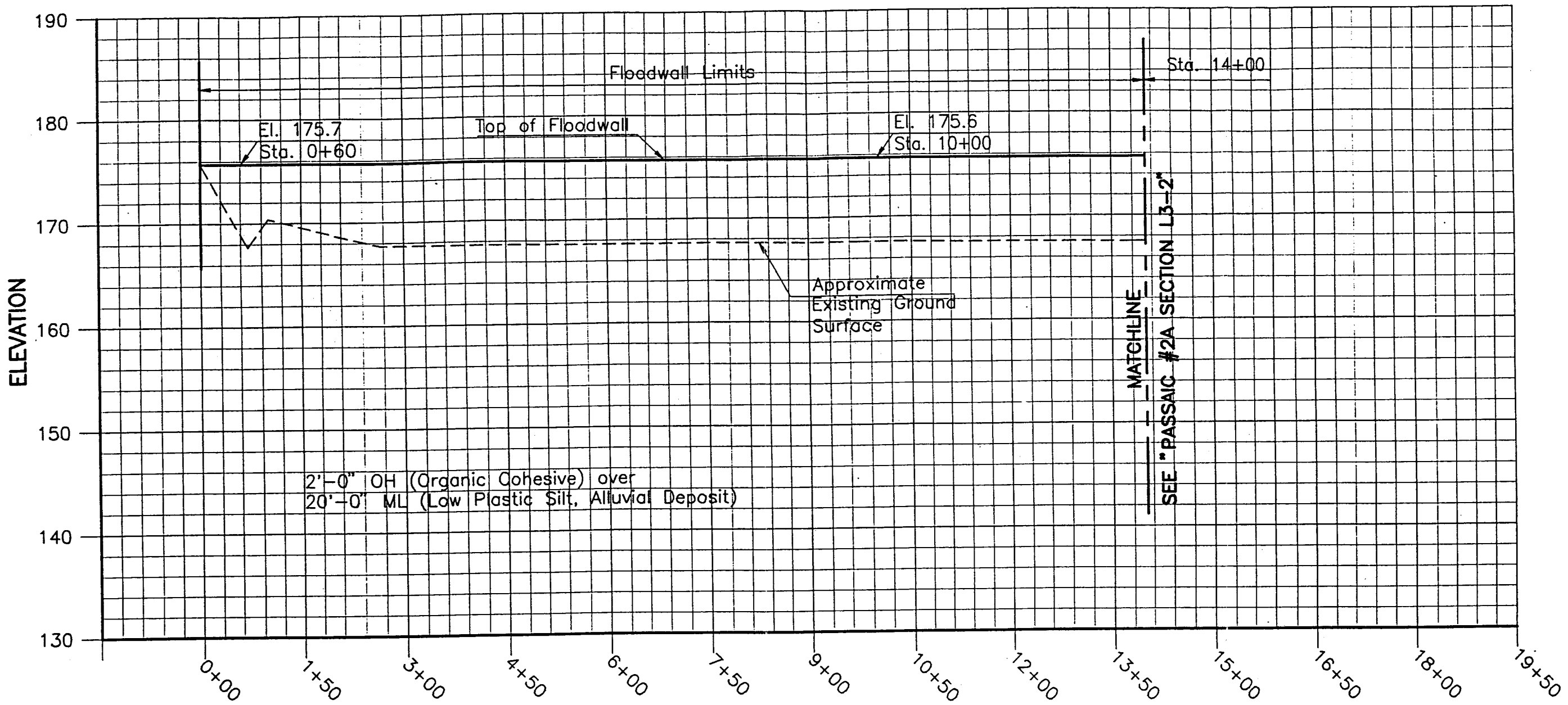
PASSAIC RIVER FLOOD DAMAGE REDUCTION PROJECT

SUBSURFACE PROFILE

PASSAIC #2A
LEVEE/FLOODWALL SYSTEM

PLATE E-12.23

CAD A&A 1218 3/9/95 JSL PASAIC3.DWG



Notes:

1. The Ground Surface Profile is approximate and was developed from the plans provided by CENAN-PR/RBA.
2. Subsurface soil classification is inferred from Boring 12-29 located West of Proposed Levee System
3. If the Organic Cohesive material is encountered, it should be overexcavated before placing the Levee foundation.

10' 5' 0 10' 20'
1" = 10'-0"

150' 0 150' 300'
1" = 150'-0"

STATION

PASSAIC #2A SECTION L3-1
PROPOSED LEVEE PROFILE

SCALE: Vert.: 1" = 10'
Horiz.: 1" = 150'

U.S. ARMY ENGINEER DISTRICT, NEW YORK
PASSAIC RIVER DIVISION
CORPS OF ENGINEERS

DWN. BY: JSL
CHK'D BY: UK
ARORA and ASSOCIATES, P.C.
CONSULTING ENGINEERS

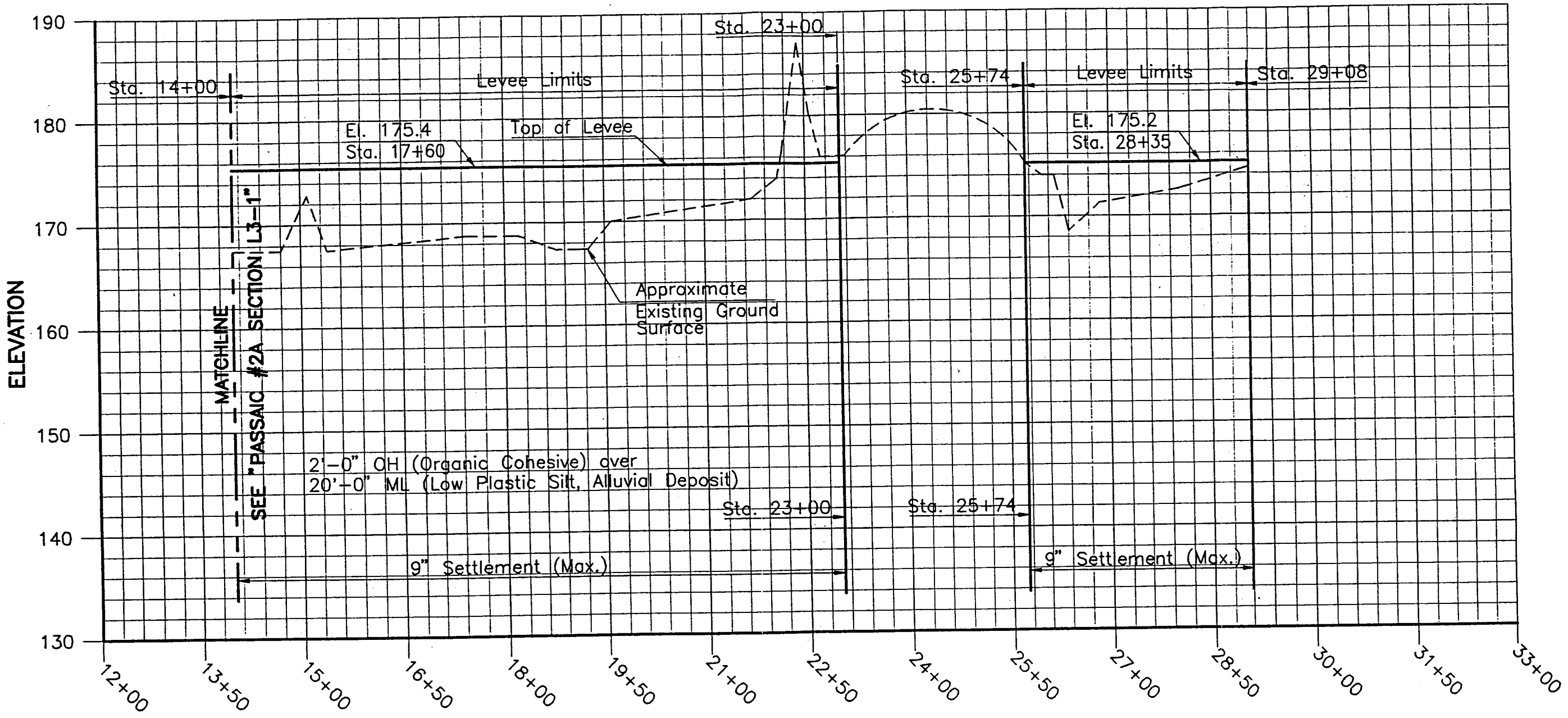
PASSAIC RIVER FLOOD DAMAGE REDUCTION PROJECT

SUBSURFACE PROFILE

PASSAIC #2A
LEVEE/FLOODWALL SYSTEM

PLATE E-12.24

CAD A&A 1218 3/9/95 JSL PAS2APRO.DWG



Notes:

1. The Ground Surface Profile is approximate and was developed from the plans provided by CENAN-PR/RBA.
2. Subsurface soil classification is inferred from Boring 12-29 located West of Proposed Levee System
3. If the Organic Cohesive material is encountered, it should be overexcavated before placing the Levee foundation.

10' 5' 0 10' 20'
1" = 10'-0"

150' 0 150' 300'
1" = 150'-0"

PASSAIC #2A SECTION L3-2
PROPOSED LEVEE PROFILE

SCALE: Vert.: 1" = 10'
Horiz.: 1" = 150'

DWN. BY: JSL
CHK'D BY: UK
ARORA and ASSOCIATES, P.C.
CONSULTING ENGINEERS

U.S. ARMY ENGINEER DISTRICT, NEW YORK
PASSAIC RIVER DIVISION
CORPS OF ENGINEERS

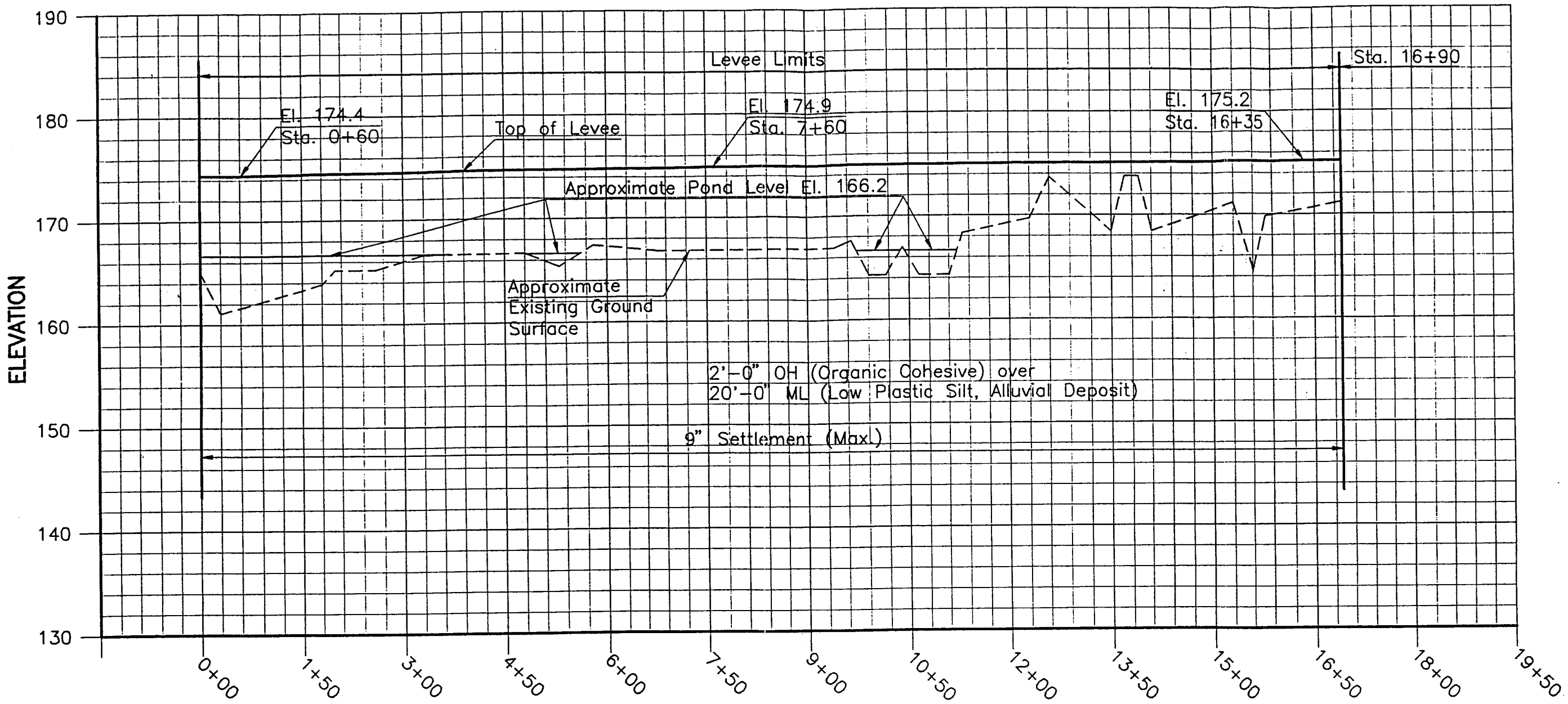
PASSAIC RIVER FLOOD DAMAGE REDUCTION PROJECT

SUBSURFACE PROFILE

PASSAIC #2A
LEVEE/FLOODWALL SYSTEM

PLATE E-12.25

CAD A&A 1218 PAS2APRO.DWG 4/12/95 JSL



Notes:

1. The Ground Surface Profile is approximate and was developed from the plans provided by CENAN-PR/RBA.
2. Subsurface soil classification is inferred from Boring 12-29 located West of Proposed Levee System
3. If the Organic Cohesive material is encountered, it should be overexcavated before placing the Levee foundation.

10' 5' 0 10' 20'
1" = 10'-0"

150' 0 150' 300'
1" = 150'-0"

STATION

PASSAIC #2A SECTION L4
PROPOSED LEVEE PROFILE

SCALE: Vert.: 1" = 10'
Horiz.: 1" = 150'

DWN. BY: JSL
CHK'D BY: UK
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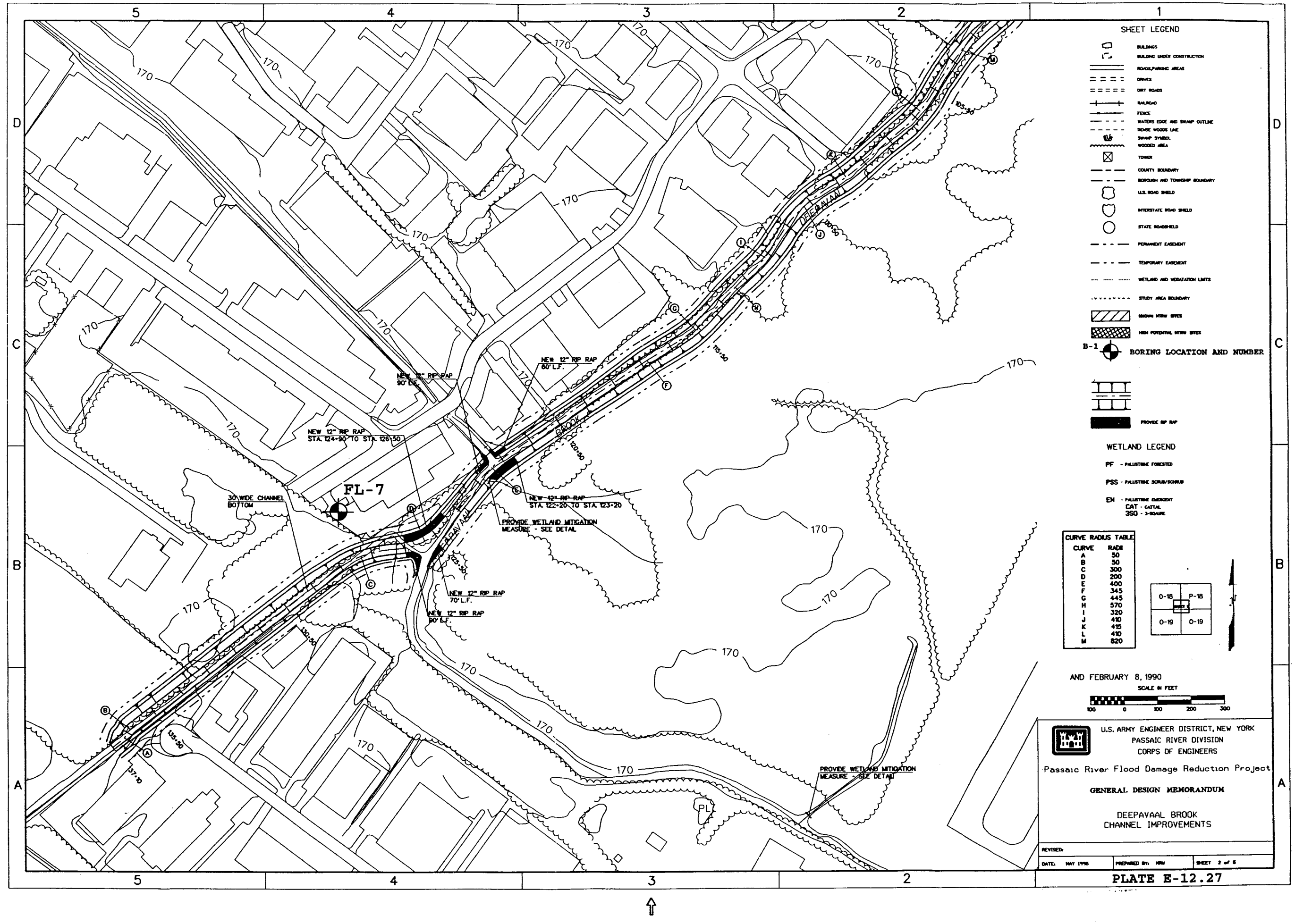
PASSAIC RIVER FLOOD DAMAGE REDUCTION PROJECT

SUBSURFACE PROFILE

PASSAIC #2A
LEVEE/FLOODWALL SYSTEM

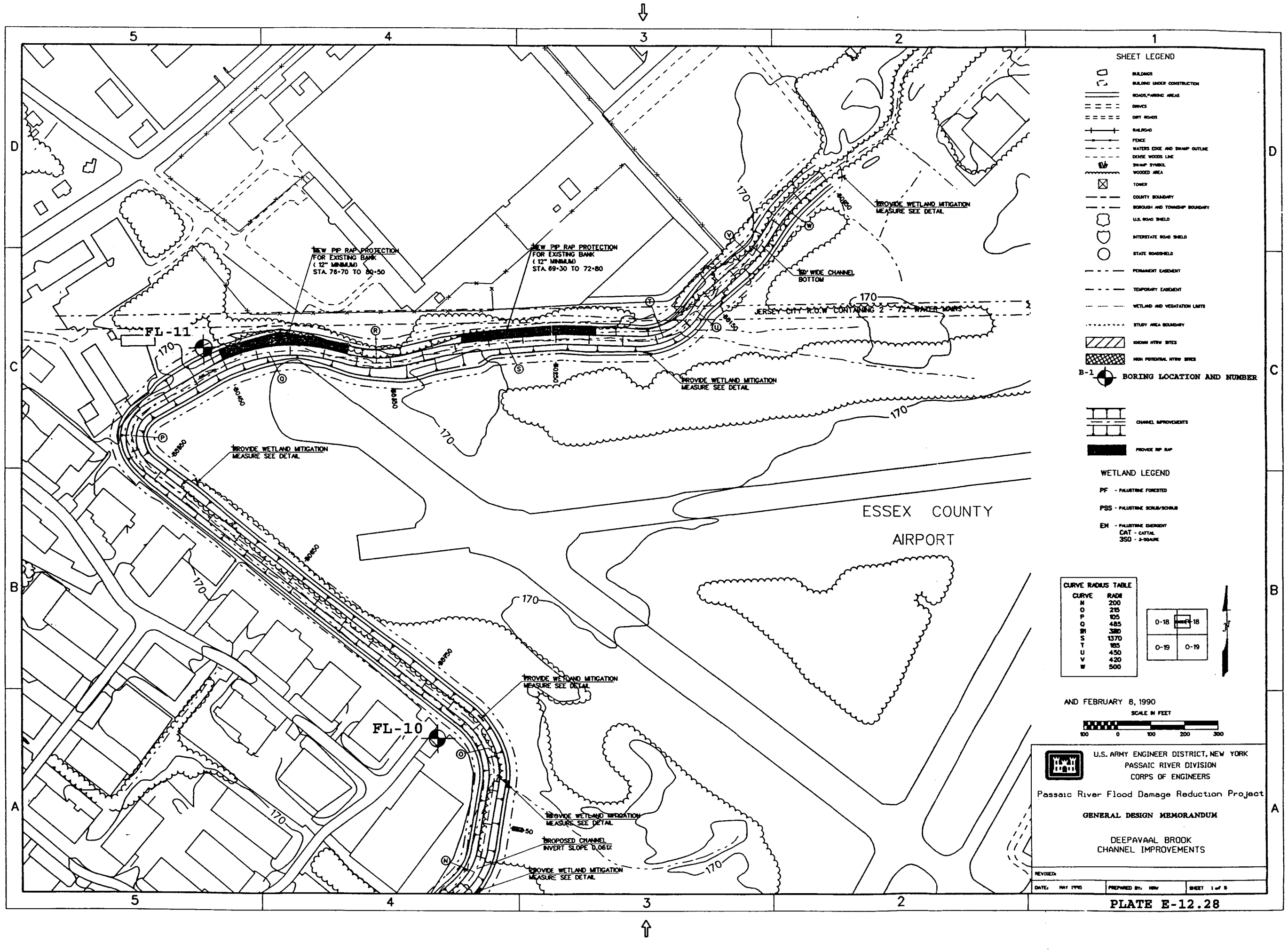
PLATE E-12.26

3/9/95 JSL
PAS2APRO.DWG
CAD A&A 1218



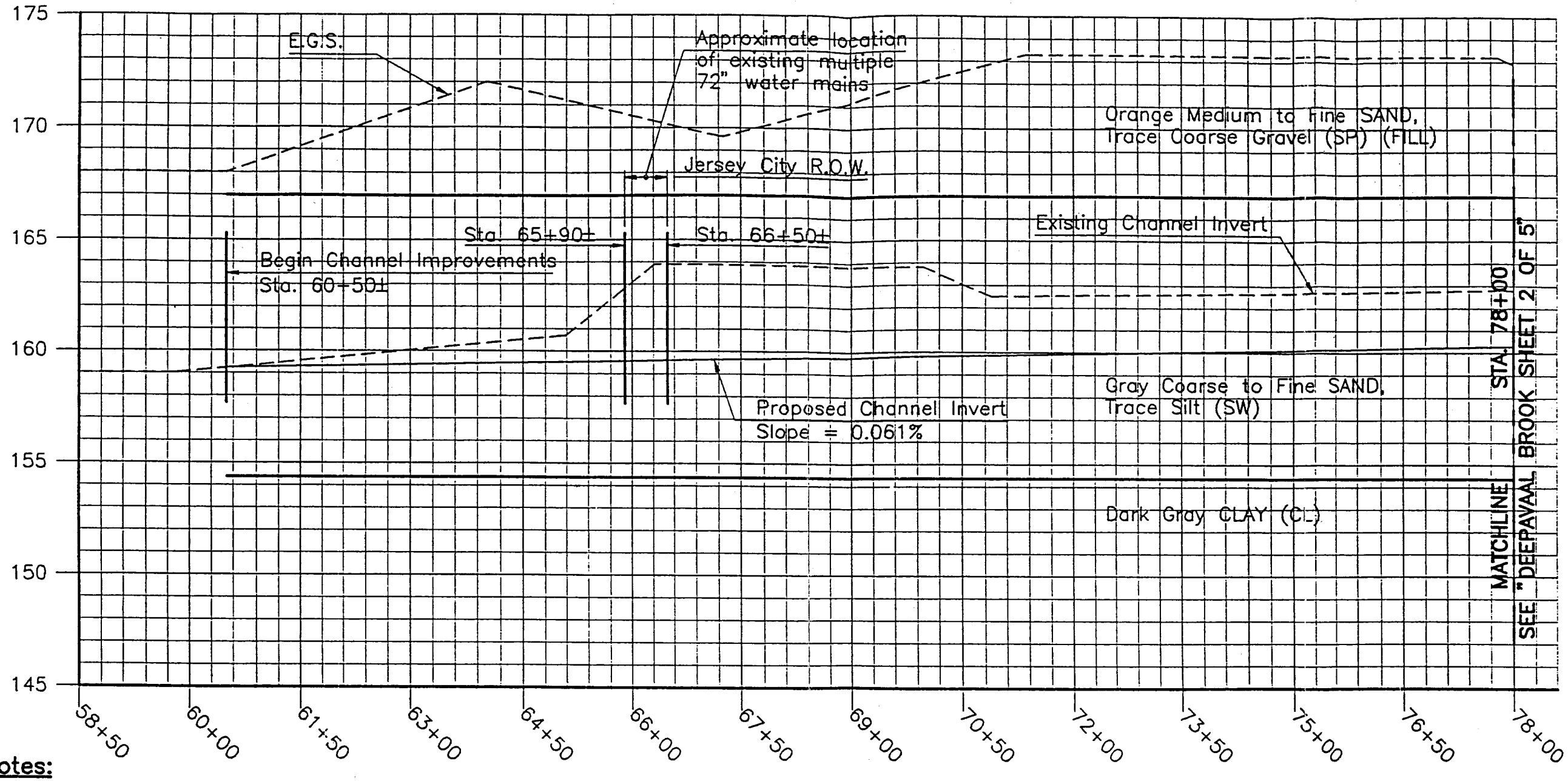
SHEET LEGEND
BUILDINGS
BUILDING UNDER CONSTRUCTION
ROADS,PARKING AREAS
DRIVES
DIRT ROADS
RAILROAD
FENCE
WATERS EDGE AND SWAMP OUTLINE
DENSE WOODS LINE
SWAMP SYMBOL
WOODED AREA
TOWER
COUNTY BOUNDARY
BOROUGH AND TOWNSHIP BOUNDARY
U.S. ROAD SHIELD
INTERSTATE ROAD SHIELD
STATE ROADSHIELD
PERMANENT EASEMENT
TEMPORARY EASEMENT
WETLAND AND VEGATATION LIMITS
STUDY AREA BOUNDARY
KNOWN NTRW SITES
HIGH POTENTIAL NTRW SITES
B-1
BORING LOCATION AND NUMBER
PROVIDE RIP RAP
WETLAND LEGEND
PF - PALUSTRINE FORESTED
PSS - PALUSTRINE SCRUB/SCHRUB
EM - PALUSTRINE EMERGENT
CAT - CATTAIL
3SQ - 3-SQUARE
CURVE RADIUS TABLE
CURVE RADII
A 50
B 50
C 300
D 200
E 400
F 345
G 445
H 570
I 320
J 410
K 415
L 410
M 820
O-18
P-18
O-19
O-19
AND FEBRUARY 8, 1990
SCALE IN FEET
100 0 100 200 300
U.S. ARMY ENGINEER DISTRICT, NEW YORK
PASSAIC RIVER DIVISION
CORPS OF ENGINEERS
Passaic River Flood Damage Reduction Project
GENERAL DESIGN MEMORANDUM
DEEPAVAAL BROOK
CHANNEL IMPROVEMENTS
REVISED:
DATE: MAY 1995
PREPARED BY: MRW
SHEET 2 of 5
FL-7
NEW 12" RIP RAP
STA. 124+90 TO STA. 126+50
NEW 12" RIP RAP
90' L.F.
NEW 12" RIP RAP
60' L.F.
NEW 12" RIP RAP
STA. 122+20 TO STA. 123+20
PROVIDE WETLAND MITIGATION
MEASURE - SEE DETAIL
NEW 12" RIP RAP
70' L.F.
NEW 12" RIP RAP
90' L.F.
30' WIDE CHANNEL
BOTTOM
DEEPAVAAL
BROOK
PROVIDE WETLAND MITIGATION
MEASURE - SEE DETAIL
PL
170

PLATE E-12.27



SHEET LEGEND
BUILDINGS
BUILDING UNDER CONSTRUCTION
ROADS, PARKING AREAS
DRIVES
DIRT ROADS
RAILROAD
FENCE
WATERS EDGE AND SWAMP OUTLINE
DENSE WOODS LINE
SWAMP SYMBOL
WOODED AREA
TOWER
COUNTY BOUNDARY
BOROUGH AND TOWNSHIP BOUNDARY
U.S. ROAD SHIELD
INTERSTATE ROAD SHIELD
STATE ROADSHIELD
PERMANENT EASEMENT
TEMPORARY EASEMENT
WETLAND AND VEGATATION LIMITS
STUDY AREA BOUNDARY
KNOWN HTRW SITES
HIGH POTENTIAL HTRW SITES
B-1 BORING LOCATION AND NUMBER
CHANNEL IMPROVEMENTS
PROVIDE RIP RAP
WETLAND LEGEND
PF - PALUSTRINE FORESTED
PSS - PALUSTRINE SCRUB/SCHRUB
EM - PALUSTRINE EMERGENT
CAT - CATTAIL
3SD - 3-SQUARE
CURVE RADIUS TABLE
CURVE RADII
N 200
O 215
P 105
Q 485
R 380
S 1370
T 185
U 450
V 420
W 500
0-18
0-19
AND FEBRUARY 8, 1990
SCALE IN FEET
100 0 100 200 300
NEW PIP RAP PROTECTION FOR EXISTING BANK (12" MINIMUM) STA. 76+70 TO 80+50
NEW PIP RAP PROTECTION FOR EXISTING BANK (12" MINIMUM) STA. 69+30 TO 72+80
PROVIDE WETLAND MITIGATION MEASURE SEE DETAIL
'ED' WIDE CHANNEL BOTTOM
JERSEY CITY R.O.W CONTAINING 2 - 72" WATER MAINS
FL-11
FL-10
ESSEX COUNTY AIRPORT
PROPOSED CHANNEL INVERT SLOPE 0.061%
170
U.S. ARMY ENGINEER DISTRICT, NEW YORK
PASSAIC RIVER DIVISION
CORPS OF ENGINEERS
Passaic River Flood Damage Reduction Project
GENERAL DESIGN MEMORANDUM
DEEPAVAAL BROOK
CHANNEL IMPROVEMENTS
REVISED:
DATE: MAY 1995
PREPARED BY: MRW
SHEET 1 of 5

PLATE E-12.28



Notes:

1. Subsurface soil classification is inferred from Boring FL–11 located at Sta. 80+50 of the Proposed Channel Improvements.
2. The Existing and Proposed Channel Invert Profiles and the Existing Ground Surface (E.G.S.) of the Right Bank are approximate and were developed from the plans provided by CENAN–PR.

5' 0 5' 10'
1" = 5'–0"

150' 0 150' 300'
1" = 150'–0"

STATION

DEEPAVAAL BROOK SHEET 1 OF 5
PROPOSED CHANNEL PROFILE

SCALE: Vert.: 1" = 5'
Horiz.: 1" = 150'

DWN. BY: JSL
CHK'D BY: UK
ARORA and ASSOCIATES, P.C.
CONSULTING ENGINEERS

U.S. ARMY ENGINEER DISTRICT, NEW YORK
PASSAIC RIVER DIVISION
CORPS OF ENGINEERS

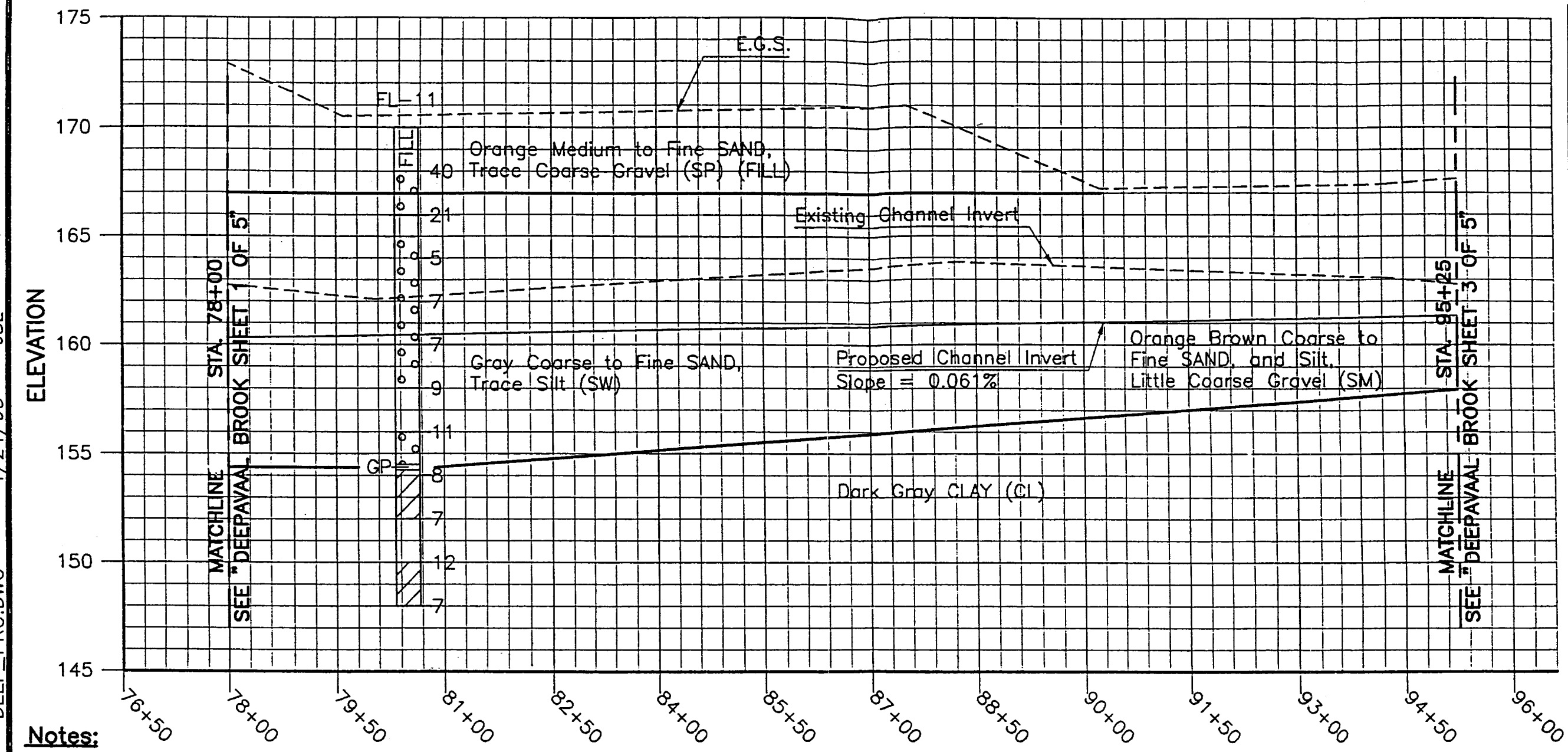
PASSAIC RIVER FLOOD DAMAGE REDUCTION PROJECT

SUBSURFACE PROFILE

DEEPAVAAL BROOK CHANNEL IMPROVEMENTS

CAD A&A 1218 4/24/95 JSL DEEP_PRO.DWG

PLATE E-12.29



Notes:

1. Subsurface soil classification is inferred from Borings FL-11 and FL-10 located at Sta. 80+50 and Sta. 96+50, respectively, of the Proposed Channel Improvements.
2. The Existing and Proposed Channel Invert Profiles and the Existing Ground Surface (E.G.S.) of the Right Bank are approximate and were developed from the plans provided by CENAN-PR.

5' 0 5' 10'
1" = 5'-0"

150' 0 150' 300'
1" = 150'-0"

STATION

DEEPAVAAL BROOK SHEET 2 OF 5
PROPOSED CHANNEL PROFILE

SCALE: Vert.: 1" = 5'
Horiz.: 1" = 150'

DWN. BY: JSL

CHK'D BY: UK

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U.S. ARMY ENGINEER DISTRICT, NEW YORK
PASSAIC RIVER DIVISION
CORPS OF ENGINEERS

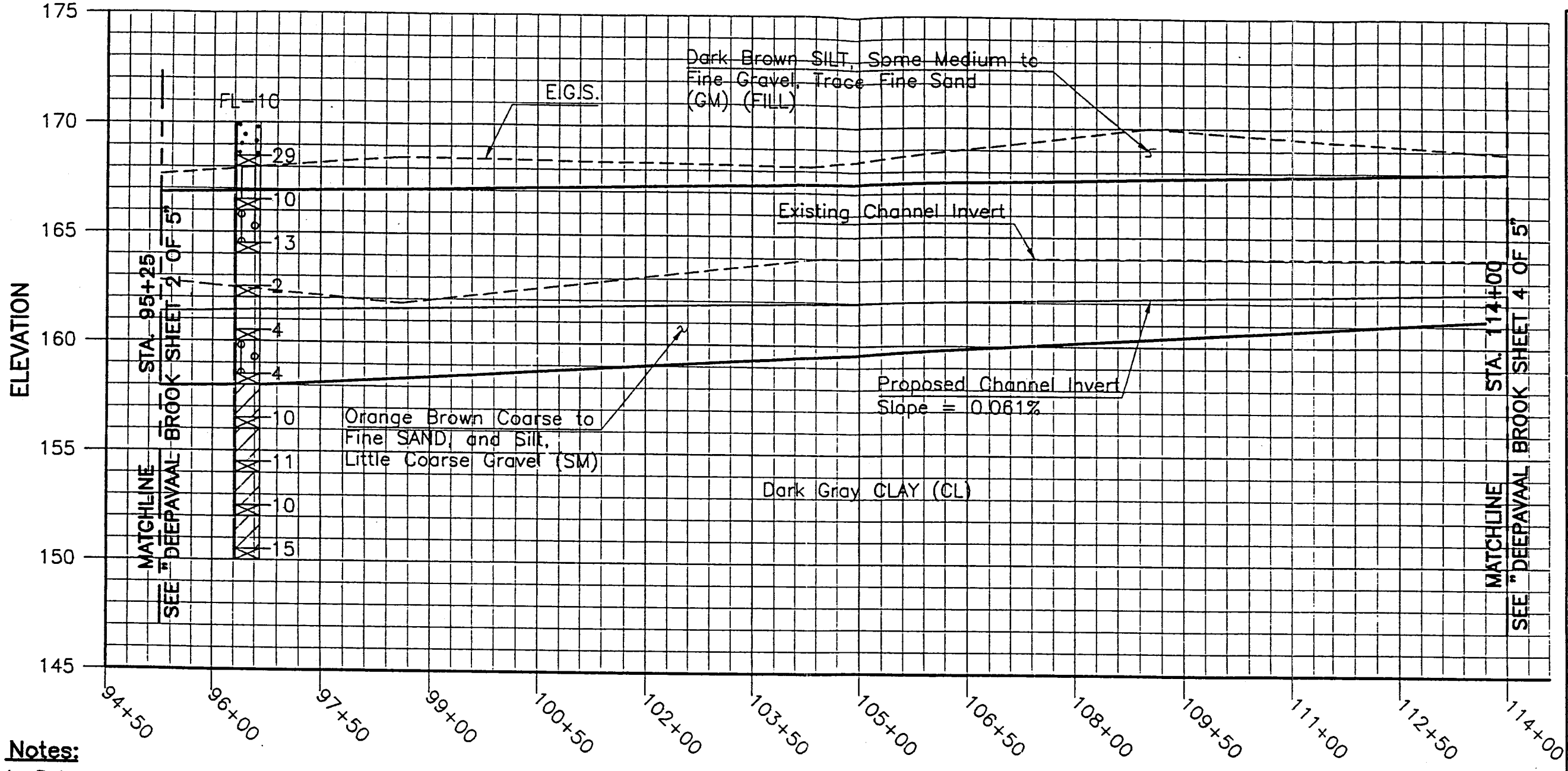
PASSAIC RIVER FLOOD DAMAGE REDUCTION PROJECT

SUBSURFACE PROFILE

DEEPAVAAL BROOK
CHANNEL IMPROVEMENTS

PLATE E-12.30

4/27/9[illegible] [illegible]
LLLP_FIN.Dwg
CAD A&A 1"=1'-0"



Notes:

1. Subsurface soil classification is inferred from Boring FL-10 located at Sta. 96+50 of the Proposed Channel Improvements.
2. The Existing and Proposed Channel Invert Profiles and the Existing Ground Surface (E.G.S.) of the Right Bank are approximate and were developed from the plans provided by CENAN-PR.

5' 0 5' 10'
1" = 5'-0"

150' 0 150' 300'
1" = 150'-0"

DEEPAVAAL BROOK SHEET 3 OF 5
PROPOSED CHANNEL PROFILE

SCALE: Vert.: 1" = 5'
Horiz.: 1" = 150'

DWN. BY: JSL
CHK'D BY: UK
ARORA and ASSOCIATES, P.C.
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PASSAIC RIVER DIVISION
CORPS OF ENGINEERS

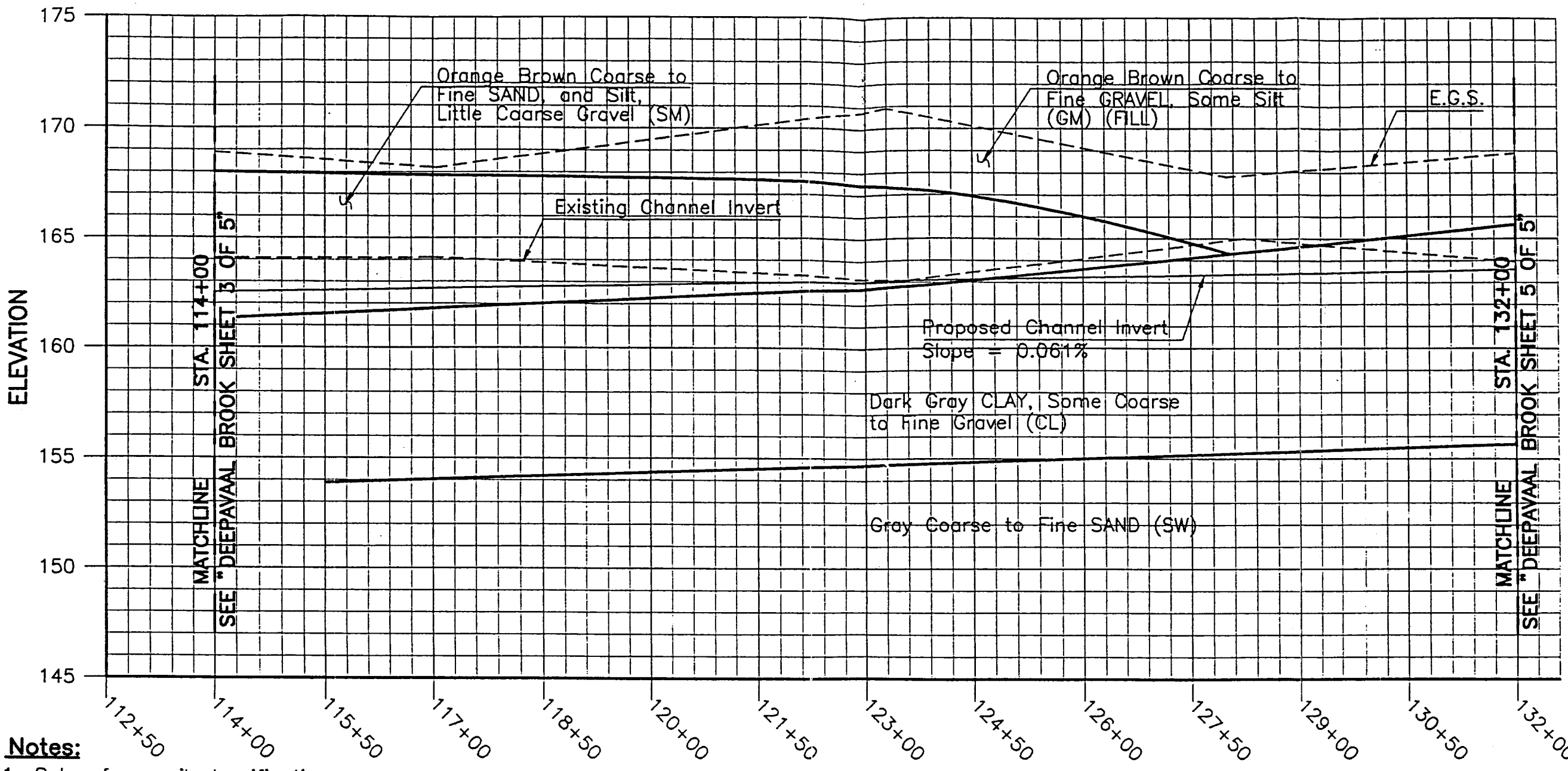
PASSAIC RIVER FLOOD DAMAGE REDUCTION PROJECT

SUBSURFACE PROFILE

DEEPAVAAL BROOK CHANNEL IMPROVEMENTS

4/24/95 JSL
DEEP_PRO.DWG
CAD A&A 1218

PLATE E-12.31



Notes:

1. Subsurface soil classification is inferred from Borings FL–10 and FL–7 located at Sta. 96+50 and Sta. 133+00, respectively, of the Proposed Channel Improvements.
2. The Existing and Proposed Channel Invert Profiles and the Existing Ground Surface (E.G.S.) of the Right Bank are approximate and were developed from the plans provided by CENAN–PR.

5' 0 5' 10'
1" = 5'–0"

150' 0 150' 300'
1" = 150'–0"

STATION

DEEPAVAAL BROOK SHEET 4 OF 5
PROPOSED CHANNEL PROFILE

SCALE: Vert.: 1" = 5'
Horiz.: 1" = 150'

DWN. BY: JSL
CHK'D BY: UK
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PASSAIC RIVER DIVISION
CORPS OF ENGINEERS

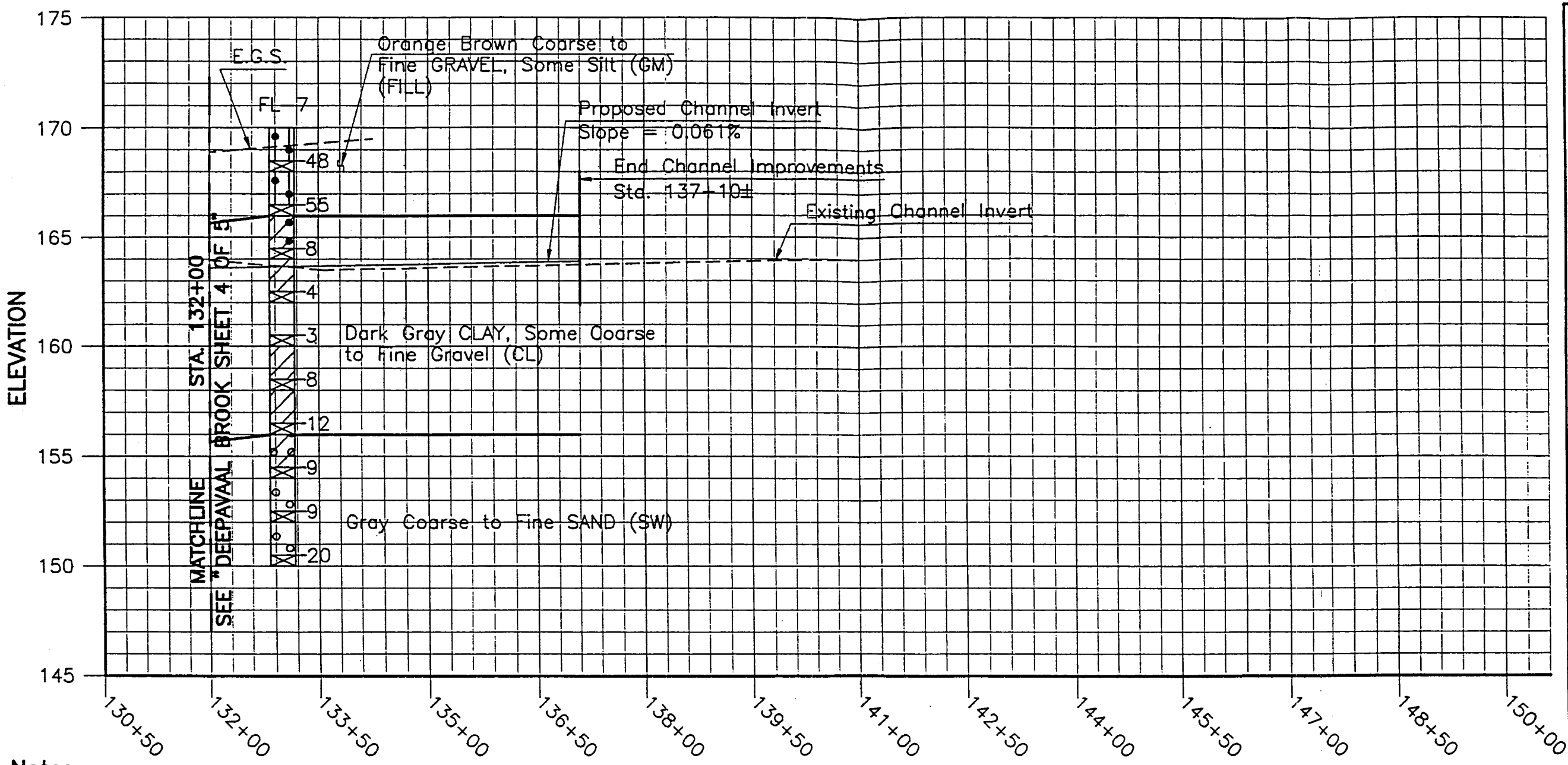
PASSAIC RIVER FLOOD DAMAGE REDUCTION PROJECT

SUBSURFACE PROFILE

DEEPAVAAL BROOK CHANNEL IMPROVEMENTS

PLATE E-12.32

4/24/95 JSL DEEP_PRO.DWG 1218 CAD A&A



Notes:

1. Subsurface soil classification is inferred from Boring FL-7 located at Sta. 133+00 of the Proposed Channel Improvements.
2. The Existing and Proposed Channel Invert Profiles and the Existing Ground Surface (E.G.S.) of the Right Bank are approximate and were developed from the plans provided by CENAN-PR.

5' 0 5' 10'
1" = 5'-0"

150' 0 150' 300'
1" = 150'-0"

STATION

DEEPAVAAL BROOK SHEET 5 OF 5
PROPOSED CHANNEL PROFILE

SCALE: Vert.: 1" = 5'
Horiz.: 1" = 150'

DWN. BY: JSL
CHK'D BY: UK
ARORA and ASSOCIATES, P.C.
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PASSAIC RIVER DIVISION
CORPS OF ENGINEERS

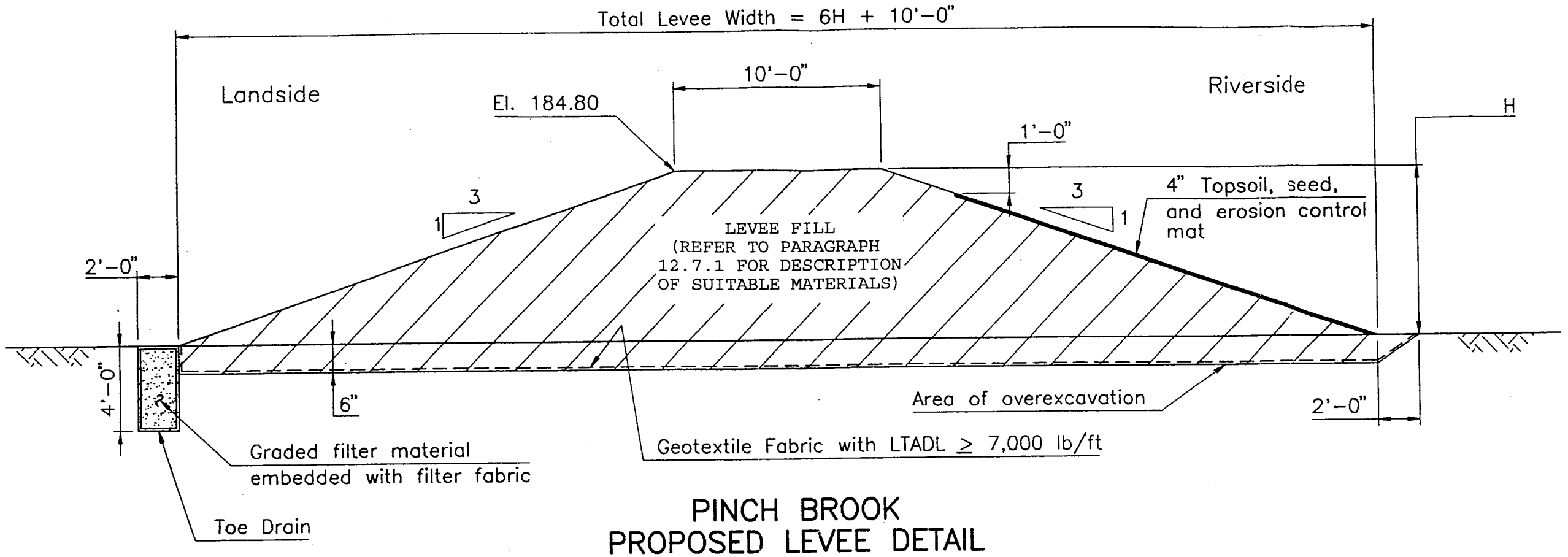
PASSAIC RIVER FLOOD DAMAGE REDUCTION PROJECT

SUBSURFACE PROFILE

DEEPAVAAL BROOK CHANNEL IMPROVEMENTS

PLATE E-12.33

DEEP_PRO.DWG 4/24/95 JSL
CAD A&A 1218



PINCH BROOK
PROPOSED LEVEE DETAIL

SCALE: N.T.S.

Construction Sequence

1. Strip about 6" depth below the levee to remove all surface vegetation and debris. Also grub to a 3' depth to remove all large vegetation & debris such as tree roots, old foundations, and pipes.

2. Haul in levee fill from offsite and compact to 90% standard proctor density. If the stripped material is organic in nature, spread it over the levee surface to promote growth of grass cover (approximate 6" layer).

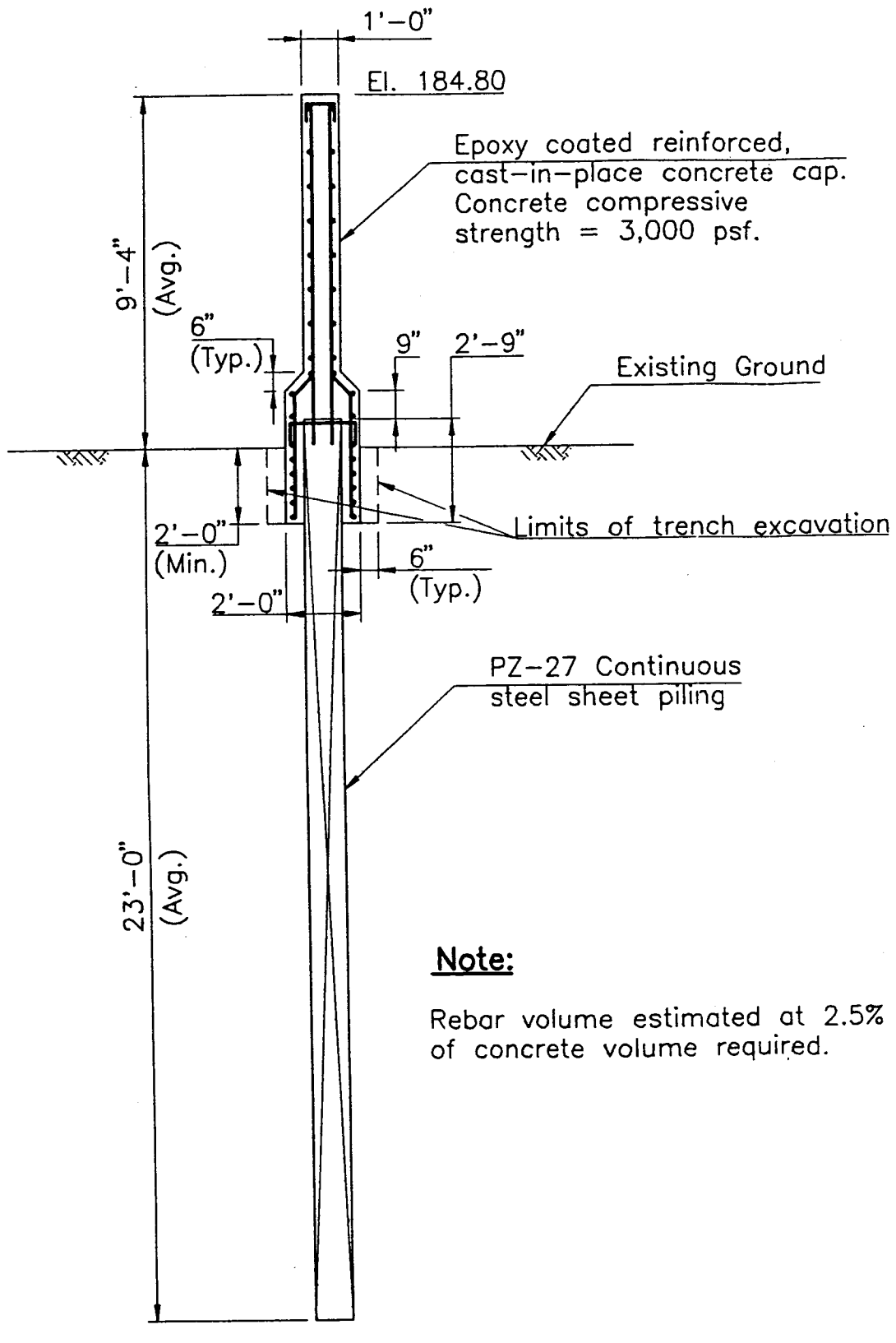
3. Provide 4" of topsoil (or stripped organic material), seeding and an erosion control mat over the levee surface.

4. A toe drain is required for the levee portion north of the floodwall.

DWN. BY: JSL	U.S. ARMY ENGINEER DISTRICT, NEW YORK PASSAIC RIVER DIVISION CORPS OF ENGINEERS
CHK'D BY: UK	PASSAIC RIVER FLOOD DAMAGE REDUCTION PROJECT
ARORA and ASSOCIATES, P.C. CONSULTING ENGINEERS	LEVEE DETAIL PINCH BROOK LEVEE/FLOODWALL SYSTEM

PLATE E-12.34

2/24/95 JSL PINCHLEV.DWG 1218 CAD A&A



Note:

Rebar volume estimated at 2.5% of concrete volume required.

Construction Sequence:

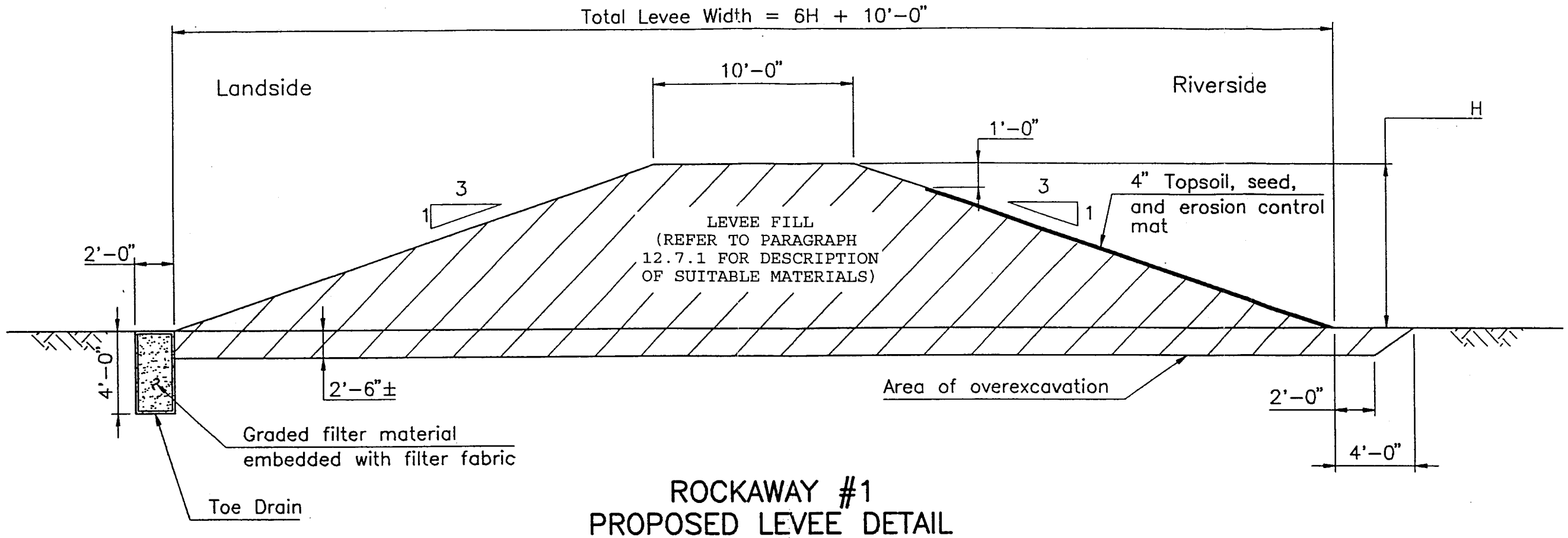
1. Relocate utilities as necessary in advance of pile driving.
2. Drive PZ-27 sheet piling as shown with a land mounted pile driving rig.
3. Grout any voids formed during pile driving with a sand, cement, and bentonite mix.
4. Construct utility crossings as necessary through the concrete cap or sheet piling.
5. Excavate trenches alongside sheet piling for the concrete cap construction.
6. Erect concrete forms, install reinforcement steel, and place concrete.

PINCH BROOK
TYPICAL I-WALL SECTION
SCALE: N.T.S.

DWN. BY: JSL	U.S. ARMY ENGINEER DISTRICT, NEW YORK PASSAIC RIVER DIVISION CORPS OF ENGINEERS
CHK'D BY: UK	PASSAIC RIVER FLOOD DAMAGE REDUCTION PROJECT
ARORA and ASSOCIATES, P.C. CONSULTING ENGINEERS	FLOODWALL DETAIL PINCH BROOK LEVEE/FLOODWALL SYSTEM

CAD A&A 1218 PINCHfw.DWG 2/24/95 JSL

PLATE E-12.35



ROCKAWAY #1
PROPOSED LEVEE DETAIL

SCALE: N.T.S.

Construction Sequence

1. An organic cohesive layer may be encountered. Overexcavate approximately 2'–6" and grub to a maximum depth of 3'–0" to remove all large vegetation and debris such as tree roots, old foundations and pipes. When the organic cohesive layer is not encountered, strip approximately 6" below the levee surface and grub 3'–0" as mentioned above.

2. Compact levee fill to a minimum of 90% standard proctor density.

3. Stripped and overexcavated organic soils can be used as topsoil on the levee slopes. Placement of an erosion control mat is recommended for the riverside of the levee only.

4. A toe drain is recommended for the Downstream levee only.

DWN. BY: JSL

CHK'D BY: UK

ARORA and ASSOCIATES, P.C.
CONSULTING ENGINEERS

U.S. ARMY ENGINEER DISTRICT, NEW YORK
PASSAIC RIVER DIVISION
CORPS OF ENGINEERS

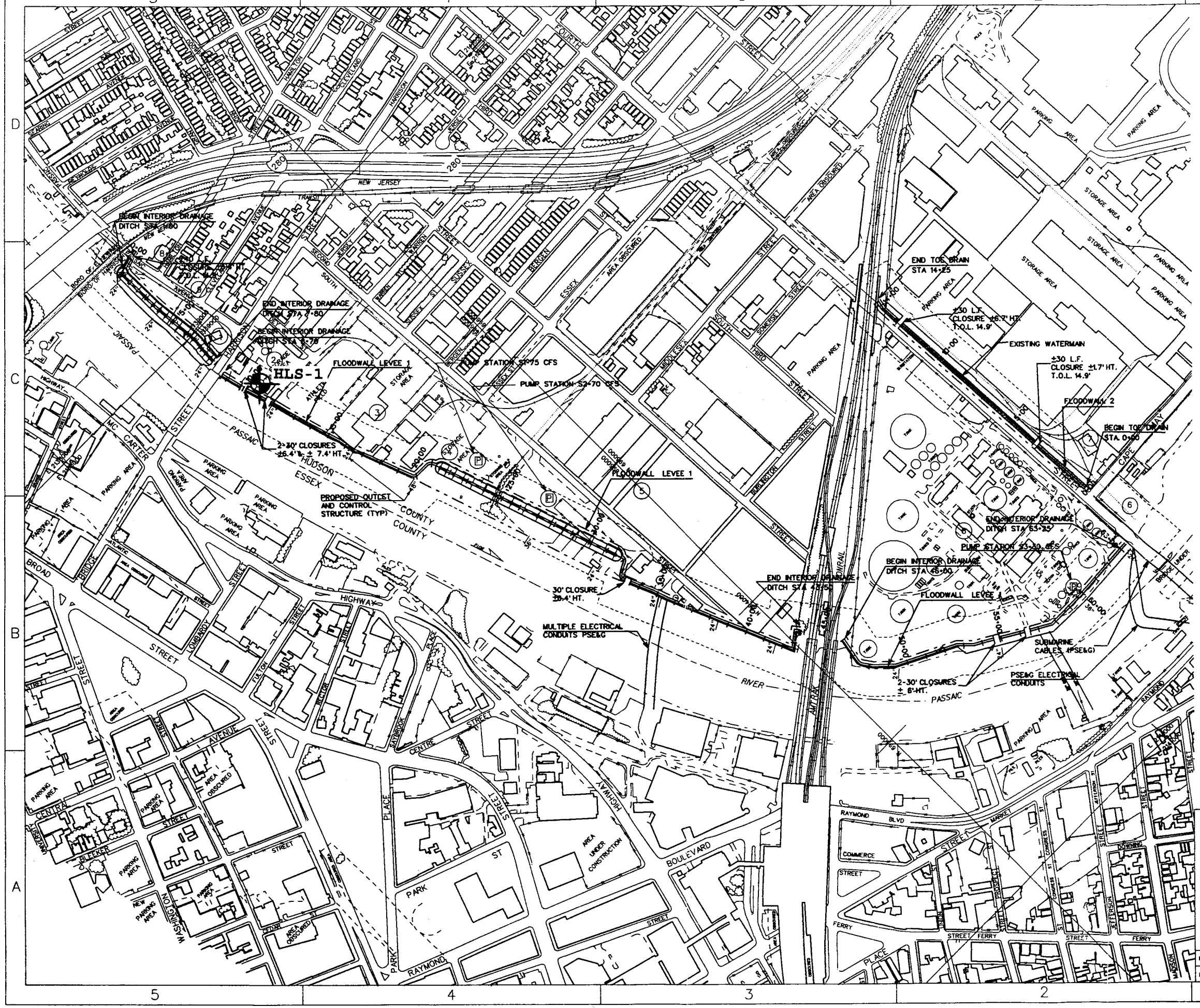
PASSAIC RIVER FLOOD DAMAGE REDUCTION PROJECT

LEVEE DETAIL

ROCKAWAY #1
LEVEE/FLOODWALL SYSTEM

PLATE E-12.36

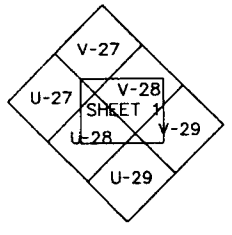
CAD A&A 1218 ROCK1LEV 4/10/95 JSL



SHEET LEGEND

- BUILDINGS
- BUILDING UNDER CONSTRUCTION
- ROADS, PARKING AREAS
- DRIVES
- DIRT ROADS
- RAILROAD
- FENCE
- WATERS EDGE AND SWAMP OUTLINE
- DENSE WOODS LINE
- SWAMP SYMBOL
- WOODED AREA
- TOWER
- COUNTY BOUNDARY
- BOROUGH AND TOWNSHIP BOUNDARY
- U.S. ROAD SHIELD
- INTERSTATE ROAD SHIELD
- STATE ROADSHIELD
- PERMANENT EASEMENT
- TEMPORARY EASEMENT
- WETLAND AND VEGATATION LIMITS
- STUDY AREA BOUNDARY
- KNOWN HTRW SITES
- HIGH POTENTIAL HTRW SITES
- LOW POTENTIAL HTRW SITES
- 15 — HTRW SITES
- STANDARD LEVEE
- STANDARD FLOOD WALL
- B-1 — BORING LOCATION AND NUMBER

KEY TO MATCHING SHEETS



DATE OF PHOTOGRAPHY JANUARY 27, 1990

SCALE IN FEET

200 0 200 400 600

U.S. ARMY ENGINEER DISTRICT, NEW YORK
PASSAIC RIVER DIVISION
CORPS OF ENGINEERS

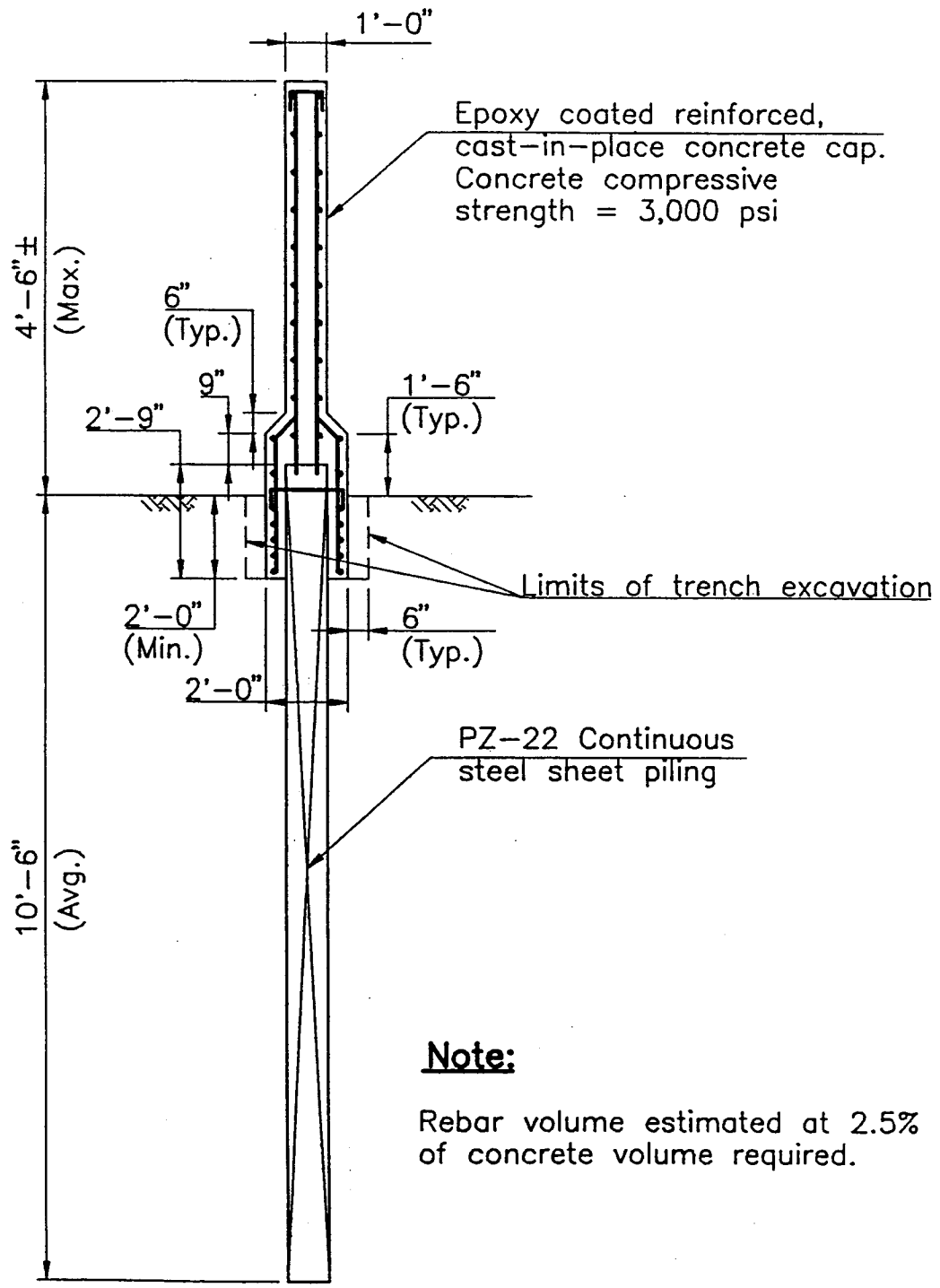
Passaic River Flood Damage Reduction Project

GENERAL DESIGN MEMORANDUM

SOUTH 1st STREET LEVEE/FLOODWALL SYSTEM

REVISED:		
DATE: JANUARY 1995	PREPARED BY: JAW	SHEET 1 of 4

PLATE E-11.1



Note:

Rebar volume estimated at 2.5% of concrete volume required.

Construction Sequence:

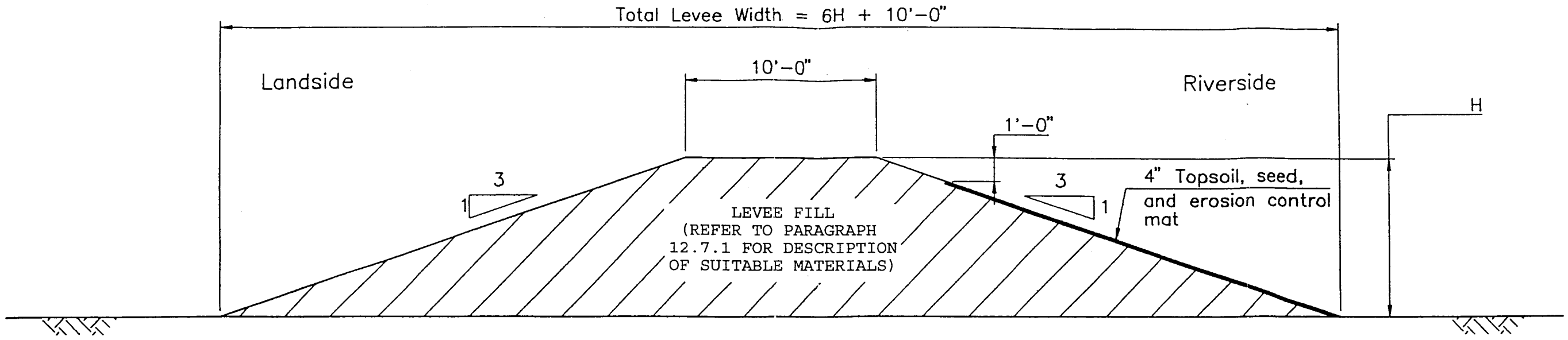
1. Relocate utilities as necessary in advance of pile driving.
2. Drive PZ-22 steel sheet piling as shown with a land mounted pile driving rig.
3. Grout any voids formed during pile driving with a sand, cement, and bentonite mix.
4. Construct utility crossings as necessary through the concrete cap or sheet piling.
5. Excavate trenches alongside sheet piling for the concrete cap construction.
6. Erect concrete forms, install reinforcement steel, and place concrete.

ROCKAWAY #1
TYPICAL I-WALL SECTION

SCALE: N.T.S.

DWN. BY: JSL	U.S. ARMY ENGINEER DISTRICT, NEW YORK PASSAIC RIVER DIVISION CORPS OF ENGINEERS
CHK'D BY: UK	PASSAIC RIVER FLOOD DAMAGE REDUCTION PROJECT **FLOODWALL DETAIL** ROCKAWAY #1 LEVEE/FLOODWALL SYSTEM
ARORA and ASSOCIATES, P.C. CONSULTING ENGINEERS	

CAD A&A 1218 ROCK1FW 4/10/95 JSL



ROCKAWAY #2
PROPOSED LEVEE DETAIL

SCALE: N.T.S.

Construction Sequence

1. Strip approximately 6" depth below the levee to remove all surface vegetation and debris. Also grub to 3' depth to remove all large vegetation and debris such as tree roots, old foundations and pipes, etc. wherever required.

2. Compact levee fill to a minimum of 90% standard proctor density.

3. Stripped soils can be used as topsoil on the levee slopes. Placement of an erosion control mat is recommended for the riverside of the levee only.

U.S. ARMY ENGINEER DISTRICT, NEW YORK
PASSAIC RIVER DIVISION
CORPS OF ENGINEERS

DWN. BY: JSL

CHK'D BY: UK

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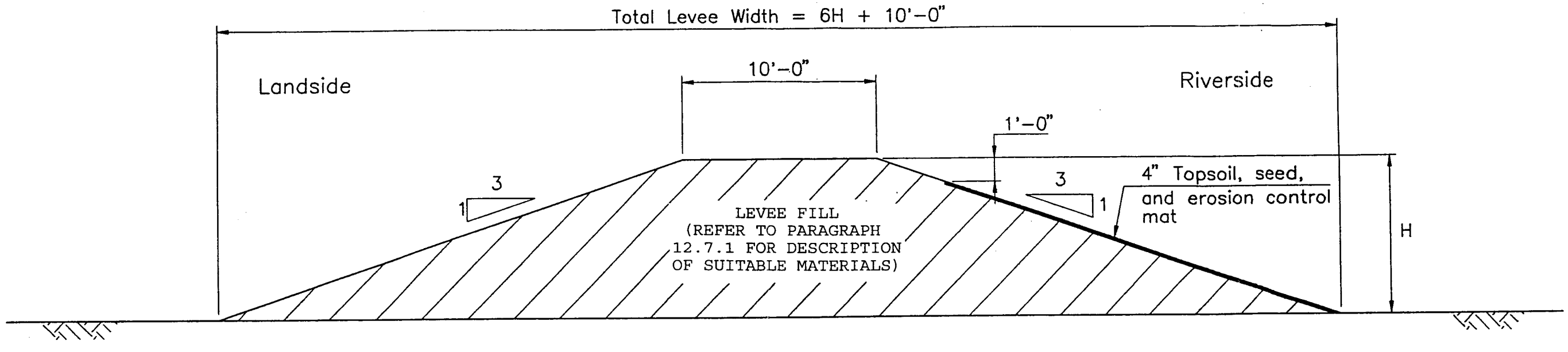
CONSULTING ENGINEERS

PASSAIC RIVER FLOOD DAMAGE REDUCTION PROJECT

LEVEE DETAIL

ROCKAWAY #2
LEVEE SYSTEM

PLATE E-12.38



Note:

This detail is applicable from Sta. 0+00 to Sta. 10+25.

ROCKAWAY #3
PROPOSED LEVEE DETAIL

SCALE: N.T.S.

Construction Sequence

1. Strip approximately 6" depth below the levee to remove all surface vegetation and debris. Also grub to 3' depth to remove all large vegetation and debris such as tree roots, old foundations and pipes, etc. wherever required.

2. Compact levee fill to a minimum of 90% standard proctor density.

3. Stripped soils can be used as topsoil on the levee slopes. Placement of an erosion control mat is recommended for the riverside of the levee only.

4. A subsurface drainage system should be constructed at the proposed location. The design and layout of this system should be the same as the existing one. The new drainage system should tie in with existing outlets.

DWN. BY: JSL

CHK'D BY: UK

ARORA and ASSOCIATES, P.C.
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PASSAIC RIVER DIVISION
CORPS OF ENGINEERS

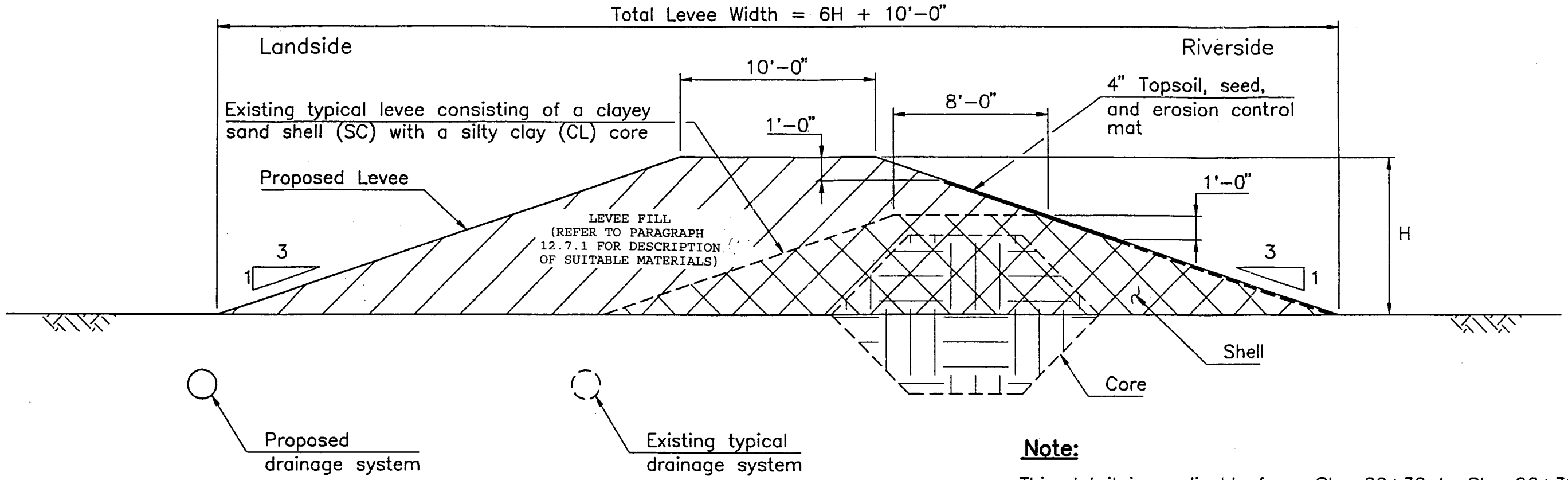
PASSAIC RIVER FLOOD DAMAGE REDUCTION PROJECT

LEVEE DETAIL

ROCKAWAY #3
LEVEE/FLOODWALL SYSTEM

PLATE E-12.39

CAD A&A 1218 ROCK3LEV 3/2/95 JSL



Note:

This detail is applicable from Sta. 20+30 to Sta. 26+30 and from Sta. 35+25 to Sta. 37+50.

ROCKAWAY #3
PROPOSED LEVEE DETAIL

SCALE: N.T.S.

Construction Sequence

1. Strip approximately 6" depth below the proposed levee and 4" depth on the top and landside slope of the existing levee to remove all surface vegetation and debris. Also grub the proposed levee area to 3' depth to remove all large vegetation and debris such as tree roots, old foundations and pipes, etc., wherever required.

2. Compact levee fill to a minimum of 90% standard proctor density.

3. Stripped soils can be used as topsoil on the levee slopes. Placement of an erosion control mat is recommended for the riverside of the levee only.

4. A subsurface drainage system should be constructed at the proposed location. The design and layout of this system should be the same as the existing one. The new drainage system should tie in with existing outlets.

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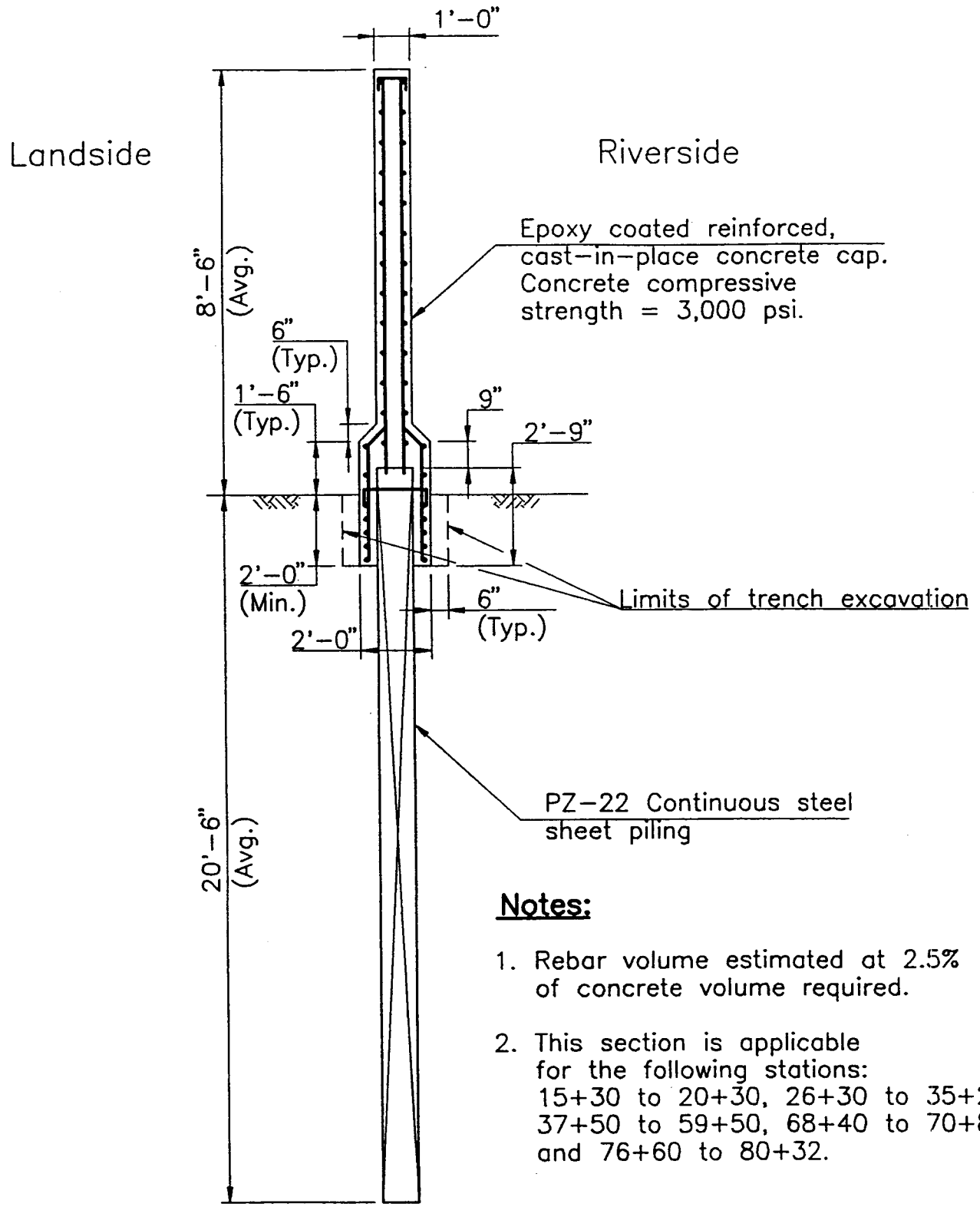
PASSAIC RIVER FLOOD DAMAGE REDUCTION PROJECT

LEVEE DETAIL

ROCKAWAY #3
LEVEE/FLOODWALL SYSTEM

PLATE E-12.40

CAD A&A 1218 RCK3LEV2 3/2/95 JSL



Notes:

1. Rebar volume estimated at 2.5% of concrete volume required.
2. This section is applicable for the following stations: 15+30 to 20+30, 26+30 to 35+25, 37+50 to 59+50, 68+40 to 70+80, and 76+60 to 80+32.

Construction Sequence:

1. Remove the existing floodwall and backfill up to the proposed floodwall cap foundation.
2. Relocate utilities as necessary in advance of pile driving.
3. Drive PZ-22 steel sheet piling as shown with a land mounted pile driving rig.
4. Grout any voids formed during pile driving with a sand, cement, and bentonite mix.
5. Construct utility crossings as necessary through the concrete cap or sheet piling.
6. Excavate trenches alongside sheet piling for the concrete cap construction.
7. Erect concrete forms, install reinforcement steel, and place concrete.

ROCKAWAY #3
TYPICAL I-WALL SECTION

SCALE: N.T.S.

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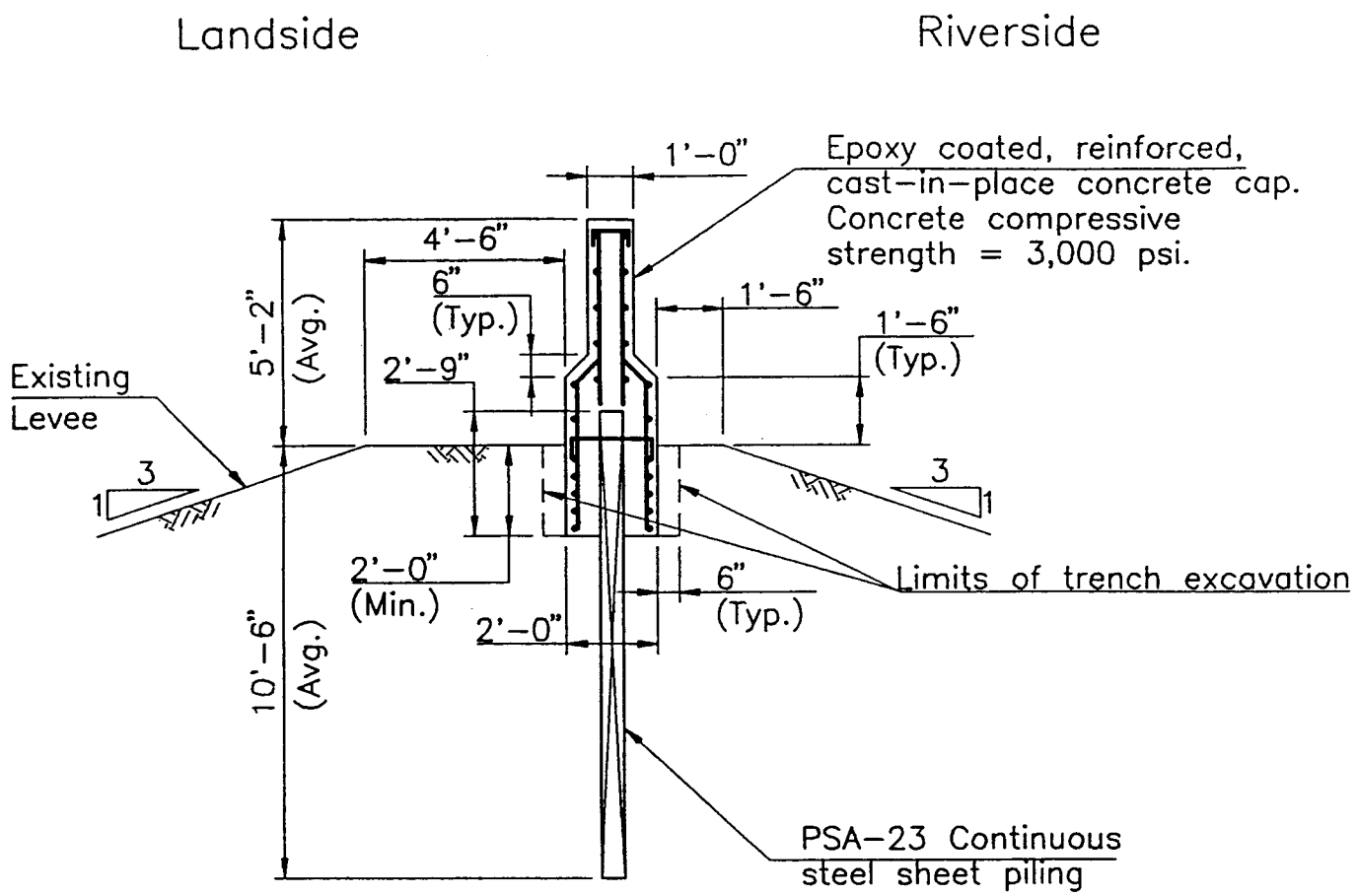
ARORA and ASSOCIATES, P.C. CONSULTING ENGINEERS	

CAD A&A 1218 ROCK3FW2 4/12/95 JSL

PLATE E-12.41



Construction Sequence:

1. Relocate utilities as necessary in advance of pile driving.
2. Drive PSA–23 steel sheet piling as shown with a land mounted pile driving rig.
3. Grout any voids formed during pile driving with a sand, cement, and bentonite mix.
4. Construct utility crossings as necessary through the concrete cap or sheet piling.
5. Excavate trenches alongside sheet piling for the concrete cap construction.
6. Erect concrete forms, install reinforcement steel, and place concrete.

Notes:

1. Rebar volume estimated at 2.5% of concrete volume required.
2. This section is applicable from Sta. 59+50 to Sta. 68+40, and from Sta. 70+80 to Sta. 76+60.

ROCKAWAY #3
TYPICAL I–WALL SECTION

SCALE: N.T.S.

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PASSAIC RIVER FLOOD DAMAGE REDUCTION PROJECT

FLOODWALL DETAIL

ROCKAWAY #3
LEVEE/FLOODWALL SYSTEM

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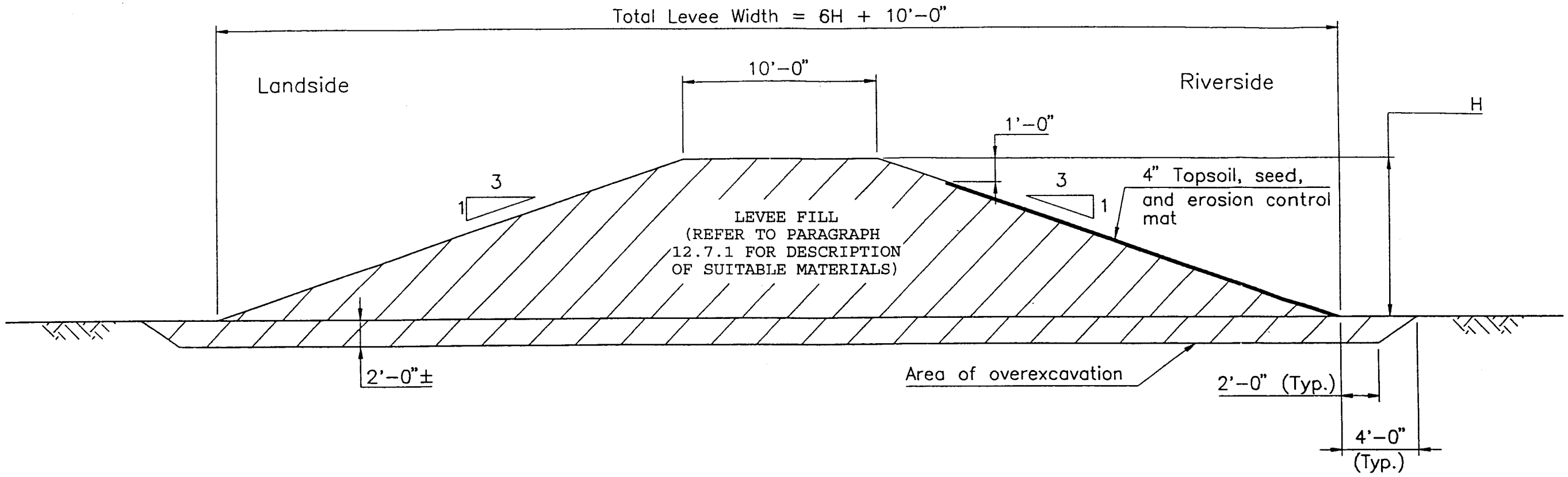
PLATE E-12.42

CAD A&A 1218 ROCK3FW 4/12/95 JSL



PASSAIC #2A
PROPOSED LEVEE DETAIL

SCALE: N.T.S.

Construction Sequence

1. An organic cohesive layer may be encountered. Overexcavate approximately 2'-0" and grub to a maximum depth of 3'-0" to remove all large vegetation and debris such as tree roots, old foundations and pipes. When the organic cohesive layer is not encountered, strip approximately 6" below the levee surface and grub 3'-0" as mentioned above.

2. Compact levee fill to a minimum of 90% standard proctor density.

3. Stripped and overexcavated organic soils can be used as topsoil on the levee slopes. Placement of an erosion control mat is recommended for the riverside of the levee only.

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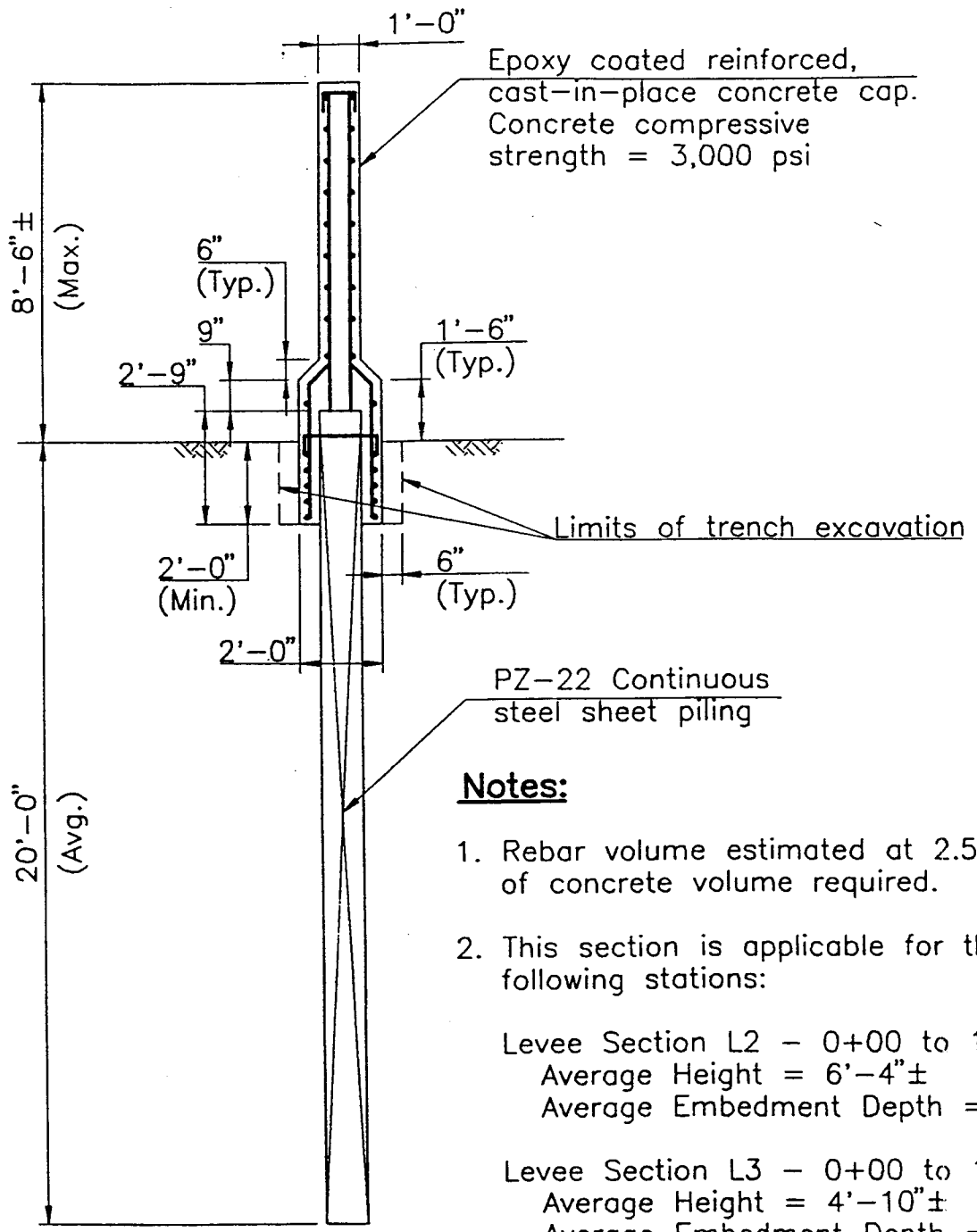
PASSAIC RIVER FLOOD DAMAGE REDUCTION PROJECT

LEVEE DETAIL

PASSAIC #2A
LEVEE/FLOODWALL SYSTEM

JSL 3/9/95 PAS2ALEV CAD A&A 1218



Notes:

1. Rebar volume estimated at 2.5% of concrete volume required.

2. This section is applicable for the following stations:

   Levee Section L2 – 0+00 to 16+82
   Average Height = 6'–4"±
   Average Embedment Depth = 15'–0"

   Levee Section L3 – 0+00 to 14+00
   Average Height = 4'–10"±
   Average Embedment Depth = 12'–0"

Construction Sequence:

1. Relocate utilities as necessary in advance of pile driving.
2. Drive PZ–22 steel sheet piling as shown with a land mounted pile driving rig.
3. Grout any voids formed during pile driving with a sand, cement, and bentonite mix.
4. Construct utility crossings as necessary through the concrete cap or sheet piling.
5. Excavate trenches alongside sheet piling for the concrete cap construction.
6. Erect concrete forms, install reinforcement steel, and place concrete.

PASSAIC #2A
TYPICAL I–WALL SECTION

SCALE: N.T.S.

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CHK'D BY: UK	PASSAIC RIVER FLOOD DAMAGE REDUCTION PROJECT **FLOODWALL DETAIL** PASSAIC #2A LEVEE/FLOODWALL SYSTEM
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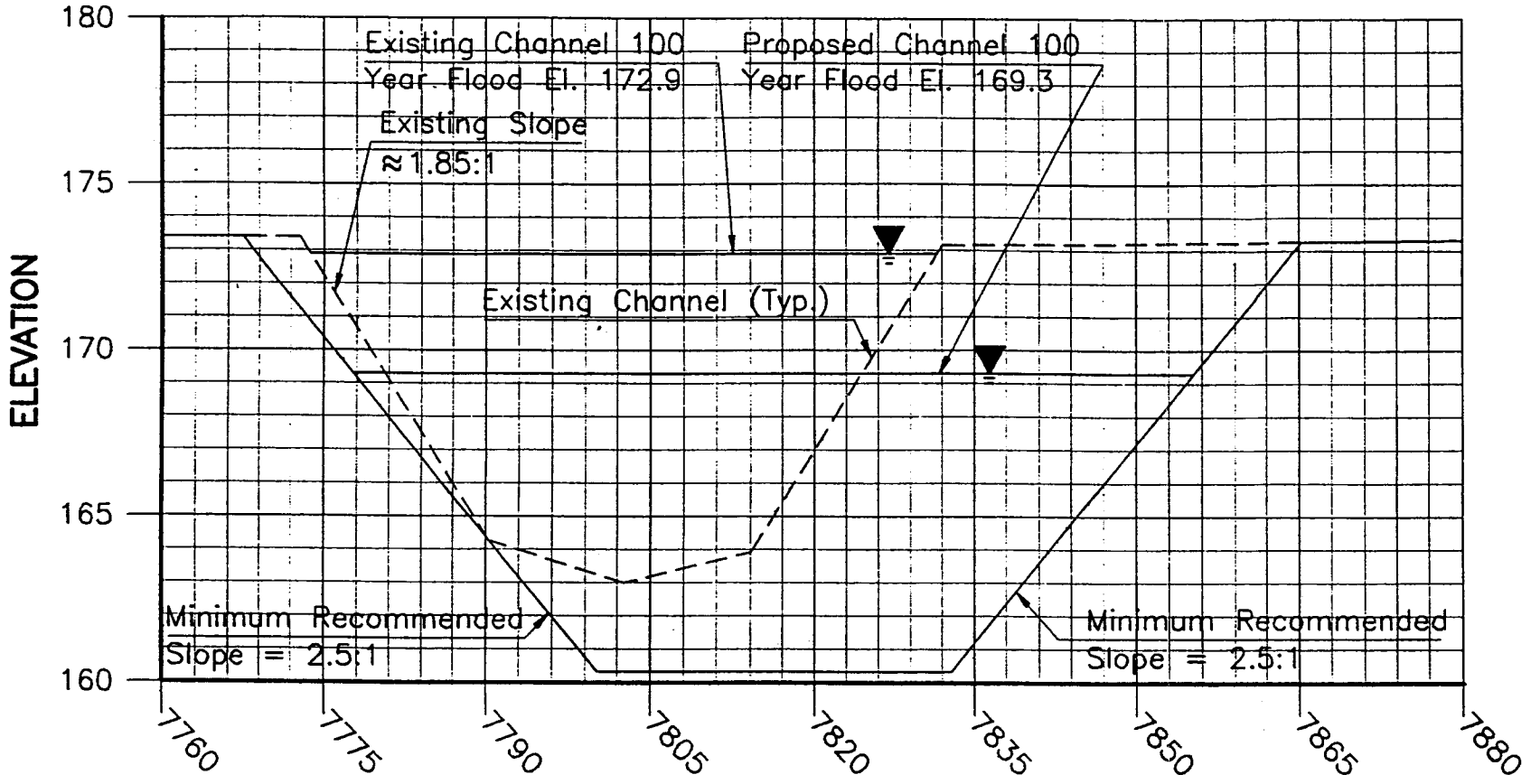
PLATE E-12.44

CAD A&A 1218 PAS2AFW 3/9/95 JSL



TYPICAL CHANNEL IMPROVEMENT AT STA. 77+80

SCALE: Vert.: 1" = 5'
Horiz.: 1" = 15'

Notes:

1. Cut Side slopes (flatter than 2.5:1) and the channel bed will require only seeding.
2. A 12" thick layer of rip rap will be provided at tributary confluence locations regardless of their slope.

5' 0 5' 10'
1" = 5'-0"

15' 0 15' 30'
1" = 15'-0"

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PASSAIC RIVER FLOOD DAMAGE REDUCTION PROJECT

CHANNEL DETAIL

DEEPAVAAL BROOK CHANNEL IMPROVEMENTS

PLATE E-12.45

CAD A&A 1218 DEEPCH1.DWG 5/17/95 JSL

APPENDIX E
SECTION 13
POMPTON LEVEES AND CHANNELS

PASSAIC RIVER FLOOD DAMAGE
REDUCTION PROJECT

GEOTECHNICAL DESIGN
APPENDIX E

SECTION 13
POMPTON LEVEES/FLOODWALLS AND CHANNELS

13.1 SCOPE

13.2 FEATURE DESCRIPTION
- 13.2.1 Channel Modifications
- 13.2.2 Levee/Floodwall

13.3 SUBSURFACE INVESTIGATIONS

13.4 SITE GEOLOGY
- 13.4.1 General
- 13.4.2 Soil Conditions
- 13.4.3 Groundwater Conditions

13.5 LABORATORY SOILS TESTING
- 13.5.1 Pequannock River
- 13.5.2 Wanaque River
- 13.5.3 Ramapo River
- 13.5.4 Pompton Inlet Area

13.6 DESIGN PARAMETERS

13.7 DESIGN ALTERNATIVES

13.8 GEOTECHNICAL ANALYSES
- 13.8.1 Levee Design (general)
- 13.8.2 Floodwall Design
- 13.8.3 Channel Work
- 13.8.4 Slope Stability
- 13.8.5 Settlement
- 13.8.6 Seepage
- 13.8.7 Riprap and Bedding

13.9 CONSTRUCTION CONSIDERATIONS
- 13.9.1 Construction Materials
  - 13.9.1.1 General
  - 13.9.1.2 Levee Material
  - 13.9.1.3 Riprap and Bedding
- 13.9.2 Dredging

PLATES

E.13.1 Plan and Boring Location Drawing Pompton Inlet, Bypass Channel, and Pequannock Weir

E.13.1A Plan and Boring Location Drawing, Ramapo Levee and Channel Work

E.13.2 Plan and Boring Location Drawing, Pequannock River Channel Work

E.13.3 Plan and Boring Location Drawing, Wanaque and Pequannock Channel Work

E.13.3A Plan and Boring Location Drawing, Upper Wanaque and Pequannock Channel Work

E.13.4 Channel Slope Stability Analysis - End of Construction (Low Water), Boring PL-4

E.13.4A Channel Slope Stability Analysis - Sudden Drawdown, Boring PL-4

E.13.5 Channel Slope Stability Analysis - End of Construction (Low Water), Boring PL-2

E.13.5A Channel Slope Stability Analysis - Sudden Drawdown, Boring PL-2

E.13.6 Levee Slope Stability Analysis - End of Constructrion (Low Water), Boring PL-2

E.13.6A Levee Slope Stability Analysis - Sudden Drawdown, Boring PL-2

FIGURES

E.13.1 Typical Levee Section

E.13.2 Floodwall Penetration Analysis

E.13.3 Levee Underseepage Analysis

E.13.4 Floodwall Underseepage Analysis

ATTACHMENTS

E.13.1 Detailed Boring Logs

E.13.2 Soil Profile Drawings

E.13.3 Laboratory Soils Test Data

TABLES

E.13.1 Riprap Requirements

E.13.2 Bedding and Filter Requiremnts

APPENDIX E

SECTION 13

POMPTON LEVEES/FLOODWALLS AND CHANNELS

13.1 SCOPE

The primary goal of this design is to prepare a reasonable cost estimate for the construction of the Pompton Levees and Channels. In this design, sufficient detail has been provided to obtain a reasonable cost estimate. This design includes a preliminary design of the proposed levee and floodwall structures, a soil analysis to evaluate existing site conditions based on field data, and a check on seepage and slope stability. It should be emphasized that a significant additional levee and channel boring and testing program will be required for final (FDM) design of the levees and channels.

13.2 FEATURE DESCRIPTION

The Pompton Levees/Floodwalls and Channels project area lies in the Passaic River Basin just upstream of the Pompton River tunnel inlet and in the Townships of Wayne, Pequannock, Pompton Lakes, and Riverdale, New Jersey. See Plates E.13.1 through E.13.3A for plan drawings. The following are components of the proposed plan.

13.2.1 Channel Modifications Channel modifications (widening and deepening) along the Pequannock, Wanaque, and Pompton Rivers and a levee/floodwall structure along the Ramapo River will help protect existing structures from flooding up to a 100 year flood event. Channel slopes will be 2.5 feet horizontal to 1 foot vertical (2.5H:1V) along the Pequannock (14,335'), Ramapo (5,655'), Wanaque (5,620'), and Pompton (1,190') Rivers.

13.2.2 Levee/Floodwall A levee (2,200') and floodwall (2,910') structure are to be located on the right bank of the Ramapo River. The levee is to have 3H:1V side slopes, be 7 feet in height on average, and have a 10 foot top width. The floodwall is to be constructed with concrete capped sheetpile and is to have a 2 to 1 penetration to height ratio.

13.3 SUBSURFACE INVESTIGATIONS

See Plates E.13.1 through E.13.1A for boring locations. Four split spoon type Borings, PL-4, PW-1, PW-2, and PW-3 were made along the Pequannock River channel. Borings PL-4 (25.5'),

PW-1 (30'), and PW-3 (26') were only 25 to 30 ft deep but Boring PW-2 was drilled to a depth of 131.3 ft. Borings PW-1, PW-2, and PW-3 were drilled at the proposed site of the new Pequannock Weir. Split spoon type Boring PL-5 was performed along the Wanaque River and was drilled to a depth of 20 feet. Borings made along the Ramapo River include 4 split spoon type Borings; WL-3 (36'), WL-4 (30'), PL-1 (28.5'), and PL-2 (23') were drilled to depths of from 23 to 36 feet.

At the site of the Pompton Tunnel Inlet (Pompton River), four Borings: DU-11A, DC-114, OW-PI, and PTI-1 were drilled. Borings DC-114 (233.5'), OW-PI (45'), and PTI-1 (220') were split spoon type borings drilled to the top of rock and Boring DU-114A (49.2') was an undisturbed boring. Wells were installed in Borings DC-114, DU-114A, and OW-PI to monitor groundwater levels. Please refer to Appendix E, Section 5 for a copy of all Pompton Inlet subsurface investigations data.

13.4 SITE GEOLOGY

13.4.1 General The area is overlain by recent alluvial sand and gravel deposits 15 to 50 feet in thickness. Beneath these alluvial sands and gravels are relatively impermeable silt and clay glacial lake deposits extending from depths of 50 to 120 feet below ground surface. Underlying the glacial lake clays is glacial till extending to the top of rock. The majority of the channel excavations will be in the alluvial sands and gravels but excavation will extend into the silt and clay glacial lake deposits in some areas.

13.4.2 Soil Conditions See Attachment E.13.1 for individual boring logs and Attachment E.13.2 for soil profile drawings.

13.4.3 Groundwater Conditions Groundwater was encountered in most borings during drilling but only the Pompton River tunnel inlet Borings (DC-114, DU-114A, OW-PI) and Pequannock Levee Borings (PW-1, PW-2, and PW-3) had their water levels recorded. However, noting that the entire Pompton Levees/Floodwalls and Channels project area is located at rivers whose soils are of the SM, ML and CL soil type, the shallow water table aquifers should reflect the river elevation water levels and are not expected to have any adverse effects on levee construction. Our borings here and elsewhere in this report confirmed these groundwater level expectations. The rivers and adjacent groundwater level elevations upstream of the Ramapo River Dam and Pequannock Weir (hydraulic reaches 8, 9, 10, 11, and 12) is normally at about elevation 175 and the waters downstream of these structures (to the downstream limit of channelization) is about elevation 168

(hydraulic reaches 13 and 14). Please refer to the Plates E.13.1 through E.13.3A for boring locations.

13.5 LABORATORY SOILS TESTING

See Attachment E.13.3 for laboratory soils testing data. These data are summarized below:

13.5.1 Pequannock River Sieve analyses with hydrometer, specific gravity and Atterberg limits tests were performed on selected samples from Boring PL-4 to confirm field log soil descriptions and to acquire basic soil characteristics and design parameters for later use. The varved silt and clay from PL-4 was found to be non-plastic, with a liquid limit of 19 and a specific gravity of 2.79. The other samples tests from PL-4 were either obviously non-plastic or had an insufficient amount of sample to determine their Atterberg limits or specific gravity. The silty sands near the weir site were non-plastic, with a specific gravity of 2.70, while the underlying clay had a liquid limit of 37 and a plasticity index of 12. Borings PW-1, PW-2, and PW-3 had no geotechnical laboratory tests performed on them.

13.5.2 Wanaque River Sieve analysis with hydrometer, specific gravity and Atterberg limits tests were performed on selected samples from Boring PL-5. All samples were found to be non-plastic or had an insufficient amount of sample to conduct Atterberg limits test. The upper silty sand layer from Boring PL-5 was found to have a liquid limit of 21 and specific gravity of 2.63.

13.5.3 Ramapo River Sieve analysis with hydrometer, specific gravity, and Atterberg limits test were performed on selected samples from Borings PL-1, PL-2, WL-3, and WL-4. The varved silt and clay was found to have a liquid limit of 37 and a plasticity index of 12. The sands, gravels and sandy silts were all found to be non-plastic. Specific gravities for samples tested ranged from 2.69 to 2.76.

13.5.4 Pompton Inlet Area Laboratory testing was performed on both split spoon and undisturbed samples. For a full description of all testing performed, please refer to Appendix E, Section 5, Main Tunnel Inlet.

13.6 DESIGN PARAMETERS

Most soil parameters were developed using Standard Penetration Test boring data and limited laboratory soils testing data in conjunction with geotechnical reference material. The

only triaxial shear and consolidation testing performed was on the samples from undisturbed Boring DU-114A at the Main Tunnel Inlet. See Section 5, Appendix E, for these data. Please refer to Plates E.13.4 through E.13.6A for the design soil parameters selected for these analyses.

13.7 DESIGN ALTERNATIVES

Levees were selected as the most economical means of achieving the desired flood protection. I-type floodwalls were selected where real estate requirements made levee construction uneconomical.

13.8 GEOTECHNICAL ANALYSES

13.8.1 Levee Design (general)

Levees will be constructed up to 14 feet in height and will have 3H:IV side slopes, a 10 foot crest width and will be constructed using a tunnel muck core with a topsoil and clay cover (Figure E.13.1). The river side toe of the levee will be at least 10 feet inland from the channel bank top. The levees are designed to protect up to the 100 year flood event.

The area beneath the entire levee footprint will be cleared of trees and stripped to a minimum depth of 6 inches to remove all vegetation and other objectiveble material. After stripping, the area will be grubbed to a depth of 3 ft to remove all large tree roots and other large debris. Then an inspection trench will be excavated to a maximum depth of 6 ft or to a depth of the height of the levee. After excavation the trench will be backfilled with the excavated material, if suitable, and compacted to at least the in-situ density.

All levee fill will be placed in maximum 12 inch loose lifts and compacted to at least 90 percent of the materials standard proctor density.

13.8.2 Floodwall Design Floodwalls will be constructed with concrete capped sheet pile (PZ-22 or PZ-27) with the concrete extending at least 1' below ground surface and the wall having a 2 to 1 penetration to height ratio. The sheetpile penetration was determined utilizing the WES program "CWALSHT." Please refer to Figure E.13.2 for the sheetpile penetration analysis.

13.8.3 Channel Work Channels will be deepened and widened and will have improved side slopes of 2.5H:IV. Channel cuts will be up to 10 ft and total bank heights will range from 12 to 24

ft. Riprap erosion protection will be placed over the channel slopes and bottom in reaches with high velocities. See Table E.13.1 for riprap requirements.

13.8.4 Slope Stability Slope stability analyses were performed for the improved channel slopes and for the levee. Channels will be deepened and widened and will have 2.5H:IV side slopes. Levees and floodwalls were checked on their effect on channel bank slope stability and were found to have a negligible effect. The design was evaluated for a factor of safety of 1.3 for the end-of-construction (low water) case and for 1.0 for sudden drawdown and was found stable. Levee and channel slope stability were checked with software developed by the Waterways Experiment Station (WES) entitled UTEXAS 3 and utilizing the criteria in Corps EM 1110-2-1193, "Design and Protection of Levees". Channel slopes were analyzed based on soil data at two representative boring locations, PL-2 and PL-4, and the levee foundation soils were based on Boring PL-2. See Plates E.13.4 and through E.13.6A for channel and levee slope stability analysis.

13.8.5 Settlement Estimate No settlement analysis was performed because the levee foundation soil consist of silty snds and silts and any foundation settlement is expected to occur during construction. Settlement within the levee itself was not calculated. When the actual borrow material source will be identified before construction, a settlement calculation of the levee material will be performed. Normally about 2-6 inches of settlement can be expected in a levee constructed of silt-clay of glacial soils. Such a condition is acceptable for levee construction.

13.8.6 Seepage Levee and floodwall underseepage analyses were performed in accordance with EM 1110-21-1913 entitled "Design and Construction of Levees". Seepage flow nets were drawn in order to compute landside seepage gradients. See Figures E.13.3 and E.13.4. These analyses indicate that during project flood, seepage gradients at the landside toe will be within the allowable. No analysis for levee through seepage was performed because the riverside clay blanket is relatively impermeable for the short term flood events.

13.8.7 Riprap and Bedding The riprap requirements for the entire project are shown on Table E.13.1. Preliminary filter design analyses were performed to determine riprap filter and bedding requirements. Since most of the riprap is to be placed on the Wanaque, Pequannock, and Ramapo Rivers, the filter and bedding requirements are presented in this section. Table E.13.2 shows the filter and bedding thickness requirements for the

various riprap sizes. Riprap, bedding, and river bed material gradations were analyzed with respect to the filter criteria in EM 1110-2-1913. As indicated on Table E.13.2, an intermediate filter layer between the riprap and bedding is required for riprap thicknesses 30 inches and greater. Filter bedding gradation requirements will be finalized during FDM studies. However, preliminary indications are that concrete gravel aggregate (3/4 in. max) will provide adequate bedding for sandy river bottoms and a more broadly graded crushed stone with some fines for silty and clayey river bottoms.

13.9 CONSTRUCTION CONSIDERATIONS

13.9.1 Construction Materials

13.9.1.1 General Please refer to the Materials Resource Study, section 15, for a list of sources of potential borrow material and stone in the area. The sources listed have been approved and are currently being used by the New Jersey Department of Transportation (NJDOT).

13.9.1.2 Levee Material A total of about 17,000 cubic yards of earth fill (loose measure) will be required for levee construction. The levee's tunnel muck core material will come from the nearby tunnel work shaft located at the Pompton Inlet, the riverside clay blanket material from the Pompton Inlet Structure excavation, and the topsoil cover from the stripping operation within the levee foot print.

13.9.1.3 Riprap and Bedding Materials These materials may be obtained from the many quarries located within a 50 mile radius of the project. There are many quarries which are located in the area which the NJDOT uses as sources of riprap stone and bedding materials and are listed in the Materials Resource Study. A list of approved quarries will be included in the construction contract specifications.

13.9.2 Channel Dredging It is anticipated that the channel dredging will be accomplished utilizing a drag line. The channel slopes and bottom in certain reaches will require riprap and bedding erosion protection which would be constrcuted by temporarily overdredging and then immediately backfilling with riprap. The slope stability calcualtions perfomed for this investigation incorporated this temporary construction conditon in the after construction design case.

PASSAIC RIVER FLOOD DAMAGE REDUCTION PROJECT

SECTION 13
POMPTON LEVEES/FLOODWALLS AND CHANNELS

PLATES

PEQUANNOCK RIVER CHANNEL MODIFICATION

RAMAPO RIVER CHANNEL MODIFICATION

PEQUANNOCK WEIR (NEW)

OLD MORRIS CHANNEL FEEDER DAM AND WEIRS

POMPTON INLET

BYPASS CHANNEL MODIFICATION

SEDIMENT CHANNEL

E MAIN 43 TUNNEL (UNDERGROUND)

PW-1
PW-2
PW-3
WL-1
WL-2
WL-3
PTI-1
DC-114
DU-114A
OW-PI
DC-147

SHEET LEGEND

- BUILDINGS
- BUILDING UNDER CONSTRUCTION
- ROADS/PARKING AREAS
- DRIVES
- DIRT ROADS
- RAILROAD
- FENCE
- WATERS EDGE AND SWAMP OUTLINE
- DENSE WOODS LINE
- WETLAND SYMBOL
- WOODED AREA
- TOWER
- COUNTY BOUNDARY
- BOROUGH AND TOWNSHIP BOUNDARY
- U.S. ROAD SHIELD
- INTERSTATE ROAD SHIELD
- STATE ROADSHIELD
- 100 YEAR FLOOD
- 500 YEAR FLOOD
- STANDARD LEVEE
- STANDARD FLOOD WALL
- CHANNEL MODIFICATION

POMPTON LAKES BOROUGH
PEQUANNOCK TOWNSHIP
WAYNE TOWNSHIP

KEY TO MATCHING SHEETS

O-10	P-10	
O-11	P-11	
O-12	P-12	

DATE OF PHOTOGRAPHY JANUARY 27, 1990

SCALE IN FEET

250 0 250 500 750

U.S. ARMY ENGINEER DISTRICT, NEW YORK
PASSAIC RIVER DIVISION
CORPS OF ENGINEERS

Passaic River Flood Damage Reduction Project

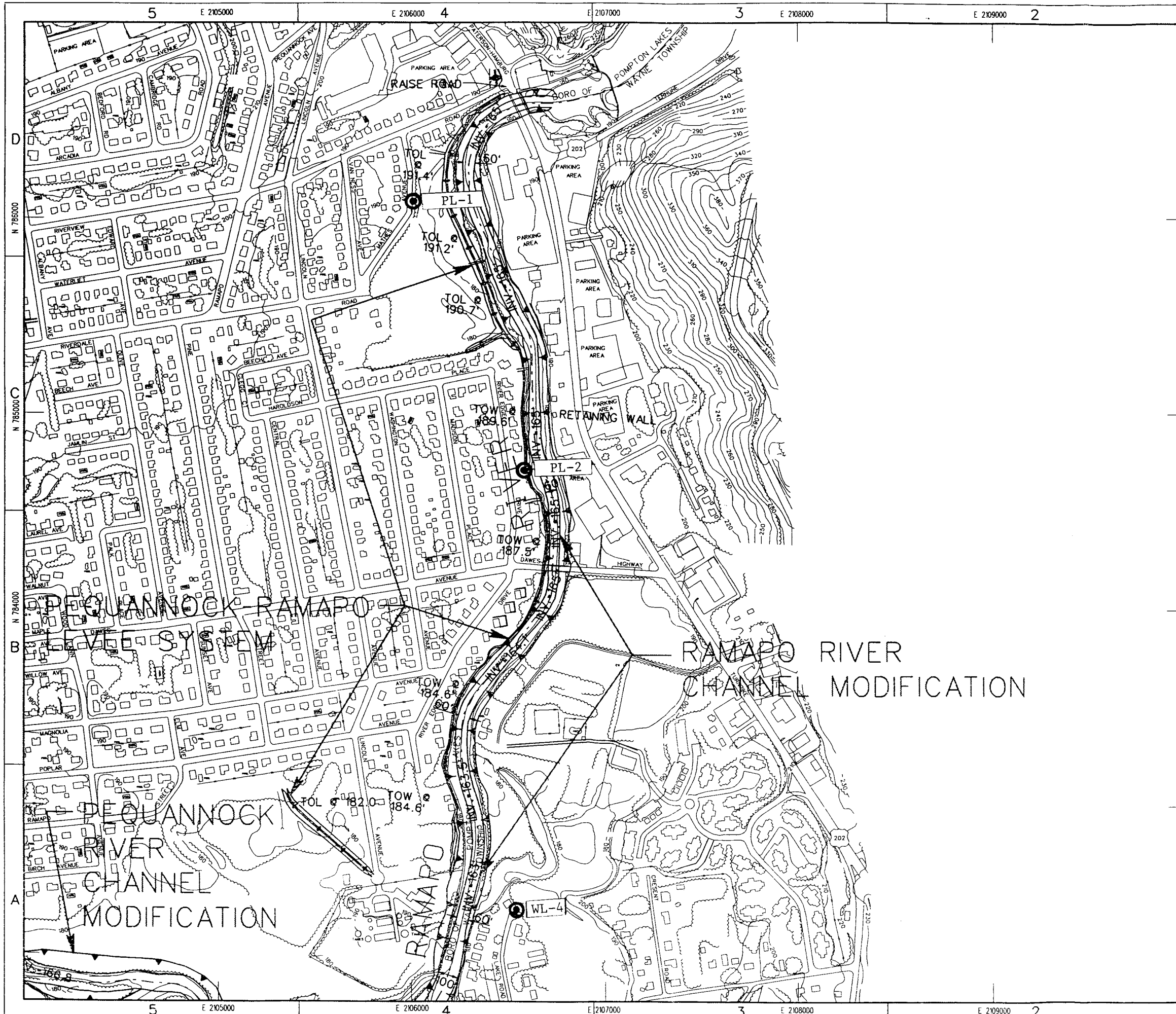
GENERAL DESIGN MEMORANDUM

POMPTON INLET CHANNELS
POMPTON INLET, BYPASS CHANNEL
PEQUANNOCK WEIR

REVISED:

DATE: | PREPARED BY: | SHEET P-11

PLATE E.13.1



SHEET LEGEND

- BUILDINGS
- BUILDING UNDER CONSTRUCTION
- ROADS,PARKING AREAS
- DRIVES
- DIRT ROADS
- RAILROAD
- FENCE
- WATERS EDGE AND SWAMP OUTLINE
- DENSE WOODS LINE
- WETLAND SYMBOL
- WOODED AREA
- TOWER
- COUNTY BOUNDARY
- BOROUGH AND TOWNSHIP BOUNDARY
- U.S. ROAD SHIELD
- INTERSTATE ROAD SHIELD
- STATE ROADSHIELD
- 100 YEAR FLOOD
- 500 YEAR FLOOD
- STANDARD LEVEE
- STANDARD FLOOD WALL
- CHANNEL MODIFICATION

WAYNE TOWNSHIP
POMPTON LAKES BOROUGH

KEY TO MATCHING SHEETS

O-9	P-9	
O-10	P-10	
O-11	P-11	

DATE OF PHOTOGRAPHY JANUARY 27, 1990

SCALE IN FEET
250 0 250 500 750

U.S. ARMY ENGINEER DISTRICT, NEW YORK
PASSAIC RIVER DIVISION
CORPS OF ENGINEERS

Passaic River Flood Damage Reduction Project

GENERAL DESIGN MEMORANDUM
POMPTON INLET CHANNELS
PEQUANNOCK-RAMAPO LEVEE
RAMAPO CHANNEL MODIFICATIONS

REVISED:
DATE: PREPARED BY: SHEET P-10

PLATE E.13.1A

PEQUANNOCK RIVER
CHANNEL MODIFICATION

SHEET LEGEND

- BUILDINGS
- BUILDING UNDER CONSTRUCTION
- ROADS, PARKING AREAS
- DRIVES
- DIRT ROADS
- RAILROAD
- FENCE
- WATERS EDGE AND SWAMP OUTLINE
- DENSE WOODS LINE
- WETLAND SYMBOL
- WOODED AREA
- TOWER
- COUNTY BOUNDARY
- BOROUGH AND TOWNSHIP BOUNDARY
- U.S. ROAD SHIELD
- INTERSTATE ROAD SHIELD
- STATE ROADSHIELD
- 100 YEAR FLOOD
- 500 YEAR FLOOD
- STANDARD LEVEE
- STANDARD FLOOD WALL
- CHANNEL MODIFICATION

POMPTON LAKES

PEQUANNOCK TOWNSHIP

KEY TO MATCHING SHEETS

	O-10	P-10
N-11	O-11	P-11
N-12	O-12	P-12

DATE OF PHOTOGRAPHY JANUARY 27, 1990

SCALE IN FEET

250 0 250 500 750

U.S. ARMY ENGINEER DISTRICT, NEW YORK
PASSAIC RIVER DIVISION
CORPS OF ENGINEERS

Passaic River Flood Damage Reduction Project

GENERAL DESIGN MEMORANDUM

POMPTON INLET CHANNELS PEQUANNOCK RIVER CHANNEL MODIFICATIONS

REVISED:			
DATE:	PREPARED BY:	SHEET	O-11

PLATE E.13.2

WANAQUE RIVER CHANNEL MODIFICATION

PEQUANNOCK RIVER CHANNEL MODIFICATION

PEQUANNOCK RIVER CHANNEL MODIFICATION

PL-5

PL-4

SHEET LEGEND

- BUILDINGS
- BUILDING UNDER CONSTRUCTION
- ROADS,PARKING AREAS
- DRIVES
- DIRT ROADS
- RAILROAD
- FENCE
- WATER'S EDGE AND SWAMP OUTLINE
- DENSE WOODS LINE
- WETLAND SYMBOL
- WOODED AREA
- TOWER
- COUNTY BOUNDARY
- BOROUGH AND TOWNSHIP BOUNDARY
- U.S. ROAD SHIELD
- INTERSTATE ROAD SHIELD
- STATE ROADSHIELD
- 100 YEAR FLOOD
- 500 YEAR FLOOD
- STANDARD LEVEE
- STANDARD FLOOD WALL
- CHANNEL MODIFICATION

KEY TO MATCHING SHEETS

	0-9	P-9
	0-10	P-10
N-11	0-11	P-11

DATE OF PHOTOGRAPHY JANUARY 27, 1990

SCALE IN FEET

250 0 250 500 750

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Passaic River Flood Damage Reduction Project

GENERAL DESIGN MEMORANDUM

POMPTON INLET CHANNELS WANAQUE AND PEQUANNOCK RIVER CHANNEL MODIFICATIONS

REVISED:

DATE: | PREPARED BY: | SHEET 0-10

PLATE E.13.3

E 2099000 5 E 2100000 4 E 2101000 3 E 2102000 2 E 2103000 1

N 791000 D C N 790000 N 789000 B A N 788000

BLOOMINGDALE

WANAQUE RIVER CHANNEL MODIFICATION

PEQUANNOCK RIVER CHANNEL MODIFICATION

RIVERDALE

PL-7

150-00

SHEET LEGEND

- BUILDINGS
- BUILDING UNDER CONSTRUCTION
- ROADS,PARKING AREAS
- DRIVES
- DIRT ROADS
- RAILROAD
- FENCE
- WATERS EDGE AND SWAMP OUTLINE
- DENSE WOODS LINE
- WETLAND SYMBOL
- WOODED AREA
- TOWER
- COUNTY BOUNDARY
- BOROUGH AND TOWNSHIP BOUNDARY
- U.S. ROAD SHIELD
- INTERSTATE ROAD SHIELD
- STATE ROADSHIELD
- 100 YEAR FLOOD
- 500 YEAR FLOOD
- STANDARD LEVEE
- STANDARD FLOOD WALL
- CHANNEL MODIFICATION

KEY TO MATCHING SHEETS

	0-8	P-8
	0-9	P-9
	0-10	P-10

DATE OF PHOTOGRAPHY JANUARY 27, 1990

SCALE IN FEET

250 0 250 500 750

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PASSAIC RIVER DIVISION
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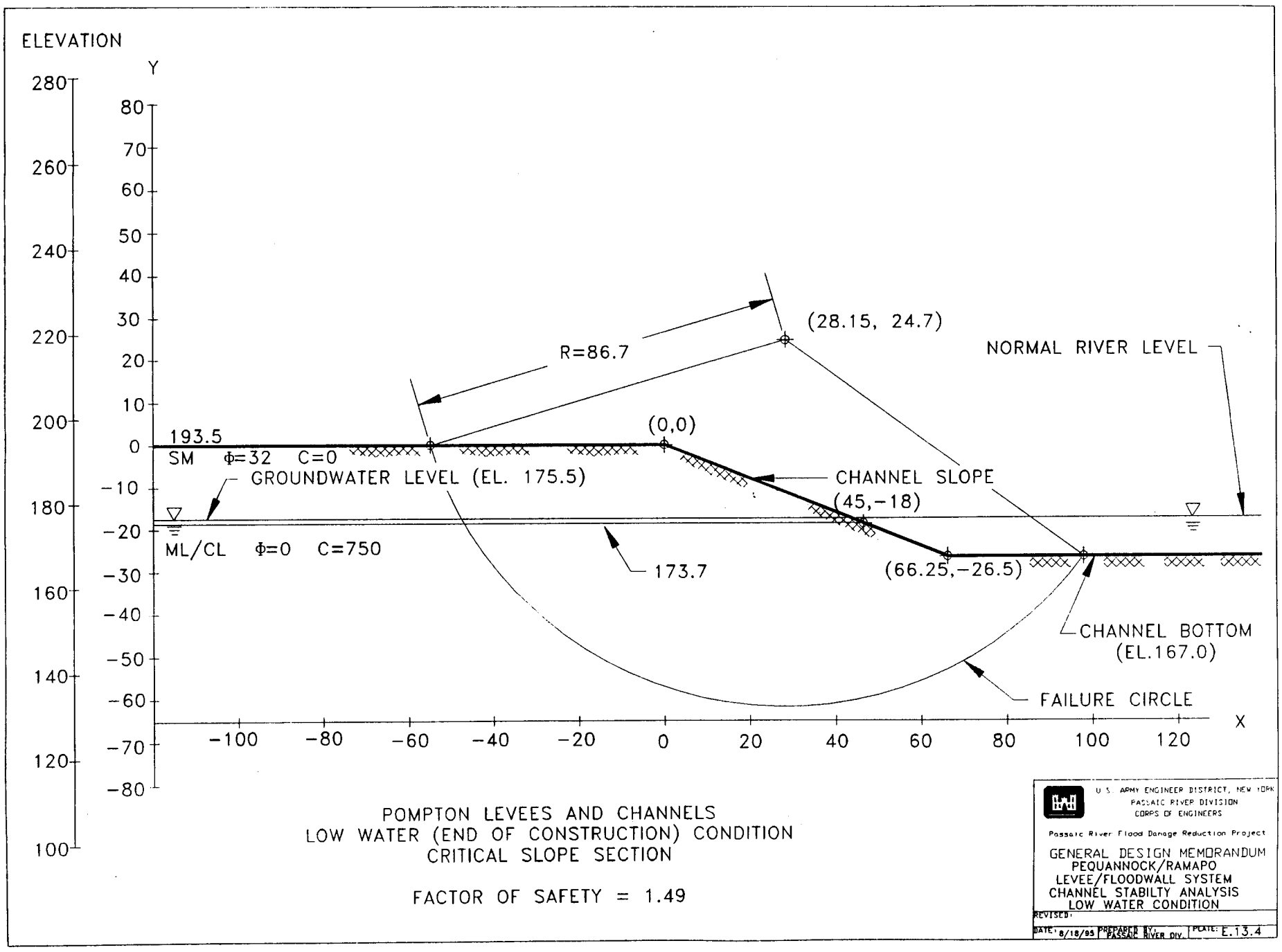
Passaic River Flood Damage Reduction Project

GENERAL DESIGN MEMORANDUM

POMPTON INLET CHANNELS UPPER WANAQUE AND PEQUANNOCK RIVER CHANNEL MODIFICATIONS

REVISED:		
DATE:	PREPARED BY:	SHEET 0-9

PLATE E.13.3A



POMPTON LEVEES AND CHANNELS
LOW WATER (END OF CONSTRUCTION) CONDITION
CRITICAL SLOPE SECTION

FACTOR OF SAFETY = 1.49

U.S. ARMY ENGINEER DISTRICT, NEW YORK
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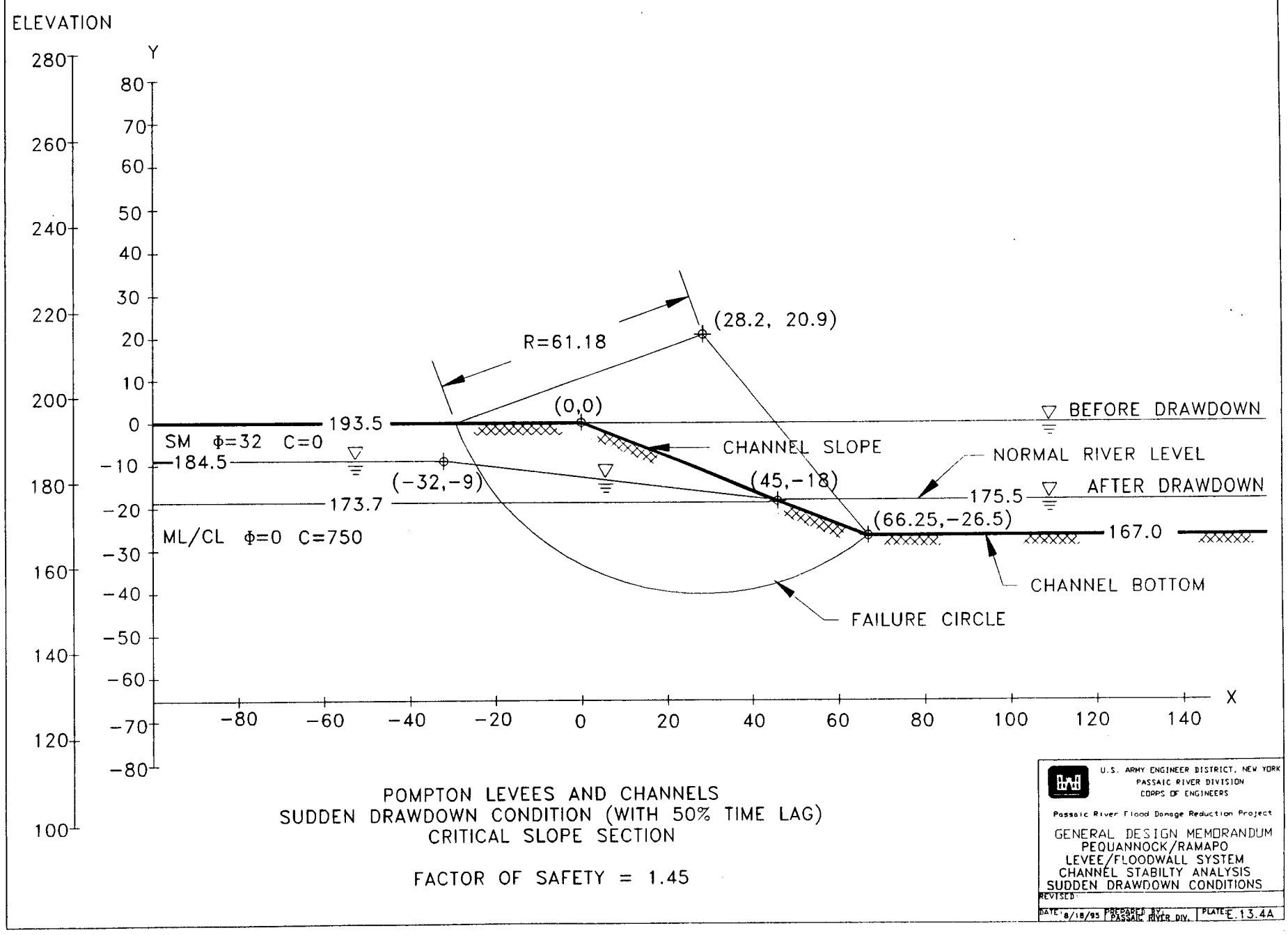
Passaic River Flood Damage Reduction Project

GENERAL DESIGN MEMORANDUM
PEQUANNOCK/RAMAPO
LEVEE/FLOODWALL SYSTEM
CHANNEL STABILTY ANALYSIS
LOW WATER CONDITION

REVISED:

DATE: 8/18/95 PREPARED BY: PASSAIC RIVER DIV. PLATE: E.13.4

PLATE E.13.4



POMPTON LEVEES AND CHANNELS
SUDDEN DRAWDOWN CONDITION (WITH 50% TIME LAG)
CRITICAL SLOPE SECTION

FACTOR OF SAFETY = 1.45

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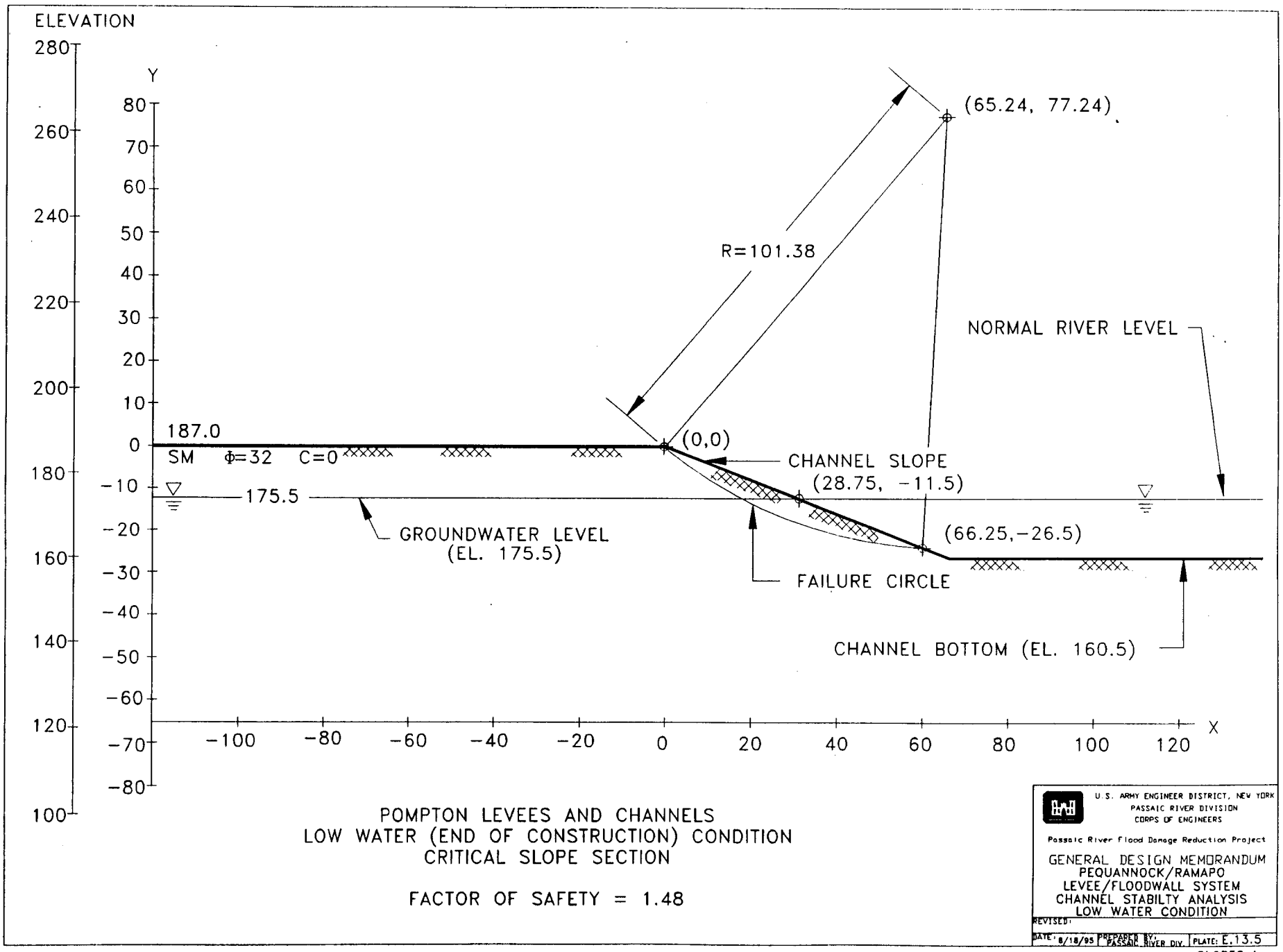
Passaic River Flood Damage Reduction Project

GENERAL DESIGN MEMORANDUM
PEQUANNOCK/RAMAPO
LEVEE/FLOODWALL SYSTEM
CHANNEL STABILTY ANALYSIS
SUDDEN DRAWDOWN CONDITIONS

REVISED

DATE	PREPARED BY	PLATE
8/18/95	PASSAIC RIVER DIV.	E.13.4A

PLATE E.13.4A



POMPTON LEVEES AND CHANNELS
LOW WATER (END OF CONSTRUCTION) CONDITION
CRITICAL SLOPE SECTION

FACTOR OF SAFETY = 1.48

U.S. ARMY ENGINEER DISTRICT, NEW YORK
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CORPS OF ENGINEERS

Passaic River Flood Damage Reduction Project

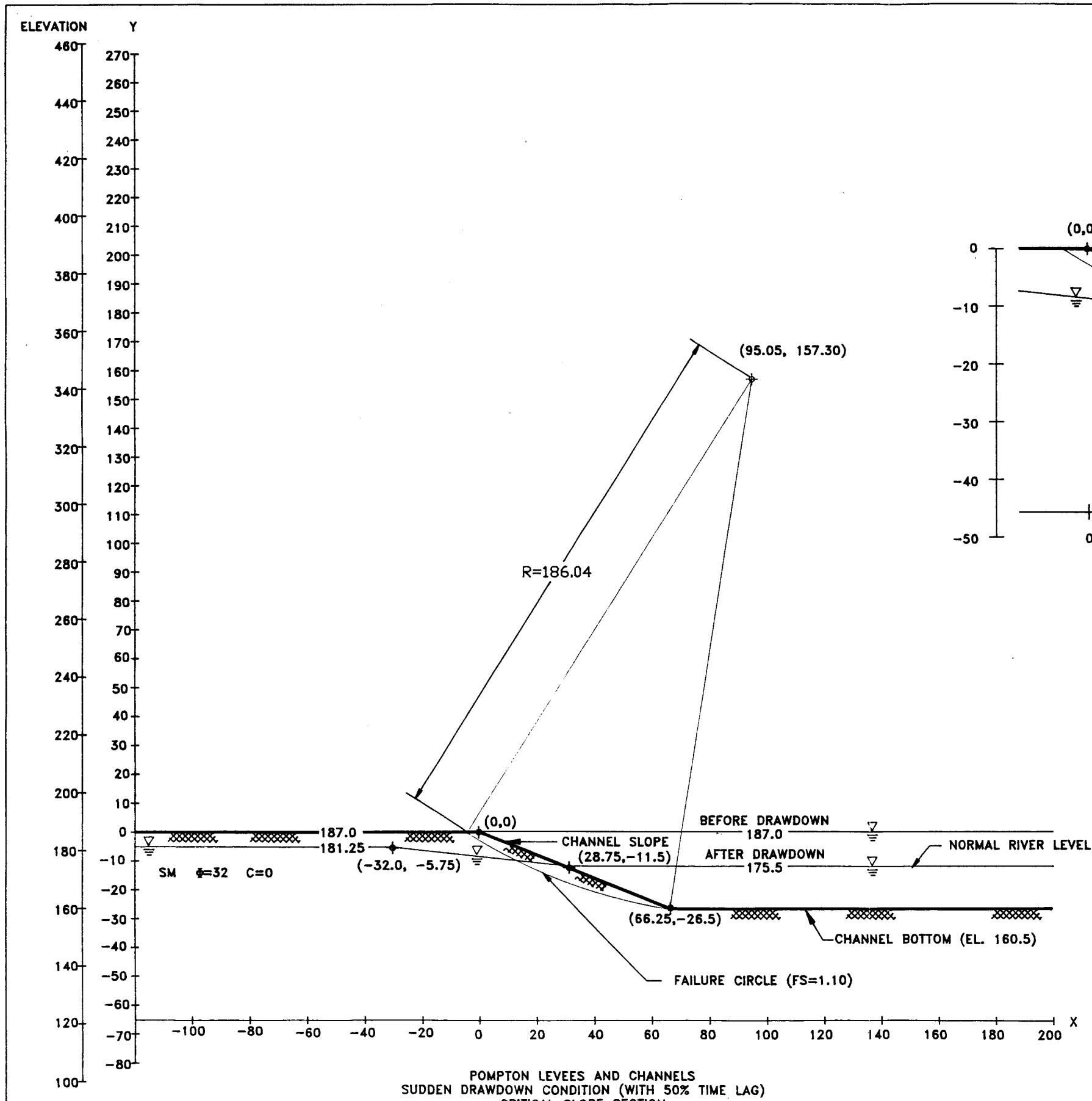
GENERAL DESIGN MEMORANDUM
PEQUANNOCK/RAMAPO
LEVEE/FLOODWALL SYSTEM
CHANNEL STABILTY ANALYSIS
LOW WATER CONDITION

REVISED:

DATE: 8/18/95 | PREPARED BY: PASSAIC RIVER DIV. | PLATE: E.13.5

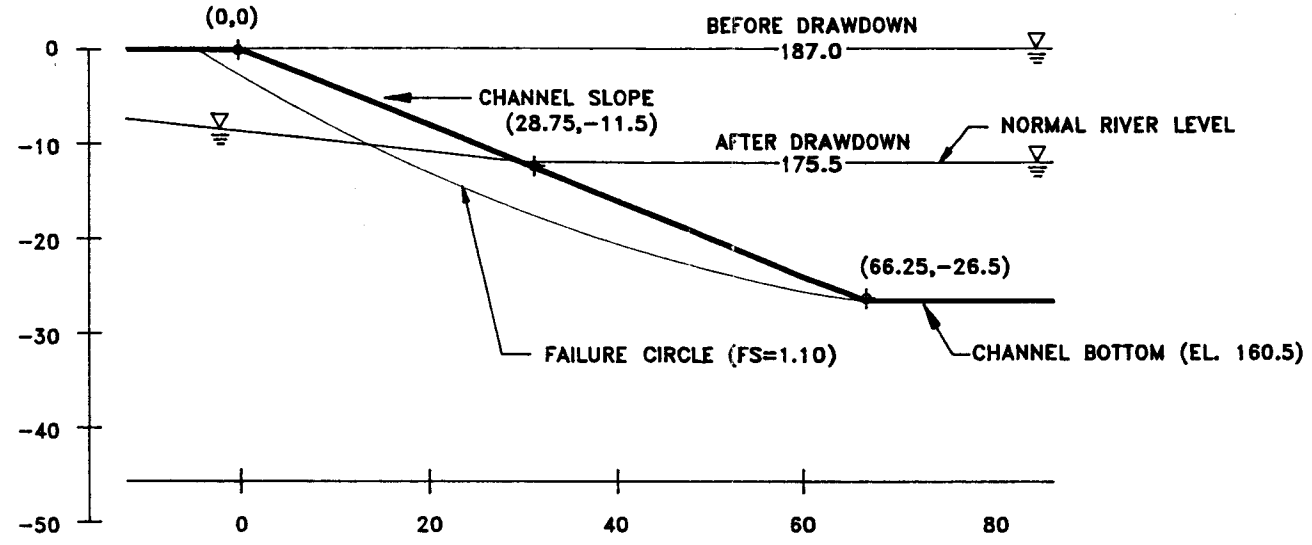
SLOPE8.dwg

PLATE E.13.5



POMPTON LEVEES AND CHANNELS
SUDDEN DRAWDOWN CONDITION (WITH 50% TIME LAG)
CRITICAL SLOPE SECTION

FACTOR OF SAFETY = 1.10



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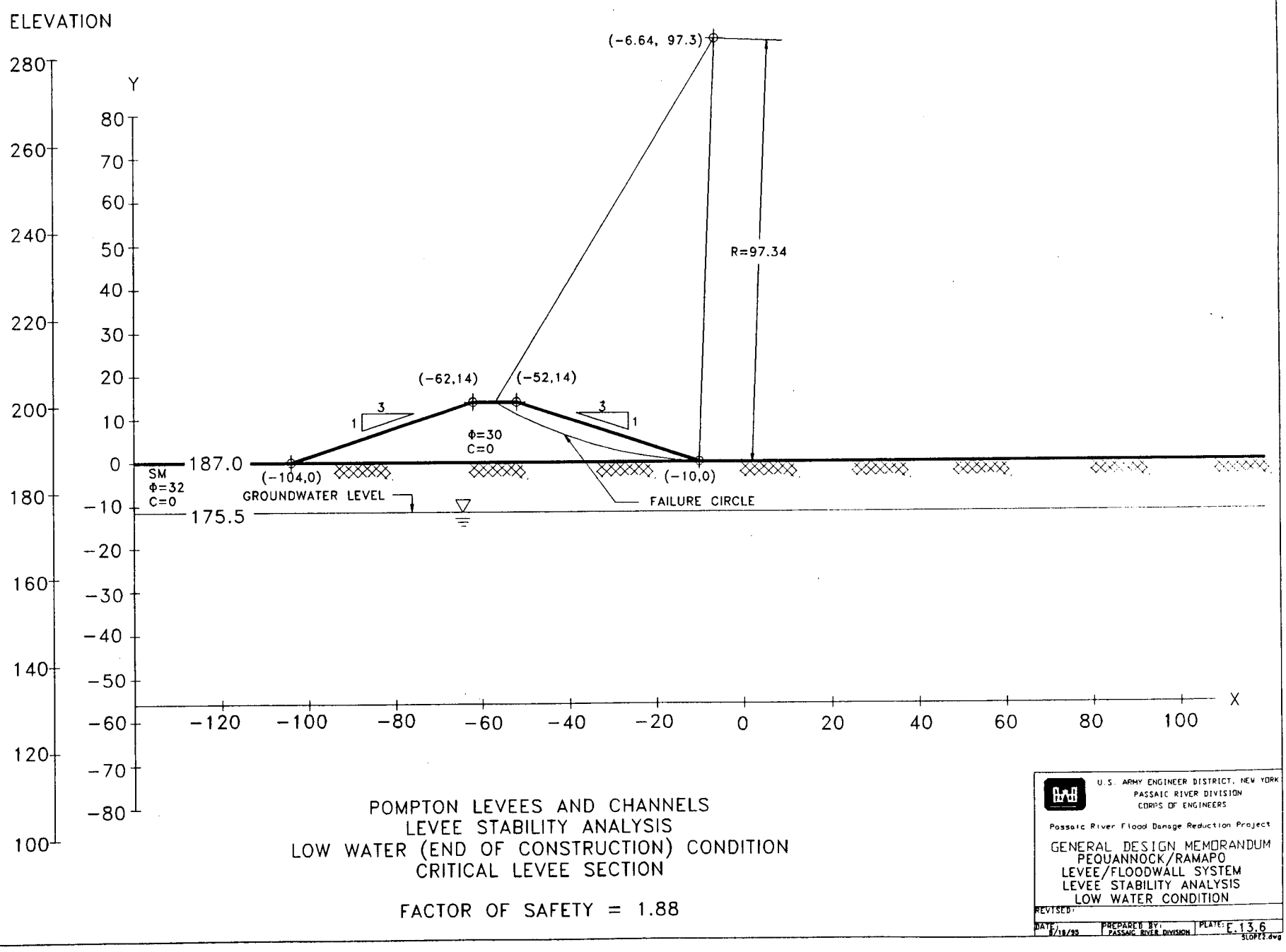
PASSAIC RIVER DIVISION
CORPS OF ENGINEERS

Passaic River Flood Damage Reduction Project

GENERAL DESIGN MEMORANDUM
PEQUANNOCK/RAMAPO
LEVEE/FLOODWALL SYSTEM
CHANNEL STABILTY ANALYSIS
LOW WATER CONDITION

REVISED:

DATE: 8/18/95 | PREPARED BY: PASSAIC RIVER DIV. | PLATE: E.13.5A



POMPTON LEVEES AND CHANNELS
LEVEE STABILITY ANALYSIS
LOW WATER (END OF CONSTRUCTION) CONDITION
CRITICAL LEVEE SECTION

FACTOR OF SAFETY = 1.88

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PASSAIC RIVER DIVISION
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Passaic River Flood Damage Reduction Project

GENERAL DESIGN MEMORANDUM
PEQUANNOCK/RAMAPO
LEVEE/FLOODWALL SYSTEM
LEVEE STABILITY ANALYSIS
LOW WATER CONDITION

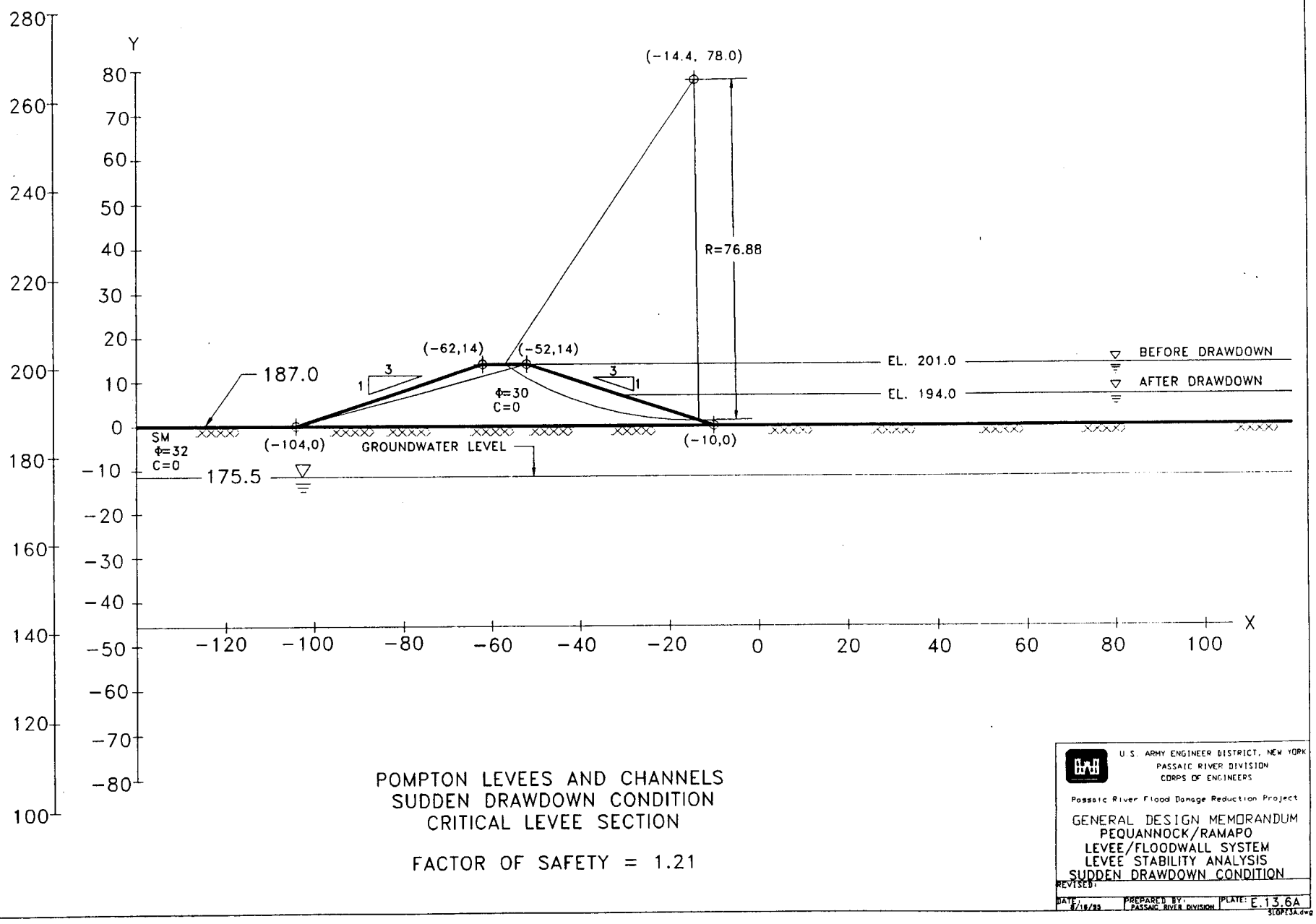
REVISED:

DATE: 8/18/95 | PREPARED BY: PASSAIC RIVER DIVISION | PLATE: E.13.6

SLOPE2.dwg

PLATE E.13.6

ELEVATION



POMPTON LEVEES AND CHANNELS
SUDDEN DRAWDOWN CONDITION
CRITICAL LEVEE SECTION

FACTOR OF SAFETY = 1.21

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PASSAIC RIVER DIVISION
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Passaic River Flood Damage Reduction Project

GENERAL DESIGN MEMORANDUM
PEQUANNOCK/RAMAPO
LEVEE/FLOODWALL SYSTEM
LEVEE STABILITY ANALYSIS
SUDDEN DRAWDOWN CONDITION

REVISED:

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8/18/93	PASSAIC RIVER DIVISION	E.13.6A

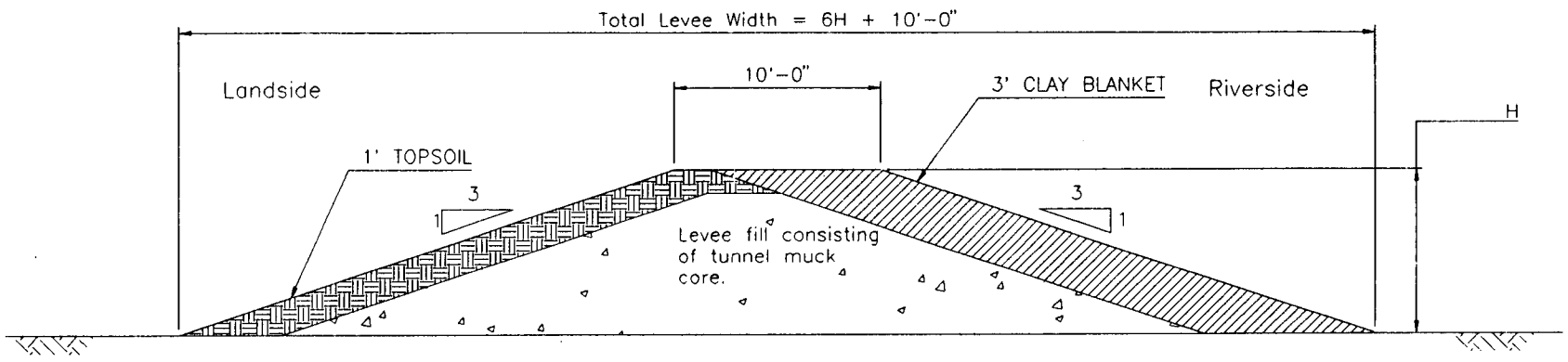
SLOPE3A.dwg

PLATE E.13.6A

PASSAIC RIVER FLOOD DAMAGE
REDUCTION PROJECT

SECTION 13
POMPTON LEVEES/FLOODWALLS AND CHANNELS

FIGURES



PEQUANNOCK/RAMAPO
PROPOSED LEVEE DETAIL

SCALE: N.T.S.

Construction Sequence

1. Strip about 6" depth below the levee to remove all surface vegetation and debris. Also grub to a 3' depth to remove all large vegetation & debris such as tree roots, old foundations, and pipes.

2. Excavate inspection trench with 6' width and 1V/1H side slopes with height trench = height levee but $\leq$ 6'. After trench inspection, replace soil and recompact to at least original in-situ conditions.

3. Haul in levee fill from offsite and compact to 90% standard proctor density. If the stripped material is organic in nature, spread it over the levee surface to promote growth of grass cover (approximate 6" layer).

4. Provide 4" of topsoil (or stripped organic material), seeding and an erosion control mat over the levee surface.

U.S. ARMY ENGINEER DISTRICT, NEW YORK
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Passaic River Flood Damage Reduction Project

TYPICAL LEVEE DETAIL

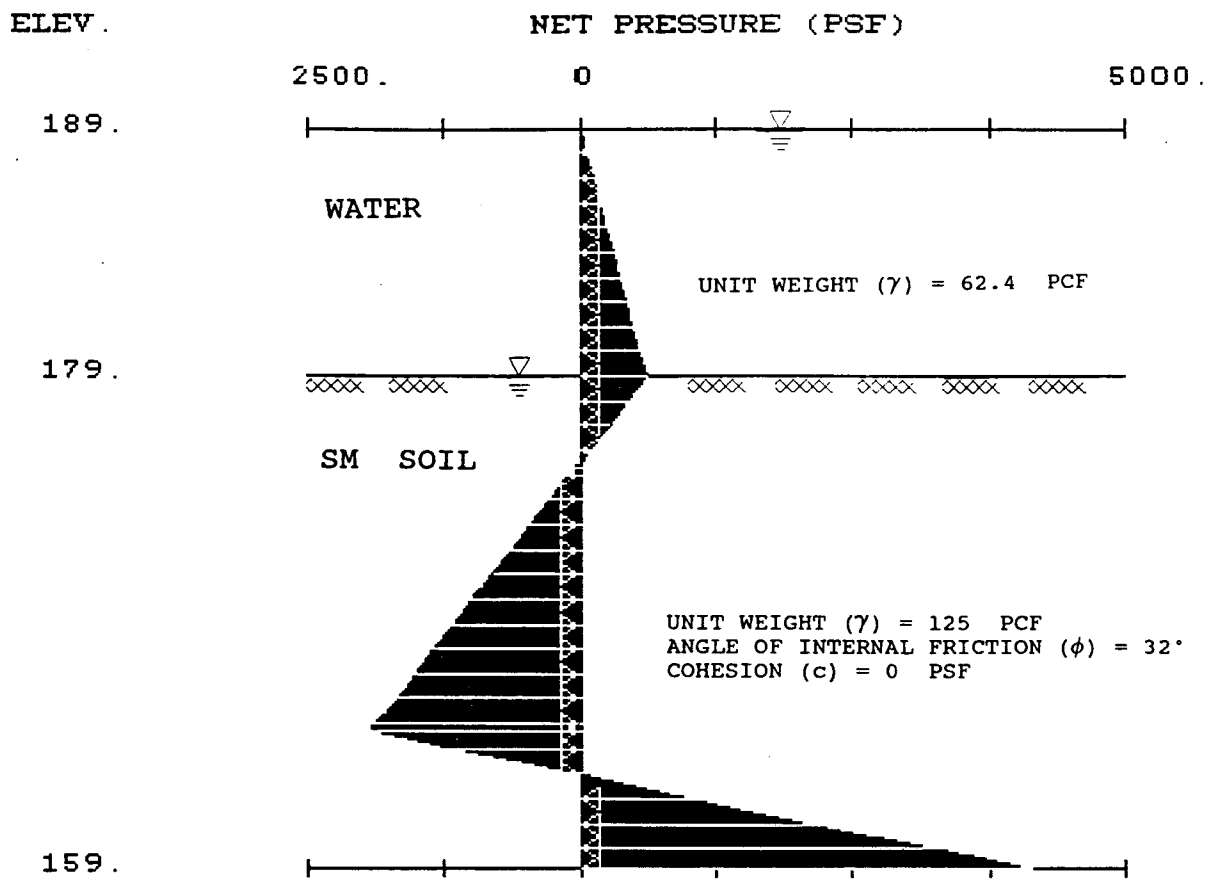
PEQUANNOCK/RAMAPO
LEVEE/FLOODWALL SYSTEM

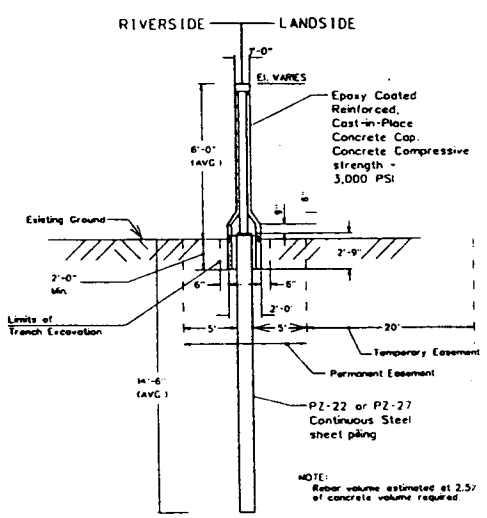
DATE:	PREPARED FOR: PASSAIC RIVER DIV.	FIGURE: E.13.1

FIGURE E.13.1

FLOODWALL PENETRATION ANALYSIS
SHEET PILE I-WALLS

TYPICAL EARTH PRESSURE DIAGRAM





PEQUANNOCK-RAMAPO
PROPOSED FLOODWALL DETAIL
SCALE: N.T.S

NOTE: NET EARTH PRESSURES ARE BASED UPON GENERALIZED SUBSURFACE SOIL CONDITIONS IN THE VICINITY OF FLOODWALL (BORING PL-2) WITH MAXIMUM SHEETPILE LEVEE HEIGHT = 10' (PEQUANNOCK/RAMAPO LEVEE/FLOODWALL SYSTEM STATION 24+00 AND RAMAPO RIVER STATION 7700)

U.S. ARMY ENGINEER DISTRICT, NEW YORK
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Passaic River Flood Damage Reduction Project
GENERAL DESIGN MEMORANDUM
FLOODWALL PENETRATION ANALYSIS
SHEET PILE I-WALLS
TYPICAL EARTH PRESSURE DIAGRAM

REVISED:	
DATE: 7/95	PREPARED BY: CENAN-PR-TG

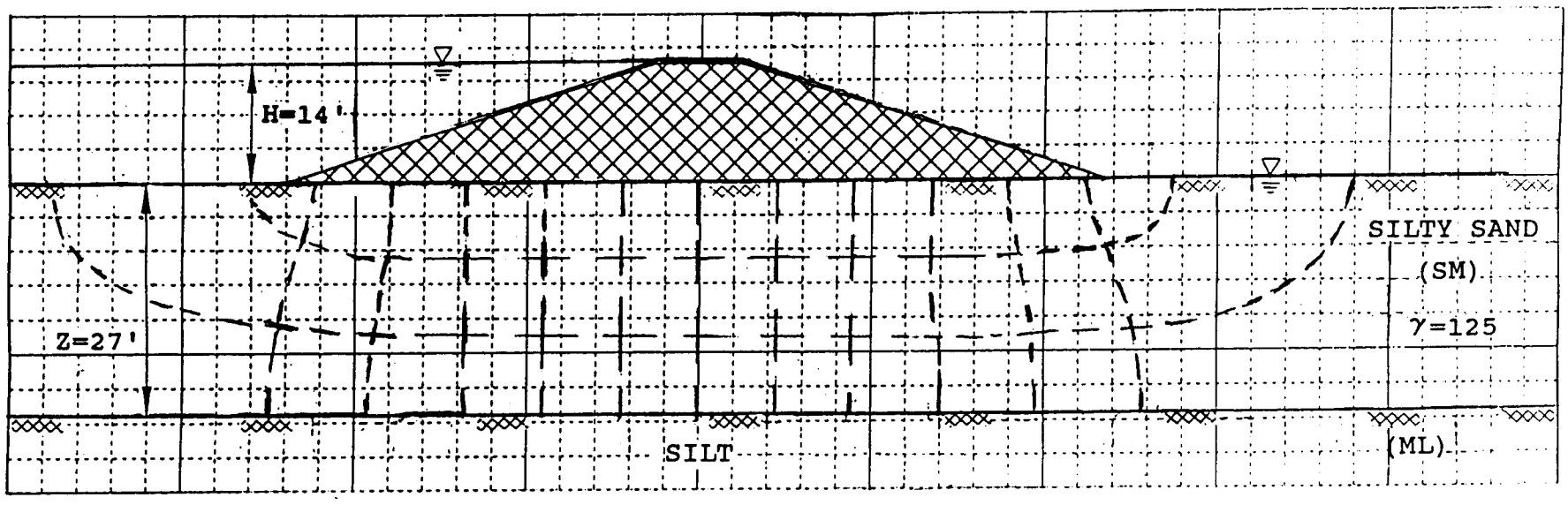
FIGURE E.13.2

PEQUANNOCK/RAMAPO LEVEE/FLOODWALL SYSTEM

LEVEE UNDERSEEPAGE ANALYSIS

STRATIGRAPHY FROM BORING PL-1

SCALE: 1" = 20'



$\Delta h = 14/12 = 1.2'$

$i_{cr} = \gamma'/\gamma_w = 62.5/62.5 = 1.0$

$i = \Delta h/l = 1.2/8.0 = 0.15$

F.S. $= i_{cr}/i = 1.0/0.15 =$ 6.7 ✓ ok

U.S. ARMY ENGINEER DISTRICT, NEW YORK
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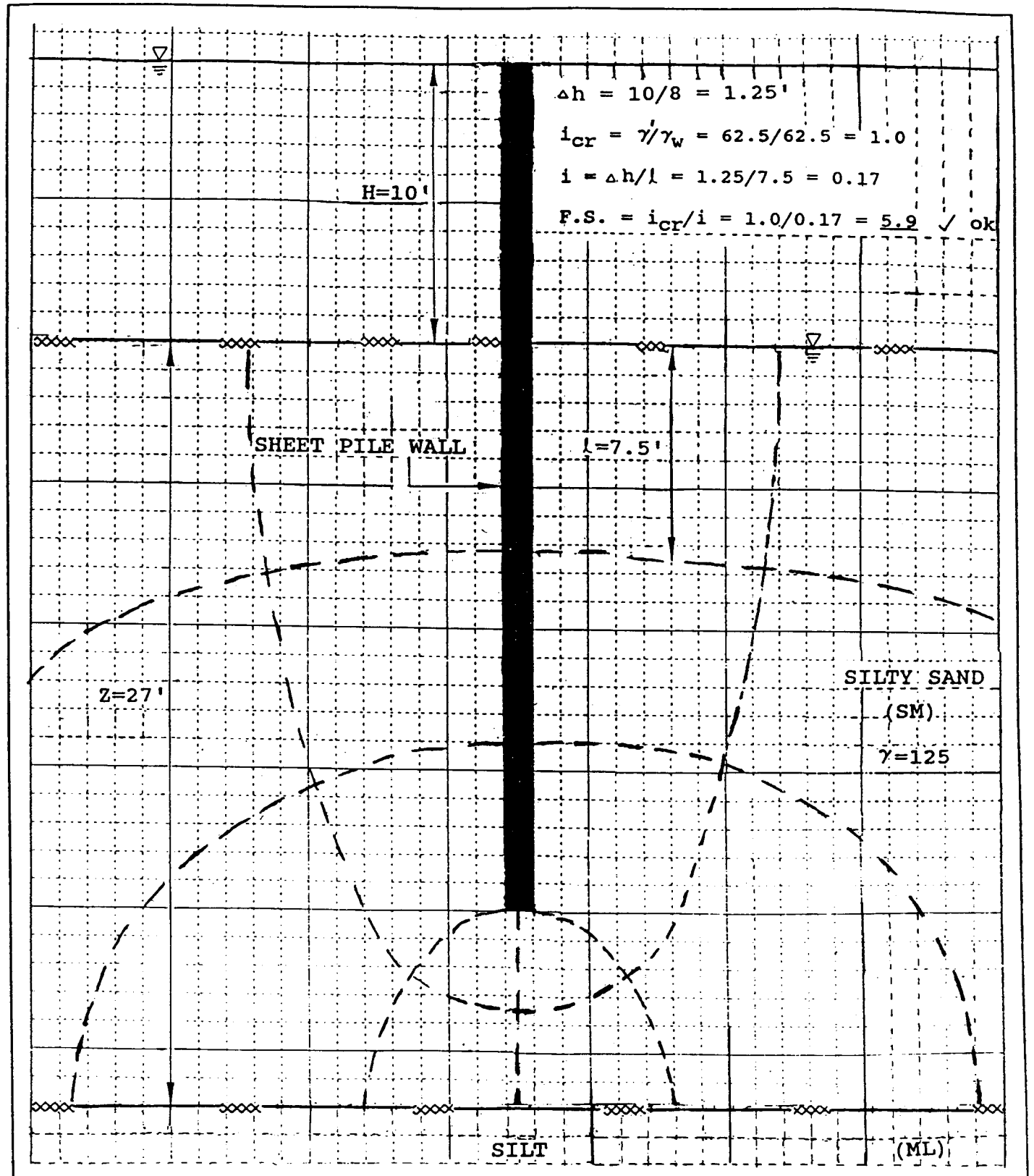
Passaic River Flood Damage Reduction Project
GENERAL DESIGN MEMORANDUM

LEVEE UNDERSEEPAGE ANALYSIS

REVISED:	
DATE: 7/95	PREPARED BY: CENAN-PR-TG

FIGURE E.13.3

FIGURE E.13.3



PEQUANNOCK/RAMAPO LEVEE/FLOODWALL SYSTEM

FLOODWALL UNDERSEEPAGE ANALYSIS

STRATIGRAPHY FROM BORING PL-1

SCALE: 1" = 5'

U.S. ARMY ENGINEER DISTRICT, NEW YORK
PASSAIC RIVER DIVISION
CORPS OF ENGINEERS

Passaic River Flood Damage Reduction Project
GENERAL DESIGN MEMORANDUM

FLOODWALL UNDERSEEPAGE ANALYSIS

REVISED:	
DATE: 7/95	PREPARED BY: CENAN-PR-TG

FIGURE E.13.4

PASSAIC RIVER FLOOD DAMAGE
REDUCTION PROJECT

SECTION 13
POMPTON LEVEES/FLOODWALLS AND CHANNELS

ATTACHMENT E.13.1
DETAILED BORING LOGS

Attachment E.13.1

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Hole No. DC-114

DRILLING LOG	DIVISION NORTH ATLANTIC	INSTALLATION NEW YORK DISTRICT	SHEET 1 OF 3 SHEETS
1. PROJECT PASSAIC RIVER FLOOD PROTECTION, MAIN TUNNEL		10. SIZE AND TYPE OF BIT SPLIT SPOON SAMPLER	
2. LOCATION (Coordinates or Station) 190 POMPTOM PLAINS CROSS RD, WAYNE		11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	
3. DRILLING AGENCY USCE MOBILE		12. MANUFACTURER'S DESIGNATION OF DRILL FAILING 314	
4. HOLE NO. (As shown on drawing title and file number) DC-114		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED 35 / UNDISTURBED
5. NAME OF DRILLER JAMES KNOX		14. TOTAL NUMBER CORE BOXES 17	
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED _____ DEGREES FROM VERTICAL		15. ELEVATION GROUND WATER .	
		16. DATE HOLE	STARTED 8-24-92 / COMPLETED 10-5-92
7. THICKNESS OF OVERBURDEN 51.0		17. ELEVATION TOP OF HOLE	
8. DEPTH DRILLED INTO ROCK 182.5		18. TOTAL CORE RECOVERY FOR BORING 99.4%	
9. TOTAL DEPTH OF HOLE 233.5		19. SIGNATURE OF INSPECTOR ROBERT R ROMA	

ELEVATION a.	DEPTH b.	LEGEND c.	CLASSIFICATION OF MATERIALS (Description) d.	SPT BLOWS e.	SAMPLE/ BOX NO. f.	REMARKS (Drilling Time, water loss, etc.) g.
	1'		CLAYEY SAND, SLIGHTLY PLASTIC FILL (CL)	6	1	1.0' RECOVERY
			LARGE GRAVELLY SAND WITH COBBLES AND WOOD FRAGMENTS (GP) -FILL	8		
				48		
	2'		LARGE GRAVEL AND COBBLES -FILL	31	2	0' RECOVERY
				12		
	3'		LARGE COBBLES -FILL			
				7	3	0.5' RECOVERY
	4'		CLAYEY GRAVEL -FILL (GC)	14		
				20		
	5'			25	4	0.4' RECOVERY
				11		
	6'			16		
				3	5	0.0' RECOVERY
	7'			4		
				3		
	8'			12	6	0.4' RECOVERY
				16		
	9'		COBBLES AND BASALT (GP)	50		
			BROWN CLAYEY GRAVEL OF MEDIUM PLASTICITY (GC)	20	7	0.8' RECOVERY
	10'		MEDIUM GRAY, DARK TO RUSTY BROWN SAND (SW) -FILL	22		
				26		
	11'			5	8	1.0' RECOVERY
			RED/BROWN SILTY GRAVEL WITH CLAY -FILL	7		
	12'			6		
			FINE GRAVEL, GRAY SAND -FILL (SP)	2	9	0.6' RECOVERY
	13'			3		
				4		
	14'			6	10	0.8' RECOVERY

Hole No. DC-114

DRILLING LOG	DIVISION NORTH ATLANTIC	INSTALLATION NEW YORK DISTRICT	SHEET 2 OF 3 SHEETS

ELEVATION a.	DEPTH b.	LEGEND c.	CLASSIFICATION OF MATERIALS (Description) d.	SPT BLOWS	SAMPLE/ BOX NO. f.	REMARKS (Drilling Time, water loss, etc.) g.
	15'		SAME	12	10	
				15		
				16	11	0.8' RECOVERY
	16'			22		
				25		
	17'		COARSE BROWN SANDY GRAVEL (GP)	18	12	0.8' RECOVERY
				20		
	18'			13		
			GRAY/BROWN SILTY SAND (SM)	13	13	0.5' RECOVERY
	19'			10		
				12		
	20'			8	14	0.0' RECOVERY
				12		
	21'			16		
			STIFF GRAY CLAY OF MEDIUM PLASTICITY (CL)	5	15	1.4' RECOVERY
	22'			5		
				4		
	23'			5	16	1.0' RECOVERY
				8		
	24'			7		
				6	17	1.3' RECOVERY
	25'			5		
				5		
	26'			3	18	1.2' RECOVERY
				3		
	27'			4		
				5	19	1.5' RECOVERY
	28'			6		
				7		
	29'			4	20	1.4' RECOVERY
				4		
	30'			5		
				5	21	1.5' RECOVERY
	31'			3		
				4		
	32'			4	22	1.5' RECOVERY
				2		
	33'			3		

Hole No. DC-114

DRILLING LOG	DIVISION NORTH ATLANTIC	INSTALLATION NEW YORK DISTRICT	SHEET 3 OF 3 SHEETS

ELEVATION a.	DEPTH b.	LEGEND c.	CLASSIFICATION OF MATERIALS (Description) d.	SPT BLOWS	SAMPLE/ BOX NO. f.	REMARKS (Drilling Time, water loss, etc.) g.
	34'		SAME	2	24	1.5' RECOVERY
				3		
				2		
	35'			3	25	1.5' RECOVERY
				2		
				3		
	36'			3	26	1.5' RECOVERY
				2		
	37'			3		
				3	27	1.5' RECOVERY
	38'			3		
				4		
	39'			2	28	1.5' RECOVERY
				3		
	40'			4		
				3	29	1.5' RECOVERY
	41'			2		
				3		
	42'			3	30	1.5' RECOVERY
				5		
	43'		REDDISH/GRAY STIFF CLAY (CL)	18		
				10	31	1.5' RECOVERY
	44'			13		
			GRAY STIFF PLASTIC SANDY CLAY (CL)	12		
	45'			3	32	1.5' RECOVERY
				2		
	46'			6		
			COARSE GRAY/BLACK GRAVEL AND COBBLE (GP) -TILL	15	33	0.4' RECOVERY
	47'			17		
				54		
	48'			54	34	0.6' RECOVERY
				44		
	49'			50+		
					35	0.4' RECOVERY
	50'		GRAY/BLACK COARSE GRAVEL (GP)			
				50+		
	51'		TOP OF ROCK = 51.0'			
	52'					

ENG FORM 1836A
(CADD Facsimilie)

PROJECT PASSAIC RIVER FLOOD PROTECTION, -MAIN TUNNEL

HOLE NO. DC-114

DRILLING LOG	DIVISION NORTH ATLANTIC	INSTALLATION NEW YORK DISTRICT	SHEET 1 OF 4 SHEETS

1. PROJECT	PASSAIC RIVER FLOOD PROTECTION, SPUR TUNNEL
2. LOCATION (Coordinates or Station)	150 POMPTON PLAINS CROSS RD, WAYNE
3. DRILLING AGENCY	USCE-C; MOBILE
4. HOLE NO. (As shown on drawing title and file number)	DC-147
5. NAME OF DRILLER	MOON
6. DIRECTION OF HOLE	☒ VERTICAL ☐ INCLINED _____ DEGREES FROM VERTICAL
7. THICKNESS OF OVERBURDEN	61.7
8. DEPTH DRILLED INTO ROCK	170.9
9. TOTAL DEPTH OF HOLE	232.6
10. SIZE AND TYPE OF BIT	1-1/2" SPLITSPOON
11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	
12. MANUFACTURER'S DESIGNATION OF DRILL	FAILING 314
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED 42 / UNDISTURBED 0
14. TOTAL NUMBER CORE BOXES	16
15. ELEVATION GROUND WATER	
16. DATE HOLE	STARTED 5-24-93 / COMPLETED
17. ELEVATION TOP OF HOLE	
18. TOTAL CORE RECOVERY FOR BORING	100%
19. SIGNATURE OF INSPECTOR	LESLIE

ELEVATION a.	DEPTH b.	LEGEND c.	CLASSIFICATION OF MATERIALS (Description) d.	SPT BLOWS e.	SAMPLE/ BOX NO. f.	REMARKS (Drilling Time, water loss, etc.) g.
	1'		RED/BROWN SILTY CLAY WITH ORGANIC MATTER -FILL (CL)	3 14 15	1	0.8' RECOVERY
	2'		SAME -FILL	18 17 13	2	1.5' RECOVERY
	3'		BROWN FINE TO MEDIUM SAND, LITTLE FINE GRAVEL, TRACE SILT (SM)	9 6 7	3	1.5' RECOVERY
	5'		SAME	8 15 23	4	1.5' RECOVERY
	6'		SAME	17 12 14	5	1.5' RECOVERY
	8'		SAME	21 13	6	1.5' RECOVERY
	9'		SAME	4 5 18	7	0.5' RECOVERY
	11'		SAME	4 5 4	8	1.5' RECOVERY
	12'		SAME	3 5 4	9	1.0' RECOVERY
	14'		BROWN SANDY CLAY, TRACE FINE GRAVEL (CL)	6	10	1.2' RECOVERY

ENG FORM 1836
(CADD Facsimilie)

PROJECT PASSAIC RIVER FLOOD PROTECTION, SPUR TUNNEL | HOLE NO. DC-147

Hole No. DC-147

DRILLING LOG	DIVISION NORTH ATLANTIC	INSTALLATION NEW YORK DISTRICT	SHEET 2 OF 4 SHEETS

ELEVATION a.	DEPTH b.	LEGEND c.	CLASSIFICATION OF MATERIALS (Description) d.	SPT BLOWS	SAMPLE/ BOX NO. f.	REMARKS (Drilling Time, water loss, etc.) g.
	15'		SAME	6 6	10	1.2' RECOVERY
	16'		SAME	2 2 4	11	1.5' RECOVERY
	17'		SAME	6 7 7	12	1.5' RECOVERY
	18'		BROWN SILTY CLAY WITH SILT VARVES (CL)	4 7 5	13	1.0' RECOVERY
	19'		SAME	4 5 8	14	1.0' RECOVERY
	20'		SAME	4 6 5	15	0.6' RECOVERY
	21'		SAME	2 4 5	16	1.5' RECOVERY
	22'		SAME	4 4 5	17	1.2' RECOVERY
	23'		SAME	4 4 5	18	1.5' RECOVERY
	24'		SAME	4 4 6	19	1.5' RECOVERY
	25'		SAME	2 4 4	20	1.5' RECOVERY
	26'		SAME	2 3 4	21	1.5' RECOVERY
	27'		SAME	2 4 4	22	1.5' RECOVERY
	28'					
	29'					
	30'					
	31'					
	32'					
	33'					

ENG FORM 1836A
(CADD Facsimilie)

PROJECT PASSAIC RIVER FLOOD PREVENTION, SPUR TUNNEL | HOLE NO. DC-147

Hole No. DC-147

DRILLING LOG	DIVISION NORTH ATLANTIC	INSTALLATION NEW YORK DISTRICT	SHEET 3 OF 4 SHEETS

ELEVATION a.	DEPTH b.	LEGEND c.	CLASSIFICATION OF MATERIALS (Description) d.	SPT BLOWS	SAMPLE/ BOX NO. f.	REMARKS (Drilling Time, water loss, etc.) g.
	34'		SAME	4 6 7	23	1.5' RECOVERY
	35'		SAME	3 2 3	24	1.5' RECOVERY
	36'		SAME	2 2 3	25	1.5' RECOVERY
	37'					
	38'		SAME	3 2 2	26	1.5' RECOVERY
	39'		SAME	7 7 7	27	1.5' RECOVERY
	40'					
	41'		SAME	2 4 5	28	1.5' RECOVERY
	42'		SAME	4 6 6	29	1.5' RECOVERY
	43'					
	44'		SAME	3 5 5	30	1.5' RECOVERY
	45'		SAME	2 2 2	31	1.5' RECOVERY
	46'					
	47'		SAME	3 3 3	32	1.5' RECOVERY
	48'		SAME	3 4 4	33	1.5' RECOVERY
	49'					
	50'		SAME	2 3 3	34	1.5' RECOVERY
	51'		SAME	2 4	35	1.5' RECOVERY
	52'					

ENG FORM 1836A
(CADD Facsimilie)

PROJECT PASSAIC RIVER FLOOD PROTECTION, MAIN TUNNEL | HOLE NO. DC-147

Hole No. DC-147

DRILLING LOG	DIVISION NORTH ATLANTIC	INSTALLATION NEW YORK DISTRICT	SHEET 4 OF 4 SHEETS

ELEVATION a.	DEPTH b.	LEGEND c.	CLASSIFICATION OF MATERIALS (Description) d.	SPT BLOWS	SAMPLE/ BOX NO. f.	REMARKS (Drilling Time, water loss, etc.) g.
			SAME	4	35	
	53'		SAME	3	36	1.5' RECOVERY
				4		
	54'			7		
			SAME	3	37	1.5' RECOVERY
	55'			6		
				7		
	56'		SAME	4	38	1.5' RECOVERY
				5		
	57'			10		
			SAME	5	39	1.4' RECOVERY
	58'			12		
			BROWN COARSE SAND, TRACE CLAY (SM)	50		
			BROWN SANDY CLAY, TRACE FINE TO COARSE GRAVEL (CL)	57	40	1.5' RECOVERY
	59'			24		
				29		
	60'		SAME	10	41	1.5' RECOVERY
				22		
	61'			58		
			TOP OF ROCK = 61.7' RED/BROWN FRACTURED SHALE			
	62'					
			ROCK CORE DRILLING TO 232.6'			
	63'					
	64'					
	65'					
	66'					
	67'					
	68'					
	69'					
	70'					
	71'					

ENG FORM 1836A
(CADD Facsimilie)

PROJECT PASSAIC RIVER FLOOD PROTECTION, SPUR TUNNEL | HOLE NO. DC-147

DRILLING LOG	DIVISION NORTH ATLANTIC	INSTALLATION NEW YORK DISTRICT	SHEET 1 OF 3 SHEETS

1. PROJECT	PASSAIC RIVER FLOOD PROTECTION, MAIN TUNNEL
2. LOCATION (Coordinates or Station)	109 POMPTON PLAINS CROSS RD, WAYNE, NJ
3. DRILLING AGENCY	USCE-C MOBILE
4. HOLE NO. (As shown on drawing title and file number)	DU-114A
5. NAME OF DRILLER	KNOX
6. DIRECTION OF HOLE	☒ VERTICAL ☐ INCLINED _____ DEGREES FROM VERTICAL
7. THICKNESS OF OVERBURDEN	49.2
8. DEPTH DRILLED INTO ROCK	0
9. TOTAL DEPTH OF HOLE	49.2
10. SIZE AND TYPE OF BIT	SPLIT SPOON
11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	
12. MANUFACTURER'S DESIGNATION OF DRILL	FAILING 314
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED 29 / UNDISTURBED 8
14. TOTAL NUMBER CORE BOXES	0
15. ELEVATION GROUND WATER	
16. DATE HOLE	STARTED 9-30-91 / COMPLETED 10-5-92
17. ELEVATION TOP OF HOLE	
18. TOTAL CORE RECOVERY FOR BORING	67%
19. SIGNATURE OF INSPECTOR	LESLIE

ELEVATION a.	DEPTH b.	LEGEND c.	CLASSIFICATION OF MATERIALS (Description) d.	SPT BLOWS e.	SAMPLE/ BOX NO. f.	REMARKS (Drilling Time, water loss, etc.) g.
	0		BROWN CLAY -FILL (CL)	2	1	1.0' RECOVERY
				6	2	
	1'		SANDY CLAY OF LOW PLASTICITY WITH COBBLES (CL) -FILL	10		
				10		0.7' RECOVERY
	2'			20	3	
	3		BOULDER (GP) -FILL	50		
				6		
				9		
	4'		SAME, WITH COBBLES (CL) -FILL	14	4	0.5' RECOVERY
				10		0.5' RECOVERY
	5'			11		
				8	5	
	6'			3		1.0' RECOVERY
				5		
	7'			7	6	
				9	7	1.0' RECOVERY
	8'		DARK BROWN, SANDY CLAY OF LOW PLASTICITY (CL) -FILL	7	8	
				10		
	9'		COBBLES (GP) -FILL	20	9	0.6' RECOVERY
				10		
	10'		DARK BROWN SANDY CLAY WITH COBBLES AND WOOD FRAGMENTS (CL) -FILL	9		
				10	10	1.2' RECOVERY
	11'			13	11	
			COARSE, MEDIUM DENSE SAND WITH GRAY CLAYEY GRAVEL (SW-SP)	13		
	12'			5		1.5' RECOVERY
				6	12	
	13'			4		1.5' RECOVERY
			BROWN/GRAY SAND WITH GRAVEL AND COBBLES	4		
	14'					

Hole No. DU-114A

DRILLING LOG	DIVISION NORTH ATLANTIC	INSTALLATION NEW YORK DISTRICT	SHEET 2 OF 3 SHEETS

ELEVATION a.	DEPTH b.	LEGEND c.	CLASSIFICATION OF MATERIALS (Description) d.	SPT BLOWS	SAMPLE/ BOX NO. f.	REMARKS (Drilling Time, water loss, etc.) g.
	15'		SAME	8	13	
				7		
				8	14	1.5' RECOVERY
	16'		BROWN SAND WITH GRAVEL AND COBBLES (SW)	11		
				10		
				6		0.3' RECOVERY
	17'		LIGHT BROWN FINE GRAVEL SAND OF VERY LOW PLASTICITY (SW)	7		
				5	15	
	18'			4	16	1.5' RECOVERY
			FAT CLAY OF HIGH PLASTICITY (CL)	5	17	
	19'			5		
	20'		SILTY FAT CLAY OF HIGH PLASTICITY (CH)			
	21'					2.0' RECOVERY
			MEDIUM GRAY, FAT CLAY OF HIGH PLASTICITY (CH)		18	
	22'					
	23'				19	
	24'				20	
	25'					
	26'		SOFT CLAY (CH)		21	
	27'					2.5' RECOVERY
	28'				22	
	29'					
	30'				23	2.5' RECOVERY
	31'				24	
	32'					
	33'		STIFF CLAY (CL)		25	

ENG FORM 1836A
(CADD Facsimilie)

PROJECT PASSAIC RIVER FLOOD PREVENTION, MAIN TUNNEL | HOLE NO. DU-114A

Hole No. DU-114A

DRILLING LOG	DIVISION NORTH ATLANTIC	INSTALLATION NEW YORK DISTRICT	SHEET 3 OF 3 SHEETS

ELEVATION a.	DEPTH b.	LEGEND c.	CLASSIFICATION OF MATERIALS (Description) d.	SPT BLOWS	SAMPLE/ BOX NO. f.	REMARKS (Drilling Time, water loss, etc.) g.
	34'		STIFF CLAY (CL)		26	
	35'					
					27	
	36'		MEDIUM STIFF CLAY (CL)			
	37'				28	
	38'					
			STIFF CLAY (CL)		29	
	39'					
	40'				30	
	41'					
			VERY STIFF CLAY (CL)		31	
	42'					
	43'				32	
	44'					
			STIFF CLAY (CL)		33	
	45'					
	46'				34	
	47'					
	48'				35	
					36	
			CLAY AND GRAVEL (CL)		37	
	49'		TOP OF ROCK			
			BOTTOM OF HOLE = 49.2'			
	50'					
	51'					
	52'					

ENG FORM 1836A

(CADD Facsimilie)

PROJECT PASSAIC RIVER FLOOD PROTECTION, - MAIN TUNNEL

HOLE NO. DU-114A

Hole No. OW-PI

DRILLING LOG	DIVISION NORTH ATLANTIC	INSTALLATION NEW YORK DISTRICT	SHEET 1 OF 3 SHEETS

1. PROJECT PASSAIC RIVER FLOOD PROTECTION, MAIN TUNNEL		10. SIZE AND TYPE OF BIT	
2. LOCATION (Coordinates or Station) POMPTON PLAIN CROSS RD, WAYNE, NJ		11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	
3. DRILLING AGENCY IT CORP		12. MANUFACTURER'S DESIGNATION OF DRILL B-57	
4. HOLE NO. (As shown on drawing title and file number)	OW-PI (IT-PI-OB01)	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED / UNDISTURBED
5. NAME OF DRILLER MARTIN A. PEPPER		14. TOTAL NUMBER CORE BOXES	
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED _____ DEGREES FROM VERTICAL		15. ELEVATION GROUND WATER	
7. THICKNESS OF OVERBURDEN		16. DATE HOLE	STARTED 7/16/94 / COMPLETED 7/17/94
8. DEPTH DRILLED INTO ROCK		17. ELEVATION TOP OF HOLE	
9. TOTAL DEPTH OF HOLE 45'		18. TOTAL CORE RECOVERY FOR BORING	
		19. SIGNATURE OF INSPECTOR	

ELEVATION a.	DEPTH b.	LEGEND c.	CLASSIFICATION OF MATERIALS (Description) d.	SPT BLOWS e.	SAMPLE/ BOX NO. f.	REMARKS (Drilling Time, water loss, etc.) g.
	1'–7'		BROWN, DRY, CLAYEY GRAVEL WITH SAND WITH 20% COBBLES, SAND ANGULAR TO SUBROUNDED, GRAVEL AND COBBLES- 1/3 ROUNDED (GC)			
	7'–9'		BLACK, MOIST, LEAVES AND TWIGS (PT)			
	9'–12'		BLACK, MOIST, LEAVES AND TWIGS WITH WELL ROUNDED COBBLES AND SUBROUNDED SAND (PT/GW)			
	12'–14'		LIGHT BROWN, WET, GRAVEL AND SAND GRAVEL ROUND TO SUBROUNDED. (GW)	33 27 24 21	S-1	

ENG FORM 1836
(CADD Facsimilie)

PROJECT PASSAIC RIVER FLOOD PROTECTION, MAIN TUNNEL | HOLE NO. OW-PI

Hole No. OW-PI

DRILLING LOG	DIVISION NORTH ATLANTIC	INSTALLATION NEW YORK DISTRICT	SHEET 2 OF 3 SHEETS

ELEVATION a.	DEPTH b.	LEGEND c.	CLASSIFICATION OF MATERIALS (Description) d.	SPT BLOWS	SAMPLE/ BOX NO. f.	REMARKS (Drilling Time, water loss, etc.) g.
	15'		(GW)	7		
				21	S-2	
				13		
	16'			27		
	17'					
	18'					
	19'					
	20'					
	21'					
	22'					
	23'					
	24'					
	25'		MOIST, GRAY, SANDY FAT CLAY, VARVE- 1" THICK (CH)	5		
				4	S-3	
	26'			6		
				8		
	27'					
	28'					
	29'					
	30'					
	31'					
	32'					
	33'					

ENG FORM 1836A
(CADD Facsimilie)

PROJECT PASSAIC RIVER FLOOD PREVENTION, MAIN TUNNEL

HOLE NO. OW-PI

Hole No. OW-PI

DRILLING LOG	DIVISION NORTH ATLANTIC	INSTALLATION NEW YORK DISTRICT	SHEET 3 OF 3 SHEETS

ELEVATION a.	DEPTH b.	LEGEND c.	CLASSIFICATION OF MATERIALS (Description) d.	SPT BLOWS	SAMPLE/ BOX NO. f.	REMARKS (Drilling Time, water loss, etc.) g.
	34					
	35		WET, GRAY SAND, FAT CLAY 1" VARVES (CH)	4		
	36			3	S-4	
				5		
	37			6		
	38					
	39					
	40					
	41					
	42					
	43		DENSE, RED, MOIST COURSE ANGULAR SAND AND FINE ANGULAR GRAVEL (SP)			
			END OF BORING = 44.5'			
	44					
	45					
	46					
	47					
	48					
	49					
	50					
	51					
	52					

ENG FORM 1836A
(CADD Facsimilie)

PROJECT PASSAIC RIVER FLOOD PROTECTION, - MAIN TUNNEL

HOLE NO. OW-PI

Hole No. PL-1

DRILLING LOG	DIVISION NORTH ATLANTIC	INSTALLATION NEW YORK DISTRICT	SHEET 1 OF 2 SHEETS
1. PROJECT PASSAIC RIVER FLOOD PROTECTION, MAIN TUNNEL		10. SIZE AND TYPE OF BIT	
2. LOCATION (Coordinates or Station)		11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	
3. DRILLING AGENCY		12. MANUFACTURER'S DESIGNATION OF DRILL	
4. HOLE NO. (As shown on drawing title and file number)	PL-1	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED / UNDISTURBED
5. NAME OF DRILLER		14. TOTAL NUMBER CORE BOXES	
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED _____ DEGREES FROM VERTICAL		15. ELEVATION GROUND WATER	
		16. DATE HOLE STARTED 3/31/86 COMPLETED	
7. THICKNESS OF OVERBURDEN		17. ELEVATION TOP OF HOLE 186'	
8. DEPTH DRILLED INTO ROCK		18. TOTAL CORE RECOVERY FOR BORING	
9. TOTAL DEPTH OF HOLE 28.5'		19. SIGNATURE OF INSPECTOR	

ELEVATION a.	DEPTH b.	LEGEND c.	CLASSIFICATION OF MATERIALS (Description) d.	SPT BLOWS e.	SAMPLE/ BOX NO. f.	REMARKS (Drilling Time, water loss, etc.) g.
	1'		BLACK TOP AND GRAVEL FILL	25		
				25	S-1	
				18		
	2'		NO RECOVERY	17		
				11	S-2	
				8		
	3'		MEDIUM BROWN, MEDIUM TO VERY COURSE SAND, TRACE SILT, TRACE FINE SUB ANG. GRAVEL (SW)	10		
				7	S-3	
	4'			8		
			BLACK FINE TO MEDIUM SAND LITTLE SILT, LITTLE COURSE ROUND GRAVEL (SW)	8		
	5'			4	S-4	
				6		
	6'		NO RECOVERY	8		
				6	S-5	
	7'			8		
			SAND, SOME FINE GRAVEL, TRACE SILT (SW-SM)	8		
	8'			6	S-6	
				4		
	9'			4		
				4	S-7	
	10'			6		
				5		
	11'			12	S-8	
				14		
	12'		DARK BROWN, MEDUIM TO VERY COURSE SAND, LITTLE SILT, TRACE FINE GRAVEL (SW)	7		
				7	S-9	
	13'			7		
			DARK BROWN SILT AND VERY FINE SAND (SM)	12	S-10	
	14'					

ENG FORM 1836
(CADD Facsimilie)

PROJECT PASSAIC RIVER FLOOD PROTECTION, MAIN TUNNEL | HOLE NO. PL-1

Hole No. PL-1

DRILLING LOG	DIVISION NORTH ATLANTIC	INSTALLATION NEW YORK DISTRICT	SHEET 2 OF 2 SHEETS

ELEVATION a.	DEPTH b.	LEGEND c.	CLASSIFICATION OF MATERIALS (Description) d.	SPT BLOWS	SAMPLE/ BOX NO. f.	REMARKS (Drilling Time, water loss, etc.) g.
	15'		SAME	9 9	S-10	
	16'		MEDIUM RED /BROWN FINE SAND (SP)	31 33 12	S-11	
	17'			8 7 8	S-12	
	18'		MEDIUM RED/BROWN VERY FINE SAND AND SILT (SM)	6 7 6	S-13	
	19'		MEDIUM RED/BROWN SILT (ML)			
	20'		DARK RED/BROWN VERY FINE SAND TRACE SILT (SP-SM)	4 4 5	S-14	
	21'			7 3 3	S-15	
	22'					
	23'		DARK RED/BROWN FINE TO VERY FINE SAND, LITTLE SILT (SM)	3 4 3	S-16	
	24'			5 6 10	S-17	
	25'					
	26'			12 16 16	S-18	
	27'		DARK RED/BROWN SILT, AND VERY FINE SAND (ML-SM)	14 16 16	S-19	
	28'		BOTTOM OF HOLE = 28.5'			
	29'					
	30'					
	31'					
	32'					
	33'					

ENG FORM 1836A
(CADD Facsimilie)

PROJECT PASSAIC RIVER FLOOD PREVENTION, MAIN TUNNEL | HOLE NO. PL-1

Hole No. PL-2

DRILLING LOG	DIVISION NORTH ATLANTIC	INSTALLATION NEW YORK DISTRICT	SHEET 1 OF 2 SHEETS

1. PROJECT PASSAIC RIVER FLOOD PROTECTION, MAIN TUNNEL		10. SIZE AND TYPE OF BIT	
2. LOCATION (Coordinates or Station) RIVERVIEW RD PARK, POMPTON LAKES, NJ		11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	
3. DRILLING AGENCY USCE- MOBIL		12. MANUFACTURER'S DESIGNATION OF DRILL	
4. HOLE NO. (As shown on drawing title and file number)	PL-2	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED / UNDISTURBED
5. NAME OF DRILLER		14. TOTAL NUMBER CORE BOXES	
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED _____ DEGREES FROM VERTICAL		15. ELEVATION GROUND WATER	
		16. DATE HOLE STARTED 3/28/86 / COMPLETED	
7. THICKNESS OF OVERBURDEN		17. ELEVATION TOP OF HOLE 181'	
8. DEPTH DRILLED INTO ROCK		18. TOTAL CORE RECOVERY FOR BORING	
9. TOTAL DEPTH OF HOLE 23.0'		19. SIGNATURE OF INSPECTOR	

ELEVATION a.	DEPTH b.	LEGEND c.	CLASSIFICATION OF MATERIALS (Description) d.	SPT BLOWS e.	SAMPLE/ BOX NO. f.	REMARKS (Drilling Time, water loss, etc.) g.
	1'		DARK ORANGE/BROWN FINE TO MEDIUM SAND, TRACE SILT TRACE FINE ROUND GRAVEL (SW)	3 6 12	S-1	
	2'		DARK ORANGE/BROWN VERY FINE SAND, SOME SILT (SM)	19 10 9	S-2	
	3'		NO RECOVERY	6 4 4	S-3	
	4'					
	5'		DARK GRAY/BROWN VERY FINE SAND, SOME SILT (SM)	6	S-4	
	6'		DARK GRAY/BROWN COARSE TO VERY COARSE SAND LITTLE GRAVEL, TRACE SILT (SW-SM)	11 11 10		
	7'		MEDIUM ORANGE/BROWN COARSE TO VERY COARSE SAND, SOME FINE TO COARSE SUB-ANGULAR TO SUB-ROUNDED GRAVEL (GW)	17 21	S-5	
	8'			22 28	S-6	
	9'			20 16		
	10'		DARK RED/BROWN MEDIUM SAND, LITTLE SILT (SM)	8 11	S-7	
	11'		DARK BROWN FINE TO VERY COARSE SAND, LITTLE SILT (SW)	1 1	S-8	
	12'			1 4		
	13'			6 9	S-9	
	14'		NO RECOVERY	4	S-10	

Hole No. PL-2

DRILLING LOG	DIVISION NORTH ATLANTIC	INSTALLATION NEW YORK DISTRICT	SHEET 2 OF 2 SHEETS

ELEVATION a.	DEPTH b.	LEGEND c.	CLASSIFICATION OF MATERIALS (Description) d.	SPT BLOWS	SAMPLE/ BOX NO. f.	REMARKS (Drilling Time, water loss, etc.) g.
	15'		NO RECOVERY	10	S-10	
				11		
			DARK BROWN FINE TO VERY COARSE SAND, LITTLE SILT (SW)	9		
	16'			9	S-11	
				10		
	17'			11		
				11	S-12	
				14		
	18'			7		
			DARK RED/BROWN VERY FINE SAND AND SILT (SM)	10	S-13	
	19'			10		
			NO RECOVERY	10		
	20'			12	S-14	
				18		
	21'		DARK RED/BROWN VERY FINE SAND AND SILT (SM)	15		
				17	S-15	
	22'			18		
				16		
	23'		BOTTOM OF HOLE = 23'			
	24'					
	25'					
	26'					
	27'					
	28'					
	29'					
	30'					
	31'					
	32'					
	33'					

ENG FORM 1836A
(CADD Facsimilie)

PROJECT PASSAIC RIVER FLOOD PREVENTION, -MAIN TUNNEL | HOLE NO. PL-2

Hole No. PL-4

DRILLING LOG	DIVISION NORTH ATLANTIC	INSTALLATION NEW YORK DISTRICT	SHEET 1 OF 2 SHEETS

1. PROJECT PASSAIC RIVER FLOOD PROTECTION, MAIN TUNNEL		10. SIZE AND TYPE OF BIT	
2. LOCATION (Coordinates or Station) WILLOW AVE., POMPTON LAKES, NJ		11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	
3. DRILLING AGENCY USCE- MOBIL		12. MANUFACTURER'S DESIGNATION OF DRILL	
4. HOLE NO. (As shown on drawing title and file number)	PL-4	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED / UNDISTURBED
5. NAME OF DRILLER		14. TOTAL NUMBER CORE BOXES	
6. DIRECTION OF HOLE [X] VERTICAL [ ] INCLINED _____ DEGREES FROM VERTICAL		15. ELEVATION GROUND WATER	
		16. DATE HOLE STARTED 3/27/86 / COMPLETED	
7. THICKNESS OF OVERBURDEN		17. ELEVATION TOP OF HOLE 184'	
8. DEPTH DRILLED INTO ROCK		18. TOTAL CORE RECOVERY FOR BORING	
9. TOTAL DEPTH OF HOLE 25.5'		19. SIGNATURE OF INSPECTOR	

ELEVATION a.	DEPTH b.	LEGEND c.	CLASSIFICATION OF MATERIALS (Description) d.	SPT BLOWS e.	SAMPLE/ BOX NO. f.	REMARKS (Drilling Time, water loss, etc.) g.
	1'		DARK GRAY MEDIUM TO VERY COARSE SAND, ANGULAR GRAVEL -FILL	12 10 12	S-1	
	2'			10 6 6	S-2	
	3'		DARK ORANGE/BROWN VERY FINE SAND, LITTLE SILT (SM)	3 2 2	S-3	
	4'			2 3 5	S-4	
	5'					
	6'		DARK ORANGE/BRN MED SAND LITTLE SILT (SP)	4 8 8	S-5	
	7'		MEDIUM ORANGE, MEDIUM TO VERY COURSE SAND, LITTLE SILT, LITTLE FINE GRAVEL (SW)	11 16 28	S-6	
	8'		MEDIUM BROWN, MEDIUM TO VERY COARSE SAND, LITTLE SILT, LITTLE FINE GRAVEL. (SW)	20 17 16	S-7	
	9'			17 18 25	S-8	
	10'		MEDIUM BROWN, MEDIUM TO VERY COURSE SAND, SOME FINE TO COURSE GRAVEL, TRACE SILT (SW)	22 18 12	S-9	
	11'		MEDIUM ORANGE/BROWN TO MEDIUM GRAY SILT (MH)	9	S-10	
	12'					
	13'		MEDIUM GRAY VARVED CLAY AND SILT (ML-CL)			
	14'					

ENG FORM 1836
(CADD Facsimilie)

PROJECT PASSAIC RIVER FLOOD PROTECTION, MAIN TUNNEL | HOLE NO. PL-4

Hole No. PL-4

DRILLING LOG	DIVISION NORTH ATLANTIC	INSTALLATION NEW YORK DISTRICT	SHEET 2 OF 2 SHEETS

ELEVATION a.	DEPTH b.	LEGEND c.	CLASSIFICATION OF MATERIALS (Description) d.	SPT BLOWS	SAMPLE/ BOX NO. f.	REMARKS (Drilling Time, water loss, etc.) g.
	15		SAME	14	S-10	
				11		
				15	S-11	
	16			10		
				11		
				8	S-12	
	17			12		
				11		
	18			10	S-13	
				15		
	19			12		
				8	S-14	
	20			8		
				6		
	21			7	S-15	
				6		
	22			8		
			SILT POORLY SORTED WITH VERY COARSE GRAINS (ML)	12	S-16	
	23			12		
				9		
	24			6	S-17	
				5		
	25			7		
			BOTTOM OF HOLE = 25.5'			
	26					
	27					
	28					
	29					
	30					
	31					
	32					
	33					

ENG FORM 1836A
(CADD Facsimilie)

PROJECT PASSAIC RIVER FLOOD PREVENTION, - MAIN TUNNEL

HOLE NO PL-4

Hole No. PL-5

DRILLING LOG	DIVISION NORTH ATLANTIC	INSTALLATION NEW YORK DISTRICT	SHEET 1 OF SHEETS

1. PROJECT PASSAIC RIVER FLOOD PROTECTION, MAIN TUNNEL	10. SIZE AND TYPE OF BIT
2. LOCATION *(Coordinates or Station)* HERSHFIELD PARK BEACH, POMPTON LAKES, NJ	11. DATUM FOR ELEVATION SHOWN *(TBM or MSL)*
3. DRILLING AGENCY	12. MANUFACTURER'S DESIGNATION OF DRILL
4. HOLE NO. *(As shown on drawing title and file number)* PL-5	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN — DISTURBED: — UNDISTURBED:
5. NAME OF DRILLER	14. TOTAL NUMBER CORE BOXES
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED _____ DEGREES FROM VERTICAL	15. ELEVATION GROUND WATER
7. THICKNESS OF OVERBURDEN	16. DATE HOLE STARTED 3/28/86 COMPLETED
8. DEPTH DRILLED INTO ROCK	17. ELEVATION TOP OF HOLE 186'
9. TOTAL DEPTH OF HOLE 20.0'	18. TOTAL CORE RECOVERY FOR BORING
	19. SIGNATURE OF INSPECTOR

ELEVATION a.	DEPTH b.	LEGEND c.	CLASSIFICATION OF MATERIALS *(Description)* d.	SPT BLOWS e.	SAMPLE/ BOX NO. f.	REMARKS *(Drilling Time, water loss, etc.)* g.
	1'		DARK BROWN VERY FINE TO FINE SAND, LITTLE SILT (SM)	7	S-1	
				12		
				12		
				11		
	2'		DARK GRAY VERY FINE SAND SOME SILT (SM)	4	S-2	
	3'			2		
				2		
				4		
	4'		DARK GRAY MEDIUM TO COARSE SAND, LITTLE SILT, ROOTS (SM)	4	S-3	
	5'			1		
				4		
				10		
	6'		MEDIUM ORANGE/BROWN COARSE TO VERY COARSE SAND, LITTLE SUB-ANGULAR TO FINE GRAVEL (GW)	14	S-4	
	7'			14		
				8		
	8'			10		
				18	S-5	
	9'		NO RECOVERY	45		
				35		
				38		
	10'		MEDIUM ORANGE/BROWN ANGULAR TO SUB-ROUNDED FINE GRAVEL, SOME COARSE TO VERY COARSE SAND, TRACE SILT (GP)	20	S-6	
	11'			17		
				18		
				14		
	12'		MEDIUM BROWN, MEDIUM TO VERY COARSE SAND, SOME COARSE ANGULAR TO SUB-ROUNDED GRAVEL (GP)	16	S-7	
	13'			20		
				23		
	14'			23		

ENG FORM 1836
(CADD Facsimilie)

PROJECT PASSAIC RIVER FLOOD PROTECTION, MAIN TUNNEL | HOLE NO. PL-5

Hole No. PL-5

DRILLING LOG	DIVISION NORTH ATLANTIC	INSTALLATION NEW YORK DISTRICT	SHEET 2 OF 2 SHEETS

ELEVATION a.	DEPTH b.	LEGEND c.	CLASSIFICATION OF MATERIALS (Description) d.	SPT BLOWS	SAMPLE/ BOX NO. f.	REMARKS (Drilling Time, water loss, etc.) g.
	15'		NO RECOVERY, SILT FELL OUT OF SPOON	14 8 14 13	S-8	
	16'		NO RECOVERY, PEBBLE BLOCK	12 15 15 10	S-9	
	18'		DARK BROWN VERY FINE TO FINE SAND, LITTLE SILT (SM)	6 4	S-10	
	19'		DARK BROWN VERY FINE SAND AND SILT (SM)	4 4		
	20'		BOTTOM OF HOLE = 20.0'			
	21'					
	22'					
	23'					
	24'					
	25'					
	26'					
	27'					
	28'					
	29'					
	30'					
	31'					
	32'					
	33'					

ENG FORM 1836A
(CADD Facsimilie)

PROJECT PASSAIC RIVER FLOOD PREVENTION, - MAIN TUNNEL | HOLE NO. PL-5

Hole No. PL-7

DRILLING LOG	DIVISION NORTH ATLANTIC	INSTALLATION NEW YORK DISTRICT	SHEET 1 OF 2 SHEETS

1. PROJECT PASSAIC RIVER FLOOD PROTECTION, POMPTON LAKE LEVEE		10. SIZE AND TYPE OF BIT	
2. LOCATION (Coordinates or Station) HENDERSON CT., POMPTON LAKES, NJ		11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	
3. DRILLING AGENCY		12. MANUFACTURER'S DESIGNATION OF DRILL	
4. HOLE NO. (As shown on drawing title and file number)	PL-7	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED / UNDISTURBED
5. NAME OF DRILLER		14. TOTAL NUMBER CORE BOXES	
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED _____ DEGREES FROM VERTICAL		15. ELEVATION GROUND WATER	
		16. DATE HOLE STARTED 4/1/86 / COMPLETED	
7. THICKNESS OF OVERBURDEN		17. ELEVATION TOP OF HOLE 169.9	
8. DEPTH DRILLED INTO ROCK		18. TOTAL CORE RECOVERY FOR BORING	
9. TOTAL DEPTH OF HOLE 22.0'		19. SIGNATURE OF INSPECTOR	

ELEVATION a.	DEPTH b.	LEGEND c.	CLASSIFICATION OF MATERIALS (Description) d.	SPT BLOWS e.	SAMPLE/ BOX NO. f.	REMARKS (Drilling Time, water loss, etc.) g.
	1'		(PAVEMENT) MEDIUM RED/BROWN FINE TO VERY FINE SAND AND SILT (SM)	12 12 14	S-1	
	2'		MEDIUM RED/BROWN VERY FINE SAND, LITTLE SILT (SM)	8 9 8	S-2	
	3'					
	4'			5 4 6	S-3	
	5'					
	6'		RED/BROWN COARSE TO FINE GRAVEL, WET COARSE TO FINE SAND, LITTLE SILT (SW)	4 6 12	S-4	
	7'					
	8'			10 19 24	S-5	
	9'					
	10'		RED/BROWN COARSE TO FINE GRAVEL, TRACE SILT, TRACE SAND (GW)	11 24 24	S-6	
	11'					
	12'		RED/BROWN VERY FINE SAND, AND SILT (SM)	10 10 19	S-7	
	13'					
	14'					

ENG FORM 1836
(CADD Facsimilie)

PROJECT PASSAIC RIVER FLOOD PROTECTION, POMPTON LAKE LEVEE | HOLE NO. PL-7

Hole No. PL-7

DRILLING LOG	DIVISION NORTH ATLANTIC	INSTALLATION NEW YORK DISTRICT	SHEET 2 OF 2 SHEETS

ELEVATION a.	DEPTH b.	LEGEND c.	CLASSIFICATION OF MATERIALS (Description) d.	SPT BLOWS	SAMPLE/ BOX NO. f.	REMARKS (Drilling Time, water loss, etc.) g.
	15'		SAME	7		
				8	S-8	
	16'			6		
				8		
	17'			7	S-9	
				5		
	18'					
				8		
	19'			9	S-10	
				11		
	20'					
			DARK BROWN FINE SAND (SP)	7		
	21'			10	S-11	
				12		
	22'					
			BOTTOM OF HOLE = 22.0'			
	23'					
	24'					
	25'					
	26'					
	27'					
	28'					
	29'					
	30'					
	31'					
	32'					
	33'					

ENG FORM 1836A
(CADD Facsimilie)

PROJECT PASSAIC RIVER FLOOD PREVENTION, - MAIN TUNNEL

HOLE NO. PL-7

Hole No. PTI-1

DRILLING LOG	DIVISION NORTH ATLANTIC	INSTALLATION NEW YORK DISTRICT	SHEET 1 OF 5 SHEETS

1. PROJECT PASSAIC RIVER FLOOD PROTECTION, MAIN TUNNEL	10. SIZE AND TYPE OF BIT
2. LOCATION *(Coordinates or Station)*	11. DATUM FOR ELEVATION SHOWN *(TBM or MSL)*
3. DRILLING AGENCY USCE- MOBILE	12. MANUFACTURER'S DESIGNATION OF DRILL
4. HOLE NO. *(As shown on drawing title and file number)* PTI-1	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN — DISTURBED: — UNDISTURBED:
5. NAME OF DRILLER	14. TOTAL NUMBER CORE BOXES
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED _____ DEGREES FROM VERTICAL	15. ELEVATION GROUND WATER
7. THICKNESS OF OVERBURDEN 88.7'	16. DATE HOLE — STARTED: — COMPLETED:
8. DEPTH DRILLED INTO ROCK 131.3	17. ELEVATION TOP OF HOLE
9. TOTAL DEPTH OF HOLE 220'	18. TOTAL CORE RECOVERY FOR BORING
	19. SIGNATURE OF INSPECTOR

ELEVATION a.	DEPTH b.	LEGEND c.	CLASSIFICATION OF MATERIALS *(Description)* d.	SPT BLOWS e.	SAMPLE/ BOX NO. f.	REMARKS *(Drilling Time, water loss, etc.)* g.
	1'–14'		NO SAMPLES TO 10' CLEANED OUT FILL AND GRAVEL TO RIVER LEVEL			
	10'–12'		RED-BROWN, MEDIUM TO COURSE SAND + .5" PEBBLES, ROTTEN GNEISS LITTLE SANDSTONE (SP)	14 14 15 19	S-1	
	12'–13'		DRILLED THROUGH BOULDER			

ENG FORM 1836
(CADD Facsimilie)

PROJECT PASSAIC RIVER FLOOD PROTECTION, MAIN TUNNEL | HOLE NO. PTI-1

Hole No. PTI-1

DRILLING LOG	DIVISION NORTH ATLANTIC	INSTALLATION NEW YORK DISTRICT	SHEET 2 OF 5 SHEETS

ELEVATION a.	DEPTH b.	LEGEND c.	CLASSIFICATION OF MATERIALS (Description) d.	SPT BLOWS	SAMPLE/ BOX NO. f.	REMARKS (Drilling Time, water loss, etc.) g.
	15'		FINE TO MEDIUM SAND, LITTLE CLAY (SC)	15 16 15 20	S-2	
	16'		BROWN, MEDIUM TO COARSE SAND, LITTLE CLAY (SC)	12 13 11 18	S-3	
	18'		BROWN, MEDIUM SAND, SOME SILT, TRACE CLAY (SC)	10 19 14 13	S-4	
	20'		BROWN, FINE TO COARSE SAND, SOME SILT, TRACE CLAY (SM)	7 12 13 14	S-5	
	22'		NO RECOVERY	10 11 13 11	S-6	
	24'		BROWN, FINE SAND AND SILT TRACE CLAY (SM)	10 15 16 20	S-7	
	26'		BROWN, SILT, SOME FINE SAND, MOSTLY QUARTZ (ML)	2 8 12 18	S-8	
	28'		FINE QUARTZ SAND, SOME SILT, TRACE CLAY, BROWN AND RUST BANDS (SM)	9 12 17 19	S-9	
	30'		FINE QUARTZ SAND, SOME SILT, TRACE CLAY (SM)	12 16 27 34	S-10	
	32'		GRAY SILT, TRACE CLAY (ML)	9 14	S-11	
	33'					

ENG FORM 1836A
(CADD Facsimilie)

PROJECT PASSAIC RIVER FLOOD PREVENTION, - MAIN TUNNEL

HOLE NO. PTI-1

Hole No. PTI-1

DRILLING LOG	DIVISION NORTH ATLANTIC	INSTALLATION NEW YORK DISTRICT	SHEET 3 OF 5 SHEETS

ELEVATION a.	DEPTH b.	LEGEND c.	CLASSIFICATION OF MATERIALS (Description) d.	SPT BLOWS	SAMPLE/ BOX NO. f.	REMARKS (Drilling Time, water loss, etc.) g.
			(ML) CONTINUED	17	S-11	
				23		
	34'		FINE SAND AND SILT, TRACE CLAY, GRAY (ML)	15	S-12	
				11		
	35'			14		
				20		
	36'		GRAY/BROWN, FINE SAND AND SILT, TRACE CLAY (SM)	13	S-13	
				21		
	37'			23		
				32		
	38'		GRAY/BROWN, FINE SAND, SOME SILT, TRACE CLAY (SM)	9	S-14	
				16		
	39'			20		
				20		
	40'		BROWN, FINE TO MEDIUM SAND, LITTLE SILT, ROCK FRAGMENTS (SM)	8	S-15	
				13		
	41'			21		
				31		
	42'		BROWN/GRAY FINE SAND, SOME SILT, TRACE CLAY (SM)	10	S-16	
				20		
	43'			19		
				23		
	44'		OCHRE CLAY, TRACE SILT (CL)	4	S-17	
				6		
	45'			10		
				9		
	46'		GRAY AND RED/GRAY CLAY, TRACE SILT (CL)	4	S-18	
				11		
	47'			21		
				29		
	48'		MEDIUM GRAY AND OCHRE CLAY, 1/8" LAMINATIONS (CL)	8	S-19	
				11		
	49'			9		
				9		
	50'		MEDIUM GRAY AND OCHRE CLAY, 1/4" LAMINATIONS (CL)	6	S-20	
				7		
	51'			7		
				8		
	52'					

ENG FORM 1836A

(CADD Facsimilie)

PROJECT PASSAIC RIVER FLOOD PROTECTION, - MAIN TUNNEL | HOLE NO. PTI-1

Hole No. PTI-1

DRILLING LOG	DIVISION NORTH ATLANTIC	INSTALLATION NEW YORK DISTRICT	SHEET 4 OF 5 SHEETS

ELEVATION a.	DEPTH b.	LEGEND c.	CLASSIFICATION OF MATERIALS (Description) d.	SPT BLOWS	SAMPLE/ BOX NO. f.	REMARKS (Drilling Time, water loss, etc.) g.
	53'		SAME	6	S-21	
				6		
				6		
				9		
	54'		BROWN/LIGHT GRAY, VARVED CLAY (CL)	3	S-22	
				7		
	55'			6		
				9		
	56'		LIGHT TO MEDIUM GRAY, CLAY (CL)	5	S-23	
				5		
	57'			7		
				11		
	58'		LIGHT GRAY AND RED/BROWN CLAY, MICROLAMINATIONS IN GRAY LAYERS (CL)	5	S-24	
				6		
	59'			7		
				9		
	60'		LIGHT GRAY/BROWN, RED/ BROWN CLAY (CL)	4	S-25	
				6		
	61'			8		
				8		
	62'		LIGHT TO MEDIUM GRAY/ BROWN CLAY (CL)	5	S-26	
				5		
	63'			3		
				6		
	64'		SAME	3	S-27	
				3		
	65'			4		
				7		
	66'		LIGHT GRAY, MEDIUM GRAY/ BROWN CLAY (CL)	4	S-28	
				6		
	67'			9		
				8		
	68'		SAME	4	S-29	
				6		
	69'			10		
				18		
	70'		CLAY (CL)	7	S-30	
				7		
	71'					

ENG FORM 1836A

(CADD Facsimilie)

PROJECT PASSAIC RIVER FLOOD PROTECTION, -MAIN TUNNEL | HOLE NO. PTI-1

Hole No. PTI-1

DRILLING LOG	DIVISION NORTH ATLANTIC	INSTALLATION NEW YORK DISTRICT	SHEET 5 OF 5 SHEETS

ELEVATION a.	DEPTH b.	LEGEND c.	CLASSIFICATION OF MATERIALS (Description) d.	SPT BLOWS	SAMPLE/ BOX NO. f.	REMARKS (Drilling Time, water loss, etc.) g.
	72'		SAME	8 10	S-30	
	73'		LIGHT TO MEDIUM GRAY, CLAY WITH SOME SILT (CL)	5 7 11 14	S-31	
	74'		MEDIUM GRAY CLAY, LIGHT GRAY SILT (CL)	6 7 8 9	S-32	
	76'		SAME	6 7 8 9	S-33	
	78'		MEDIUM TO LIGHT GRAY CLAY TRACE SILT (CL)	5 5 8 11	S-34	
	80'		LIGHT TO MEDIUM BROWN/ GRAY CLAY WITH SOME SILT (CL)	5 9 27	S-35	
	81'		GRAY BROWN SILT (ML)	16		
	82'		RED/BROWN FINE SAND, SOME FINE TO COURSE GRAVEL, TRACE CLAY (GM-GC)	14 50 74 69	S-36	
	84'		RED/BROWN CLAY, LITTLE FINE GRAVEL (GM-GC)	11 50 3	S-37	
	86'		REFUSAL AT 85.6' -TILL BASALT AND GNEISS BOULDERS (GP)			
	89'		TOP OF ROCK = 88.9'			
	90'					

ENG FORM 1836A

(CADD Facsimilie)

PROJECT PASSAIC RIVER FLOOD PROTECTION, MAIN TUNNEL

HOLE NO. PTI-1

Hole No: PW-1

DRILLING LOG	DIVISION NORTH ATLANTIC	INSTALLATION NEW YORK DISTRICT	SHEET 1 OF 2 SHEETS

1. PROJECT	PASSAIC RIVER FLOOD PROTECTION MAIN TUNNEL	10. SIZE AND TYPE OF BIT	
2. LOCATION (Coordinates or Station)	PEQUANNOCK WEIR SITE	11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	NGVD
3. DRILLING AGENCY	MOBILE	12. MANUFACTURER'S DESIGNATION OF DRILL	
4. HOLE NO. (As shown on drawing title and file number)	PW-1	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED 14 / UNDISTURBED 0
5. NAME OF DRILLER	BROWN / KNOX	14. TOTAL NUMBER CORE BOXES	
6. DIRECTION OF HOLE	[X] VERTICAL [ ] INCLINED _____ DEGREES FROM VERTICAL	15. ELEVATION GROUND WATER	
		16. DATE HOLE	STARTED 11/8/94 / COMPLETED 11/8/94
7. THICKNESS OF OVERBURDEN	N / A	17. ELEVATION TOP OF HOLE	8' ABOVE ELEV OF PW-2
8. DEPTH DRILLED INTO ROCK	0"	18. TOTAL CORE RECOVERY FOR BORING	
9. TOTAL DEPTH OF HOLE	30'	19. SIGNATURE OF INSPECTOR	EDC

ELEVATION a.	DEPTH b.	LEGEND c.	CLASSIFICATION OF MATERIALS (Description) d.	SPT BLOWS	SAMPLE/ BOX NO. f.	REMARKS (Drilling Time, water loss, etc.) g.
	1'		DARK BROWN GRAVELLY SILT WITH SAND (ML), DRY TO MOIST -FILL	3 2 9 13	S-1	0.4' RECOVERED LARGE GRAVEL PIECE IN SHOE
	2'		DARK BROWN SAND WITH SILT, AND TRACE GRAVEL -FILL, DRY TO MOIST (SM)	6 6 4 3	S-2	0.7' RECOVERED
	4'		DARK BROWN SILTY SAND WITH TRACE GRAVEL -FILL, DRY TO MOIST (SM)	3 8 6 7	S-3	0.5' RECOVERED
	6'		SAME, WITH SOME GRAVEL TRACE ORGANICS (SM), DRY TO MOIST	5 4 4 5	S-4	0.3' RECOVERED
	8'		SAME, MOIST	4 14	S-5	1.1' RECOVERED GROUNDWATER AT 9.0'
	9'		GRAY SANDY GRAVEL WITH TRACE SILT (GP), WET	16 20		0.4' RECOVERED DROVE CASING TO KEEP HOLE OPEN
	10'		SAME, GREEN/GRAY WET, VERY DENSE	20 30 21 20	S-6	0.7' RECOVERED
	12'		GREEN/GRAY GRAVEL WITH SOME SAND (GP), WET	8 6 4 6	S-7	0.2' RECOVERED
	13'					
	14'					

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(CADD Facsimile)

PROJECT: PASSAIC RIVER FLOOD PROTECTION MAIN TUNNEL | HOLE NO PW-1

Hole No. PW-1

DRILLING LOG	DIVISION NORTH ATLANTIC	INSTALLATION NEW YORK DISTRICT	SHEET 2 OF 2 SHEETS

ELEVATION a.	DEPTH b.	LEGEND c.	CLASSIFICATION OF MATERIALS (Description) d.	SPT BLOWS	SAMPLE/ BOX NO. f.	REMARKS (Drilling Time, water loss, etc.) g.
	15'		SAME	2 6 10 6	S-8	0.4' RECOVERED
	16' 17'		BROWN SILTY SAND (SM), FINE TO MEDIUM WET, LOOSE TO MEDIUM DENSE	8 10 11 11	S-9	0.9' RECOVERED
	18' 19'		SAME	11 10 7 8	S-10	0.2' RECOVERED
	20' 21'		BROWN FINE SILTY SAND (SM), WET	11 11 11 11	S-11	0.2' RECOVERED LOW RECOVERY DUE TO PEICE OF GRAVEL IN SPOON
	22' 23'		BROWN SANDY SILT (ML), W/A FEW PIECES OF SMALL GRAVEL, WET	11 10 10 10	S-12	1.7' RECOVERED
	24' 25'		BROWN FINE SILTY SAND (SM), WET, LOOSE TO MEDIUM DENSE	10 11 12 10	S-13	1.5' RECOVERED
	26' 27'		NO SAMPLE	9 11 10 11	S-15	NO RECOVERY DUE TO GRAVEL BLOCKING SPOON
	28' 29'		BROWN FINE SILTY SAND (SM), WET, LOOSE TO MEDIUM DENSE	7 10 11 11	S-15	0.7' RECOVERED
	30'		BOTTOM OF HOLE 30.0			
	31'					
	32'					
	33'					

ENG FORM 1836A

(CADD Facsimile)

PROJECT PASSAIC RIVER FLOOD PROTECTION, MAIN TUNNEL | HOLE NO. PW-1

Hole No. PW-2

DRILLING LOG	DIVISION NORTH ATLANTIC	INSTALLATION NEW YORK DISTRICT	SHEET 1 OF 6 SHEETS
1. PROJECT PASSAIC RIVER FLOOD PROTECTION, MAIN TUNNEL		10. SIZE AND TYPE OF BIT 5" AUGUR & 4" ROCKBIT	
2. LOCATION (Coordinates or Station) PEQUANNOCK WEIR		11. DATUM FOR ELEVATION SHOWN (TBM or MSL) NGVD	
3. DRILLING AGENCY MOBIL DIST.		12. MANUFACTURER'S DESIGNATION OF DRILL FALLING, TRUCK MOUNTED	
4. HOLE NO. (As shown on drawing title and file number) PW-2		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED / UNDISTURBED
5. NAME OF DRILLER KNOX / BROWN		14. TOTAL NUMBER CORE BOXES	
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED _____ DEGREES FROM VERTICAL		15. ELEVATION GROUND WATER	
		16. DATE HOLE STARTED 11/4/94 COMPLETED 11/7/94	
7. THICKNESS OF OVERBURDEN		17. ELEVATION TOP OF HOLE	
8. DEPTH DRILLED INTO ROCK		18. TOTAL CORE RECOVERY FOR BORING	
9. TOTAL DEPTH OF HOLE 131.3'		19. SIGNATURE OF INSPECTOR	

ELEVATION a.	DEPTH b.	LEGEND c.	CLASSIFICATION OF MATERIALS (Description) d.	SPT BLOWS	SAMPLE/ BOX NO. f.	REMARKS (Drilling Time, water loss, etc.) g.
	1'		TOP SOIL DARK BROWN SILT (ML), DRY TO MOIST	4 4 3 2	S-1	0.5' RECOVERED
	2' 3'		DARK BROWN SANDY SILT (ML), DRY TO MOIST	2 1 2 3	S-2	0.5' RECOVERED GROUNDWATER AT 4.0'
	4' 5'		DARK BROWN GRAVELLY SAND WITH SOME SILT (GM), WET	3 12 12 16	S-3	SAMPLES WET AT 4' AND BELOW 0.5' RECOVERED
	6' 7'		SAME, RED/GRAY 1-1/2" DIA	10 9 20 20	S-4	MORE GRAVEL TOWARDS BOTTOM OF SPOON 1.2' RECOVERED
	8' 9'		SAME WITH TRACE SILT	12 15 23	S-5	1.1' RECOVERED
	10' 11'		BROWN GRAY GRAVEL WITH SOME SAND	14 13 17 12	S-6	0.6' RECOVERED SWITCHED TO MUD
	12' 13' 14'		BROWN VERY FINE SILTY SAND MEDIUM	7 5 5 7	S-7	0.4' RECOVERED

Hole No. PW-2

DRILLING LOG	DIVISION NORTH ATLANTIC	INSTALLATION NEW YORK DISTRICT	SHEET 2 OF 6 SHEETS

ELEVATION a.	DEPTH b.	LEGEND c.	CLASSIFICATION OF MATERIALS (Description) d.	SPT BLOWS	SAMPLE/ BOX NO. f.	REMARKS (Drilling Time, water loss, etc.) g.
	15'		NO SAMPLE			TOO MUCH FALL IN, HAD TO START USING CASING PROBABLY GRAVEL
	16'		SAME WITH TRACE CLAY MOIST TO WET	2	S-8	0.3' RECOVERY
	17'			2		
				5		
	18'			6		
			SAME, MOIST TO WET	6	S-9	1.0' RECOVERY
	19'			6		
				7		
	20'			11		
			SAME, SLIGHTLY LESS SILT, NO CLAY, MOIST	6	S-10	0.7' RECOVERY
	21'			8		
				11		
	22'			10		
			SAME, MOIST	5	S-11	1.0' RECOVERY
	23'			7		
				5		
	24'			10		
			BROWN (f-m) SAND WITH SILT, MOIST (SM)	6	S-12	1.0' RECOVERY
	25'			10		
				10		
	26'			10		
			SAME, MOIST	5	S-13	1.0' RECOVERY
	27'			8		
				9		
	28'			7		
			SAME, MOIST	4	S-14	0.6' RECOVERY
	29'			5		
				9		
	30'			8		
			SAME, SILTY	2	S-15	0.8' RECOVERY
	31'			4		
				6		
	32'			9		
			SAME, MORE SILT TOWARDS BOTTOM	4	S-16	1.0' RECOVERY
	33'			7		

ENG FORM 1836A

PROJECT PASSAIC RIVER FLOOD PROTECTION, MAIN TUNNEL | HOLE NO PW-2

Hole No. PW-2

DRILLING LOG	DIVISION NORTH ATLANTIC	INSTALLATION NEW YORK DISTRICT	SHEET 3 OF 6 SHEETS

ELEVATION a.	DEPTH b.	LEGEND c.	CLASSIFICATION OF MATERIALS (Description) d.	SPT BLOWS	SAMPLE/ BOX NO. f.	REMARKS (Drilling Time, water loss, etc.) g.
				4	S-16	
				8		
	34'		BROWN SILT WITH SOME SAND, WET, TRACE CLAY TOWARDS BOTTOM, (ML)	6	S-17	1.2' RECOVERY
	35'			5		
				9		
				10		
	36'		SAME, NO SAND, WET	6	S-18	1.0' RECOVERY
	37'			7		
				8		
				10		
	38'		SAME, WET	4	S-19	1.1' RECOVERY
	39'			6		
				6		
				11		
	40'		SAME, WET, MEDIUM DENSE	11	S-20	1.2' RECOVERY
	41'			10		
				10		
				13		
	42'		SAME, TRACE CLAY WET, MEDIUM DENSE	15	S-21	1.3' RECOVERY
	43'			10		
				8		
				6		
	44'		SAME, WET LOOSE TO MEDIUM DENSE	6	S-22	0.8' RECOVERY
	45'			4		
				5		
				9		
	46'		SAME, WET LOOSE TO MEDIUM DENSE	8	S-23	0.7' RECOVERY
	47'			10		
				8		
				8		
	48'		SAME, WET, MEDIUM DENSE	9	S-24	1.3' RECOVERY
	49'			8		
				6		
				6		
	50'		SAME, GRAY/RED WET, MEDIUM DENSE SLIGHTLY MORE CLAY	5	S-25	1.4' RECOVERY
	51'			7		
				9		
	52'			10		

ENG FORM 1836A

(CADD Facsimile)

PROJECT PASSAIC RIVER FLOOD PROTECTION MAIN TUNNEL | HOLE NO. PW-2

Hole No. PW-2

DRILLING LOG	DIVISION NORTH ATLANTIC	INSTALLATION NEW YORK DISTRICT	SHEET 4 OF 6 SHEETS

ELEVATION a.	DEPTH b.	LEGEND c.	CLASSIFICATION OF MATERIALS (Description) d.	SPT BLOWS	SAMPLE/ BOX NO. f.	REMARKS (Drilling Time, water loss, etc.) g.
	53'		SAME, WET, MEDIUM DENSE	11 11 13 19	S-26	1.2' RECOVERY
	54'		SAME, TRACE SAND WET, DENSE	12 27 22 27	S-27	1.6' RECOVERY
	56'		GRAY/RED SILT WITH TRACE CLAY, WET, DENSE (ML)	19 27 30 33	S-28	1.5' RECOVERY
	58'		SAME, WET, DENSE	30 29 34 16	S-29	1.4' RECOVERY
	60'		GRAY/BROWN SILT WITH SOME CLAY, TRACE SAND WET, MEDIUM DENSE (ML), MORE CLAY TOWARDS BOTTOM. LOST SOME WATER	7 9 9 8	S-30	1.3' RECOVERY
	62'		SAME, NO SAND TRACE CLAY, WET, DENSE LIQUIFIES W/ VIBRATION	18 14 13 15	S-31	1.2' RECOVERY
	64'		SAME, MOIST VERY DENSE GRAY / BROWN THIN LAYERS INTERMIXING	17 23 22 28	S-32	1.3' RECOVERY
	66'		SAME MOIST TO WET VERY DENSE	16 22 27 34	S-33	1.2' RECOVERY
	68'		SAME WET DENSE	29 26 28 30	S-34	1.1' RECOVERY
	70'		GRAY SAME WITH SOME CLAY WET MED - DENSE	22 19	S-35	1.4' RECOVERY
	71'					

ENG FORM 1836A

(CADD Facsimilie)

PROJECT PASSAIC RIVER FLOOD PROTECTION, MAIN TUNNEL

HOLE NO. PW-2

Hole No. PW-2

DRILLING LOG	DIVISION NORTH ATLANTIC	INSTALLATION NEW YORK DISTRICT	SHEET 5 OF 6 SHEETS

ELEVATION a.	DEPTH b.	LEGEND c.	CLASSIFICATION OF MATERIALS (Description) d.	SPT BLOWS	SAMPLE/ BOX NO. f.	REMARKS (Drilling Time, water loss, etc.) g.
	72'		SAME	20 21	S-35	
	73'		SAME, MOIST TO WET CLAYEY TOWARDS BOTTOM	7 8 8 14	S-36	1.4' RECOVERY
	74'					
	75'		DARK GRAY/BROWN SILTY CLAY, 1 PIECE OF GRAVEL (CL)	16 14 15 16	S-37	0.8' RECOVERY
	76'					
	77'		DARK GRAY CLAY, MOIST (CL)	13 14 13 15	S-38	1.6' RECOVERY
	78'					
	79'		DARK GRAY SILTY CLAY (CL), MOIST	6 18 21 24	S-39	1.5' RECOVERY
	80'					
	81'		DARK GRAY CLAY WITH SILT, MOIST, MED -DENSE (CL)	7 10 20 18	S-40	1.0' RECOVERY
	82'					
	83'		DARK GRAY SILTY CLAY (CL) MOIST MED -DENSE	17 19 19 20	S-41	1.4' RECOVERY
	84'					
	85'		SAME MOIST MEDIUM	20 17 16 12	S-42	1.0' RECOVERY
	86'					
	87'		SAME MOIST VERY DENSE	15 24 21 23	S-43	1.5' RECOVERY
	88'					
	89'		DARK GRAY CLAYEY SILT SMOOTH TO DRY VERY DENSE	19 21 27 34	S-44	1.2' RECOVERY
	90'					

ENG FORM 1836A
(CADD Facsimile)

PROJECT PASSAIC RIVER FLOOD PROTECTION MAIN TUNNEL | HOLE NO. PW-2

Hole No. PW-2

DRILLING LOG	DIVISION NORTH ATLANTIC	INSTALLATION NEW YORK DISTRICT	SHEET 6 OF 6 SHEETS

ELEVATION a.	DEPTH b.	LEGEND c.	CLASSIFICATION OF MATERIALS (Description) d.	SPT BLOWS	SAMPLE/ BOX NO. f.	REMARKS (Drilling Time, water loss, etc.) g
	91'		SAME, DRY TO MOIST VERY DENSE	26 29 35 31	S-45	1.3' RECOVERY
	92'		SAME, WET, SOFT-MEDIUM	9 9 16 22	S-46	2.0' RECOVERY
	93'					
	94'		DARK GRAY SILTY CLAY (CL), MOIST, MED. DENSE	15 17 25 29	S-47	2.0' RECOVERY
	95'					
	96'		SAME, LESS SILT	16 22 22 23	S-48	1.1' RECOVERY
	97'					
	98'		DRILLED WITHOUT SAMPLING TO 130'			THE CUTTINGS SHOWED ALL SOFT MATERIAL UNTIL A DEPTH OF BETWEEN 125' AND 130' A SPOON SAMPLE WAS TAKEN.
	130'		DARK GRAY (f-m) SAND WITH SOME SILT (SM)	49 49 50/3"	S-50	0.8' RECOVERY
	131'					
	132'		BOTTOM OF HOLE 131.3'			

ENG FORM 1836A
(CADD Facsimile)

PROJECT PASSAIC RIVER FLOOD PROTECTION MAIN TUNNEL | HOLE NO PW-2

Hole No: PW-3

DRILLING LOG	DIVISION NORTH ATLANTIC	INSTALLATION NEW YORK DISTRICT	SHEET 1 OF 2 SHEETS
1. PROJECT PASSAIC RIVER FLOOD PROTECTION, MAIN TUNNEL		10. SIZE AND TYPE OF BIT	
2. LOCATION (Coordinates or Station) PEQUANNOCK WEIR SITE		11. DATUM FOR ELEVATION SHOWN (TBM or MSL) NGVD	
3. DRILLING AGENCY MOBIL DIST.		12. MANUFACTURER'S DESIGNATION OF DRILL	
4. HOLE NO. (As shown on drawing title and file number) PW-3		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED / UNDISTURBED
5. NAME OF DRILLER BROWN / KNOX		14. TOTAL NUMBER CORE BOXES	
6. DIRECTION OF HOLE [X] VERTICAL [ ] INCLINED _____ DEGREES FROM VERTICAL		15. ELEVATION GROUND WATER	
		16. DATE HOLE STARTED 11-9-94 COMPLETED 11-9-94	
7. THICKNESS OF OVERBURDEN		17. ELEVATION TOP OF HOLE	
8. DEPTH DRILLED INTO ROCK		18. TOTAL CORE RECOVERY FOR BORING	
9. TOTAL DEPTH OF HOLE 26.0'		19. SIGNATURE OF INSPECTOR	

ELEVATION a.	DEPTH b.	LEGEND c.	CLASSIFICATION OF MATERIALS (Description) d.	SPT BLOWS	SAMPLE/ BOX NO. f.	REMARKS (Drilling Time, water loss, etc.) g.
	1'		BROWN SILTY (f-m) SAND WITH TRACE GRAVEL, FILL DRY TO MOIST, LOOSE (SM)	4 7 9 11	S-1	0.7' RECOVERY
	2' 3'		BROWN (f-m) SAND WITH GRAVEL AND SOME SILT DRY TO MOIST, LOOSE MORE GRAVEL NEAR BOTTOM (SM), FILL	15 19 22 26	S-2	1.6' RECOVERY
	4' 5'		SAME, DRY TO MOIST FILL, LOOSE SOME CONCRETE PIECES	24 25 17 17	S-3	1.2' RECOVERY
	6' 7'		SAME, WET, LOOSE MEDIUM TO DENSE, FILL SOME CONCRETE IN SHOE	10 9 6 8	S-4	0.5' RECOVERY GROUNDWATER AT 7.0'
	8' 9'		BROWN SILTY FINE SAND (SM), WET, LOOSE TO MEDIUM DENSE	4 4 4 5	S-5	NO RECOVERY ON FIRST ATTEMPT
	10' 11'		BROWN SANDY SILT (ML), WET TO MOIST MEDIUM TO DENSE	11 12 12 13	S-6	DROVE CASING BEFORE SAMPLE WAS TAKEN(ALSO MIXED MUD)
	12' 13' 14'		BROWN SILT WITH SOME SAND, WET MEDIUM DENSE (ML)	8 8 7 9	S-7	LIQUIFIES UPON SLIGHT VIBRATION OF JAR

ENG FORM 1836
(CADD Facsimile)

PROJECT PASSAIC RIVER FLOOD PROTECTION, MAIN TUNNEL | HOLE NO PW-3

Hole No. PW-3

DRILLING LOG	DIVISION NORTH ATLANTIC	INSTALLATION NEW YORK DISTRICT	SHEET 2 OF 2 SHEETS

ELEVATION a.	DEPTH b.	LEGEND c.	CLASSIFICATION OF MATERIALS (Description) d.	SPT BLOWS	SAMPLE/ BOX NO. f.	REMARKS (Drilling Time, water loss, etc.) g.
	15'		SAME, WET, MED. DENSE	10 11 10 9	S-8	1.4' RECOVERY LIQUFIES
	16' 17'		BROWN SILT WITH SAND (ML), WET TO MED. DENSE MORE SAND NEAR BOTTOM	10 10 10 11	S-9	1.3' RECOVERY
	18' 19'		SAME, LESS SAND WET, MEDIUM DENSE	5 6 6 6	S-10	1.1' RECOVERY
	20' 21'		BROWN SILT WITH SOME SAND, WET TO MED. DENSE (ML)	5 5 4 4	S-11	1.2' RECOVERY LIQUFIES
	22' 23'		SAME, MOIST TO WET	5 5 6 6	S-12	1.5' RECOVERY
	24' 25'		SAME, MOIST TO WET	7 5 6 6	S-13	1.2' RECOVERY
	26'		BOTTOM OF HOLE = 26.0'			

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(CADD Facsimile)

PROJECT PASSAIC RIVER FLOOD PROTECTION, MAIN TUNNEL | HOLE NO PW-3

Hole No. WL-1

DRILLING LOG	DIVISION NORTH ATLANTIC	INSTALLATION NEW YORK DISTRICT	SHEET 1 OF 2 SHEETS

1. PROJECT PASSAIC RIVER FLOOD PROTECTION, MAIN TUNNEL	10. SIZE AND TYPE OF BIT
2. LOCATION *(Coordinates or Station)* 77 MAPLE LANE, WAYNE NJ	11. DATUM FOR ELEVATION SHOWN *(TBM or MSL)*
3. DRILLING AGENCY	12. MANUFACTURER'S DESIGNATION OF DRILL
4. HOLE NO. *(As shown on drawing title and file number)* WL-1	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN — DISTURBED: — UNDISTURBED:
5. NAME OF DRILLER	14. TOTAL NUMBER CORE BOXES
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED _____ DEGREES FROM VERTICAL	15. ELEVATION GROUND WATER
7. THICKNESS OF OVERBURDEN	16. DATE HOLE STARTED 3/24/86 COMPLETED
8. DEPTH DRILLED INTO ROCK	17. ELEVATION TOP OF HOLE 185'
9. TOTAL DEPTH OF HOLE 25.5'	18. TOTAL CORE RECOVERY FOR BORING
	19. SIGNATURE OF INSPECTOR

ELEVATION a.	DEPTH b.	LEGEND c.	CLASSIFICATION OF MATERIALS *(Description)* d.	SPT BLOWS e.	SAMPLE/ BOX NO. f.	REMARKS *(Drilling Time, water loss, etc.)* g.
	1'		ROCK BIT			
	2'		DARK BROWN SILT, SOME ROUND FINE GRAVEL, LITTLE CLAY (ML)	9 24 18	S-1	
	3'		DARK TAN FINE SAND AND SILT, LITTLE ANGULAR AND ROUND FINE GRAVEL (ML)	3 3 5	S-2	
	4'					
	5'		NO RECOVERY	2 3 4	S-3	
	6'		MEDIUM BROWN, MEDIUM SAND, LITTLE CLAY, TRACE FINE ROUND GRAVEL (SM)	4 2 3	S-4	
	7'					
	8'		NO RECOVERY	2 1 1	S-5	
	9'		NO RECOVERY	1 1 1	S-6	
	10'					
	11'		MEDIUM BROWN SAND, LITTLE CLAY, TRACE FINE GRAVEL (SM)	1 1 1	S-7	
	12'		DARK GRAY/BLACK MEDIUM COURSE SAND LITTLE SILT, TRACE FINE GRAVEL (SM)	1 1 1	S-8	
	13'					
	14'			1	S-9	

ENG FORM 1836
(CADD Facsimilie)

PROJECT PASSAIC RIVER FLOOD PROTECTION, MAIN TUNNEL — HOLE NO. WL-1

Hole No. WL-1

DRILLING LOG	DIVISION NORTH ATLANTIC	INSTALLATION NEW YORK DISTRICT	SHEET 2 OF 2 SHEETS

ELEVATION a.	DEPTH b.	LEGEND c.	CLASSIFICATION OF MATERIALS (Description) d.	SPT BLOWS	SAMPLE/ BOX NO. f.	REMARKS (Drilling Time, water loss, etc.) g.
	15'		SAME (SM)	1 2	S-9	
	16'		MEDIUM TAN/ORANGE FINE TO VERY COURSE SAND, LITTLE FINE GRAVEL (SM)	5 6 8	S-10	
	17'		SAME	6 9 12	S-11	
	18'		MED. BRN. VARVED CLAY (ML)			
	19'		SAME	18 14 12	S-12	
	20'		SAME	5 8 7	S-13	
	21'		MEDIUM GRAY/BROWN VARVED CLAY AND SILT, FINE GRAVEL (CL/ML)	3 6 7	S-14	
	22'					
	23'		MEDIUM GRAY/BROWN VARVED CLAY AND SILT (CL/ML)	4 2 3	S-15	
	24'		SAME	3 3 5	S-16	
	25'		BOTTOM OF HOLE = 25.5'			
	26'					
	27'					
	28'					
	29'					
	30'					
	31'					
	32'					
	33'					

ENG FORM 1836A
(CADD Facsimilie)

PROJECT PASSAIC RIVER FLOOD PREVENTION, MAIN TUNNEL

HOLE NO. WL-1

DRILLING LOG	DIVISION NORTH ATLANTIC	INSTALLATION NEW YORK DISTRICT	SHEET 1 OF 2 SHEETS

1. PROJECT	PASSAIC RIVER FLOOD PROTECTION, MAIN TUNNEL
2. LOCATION (Coordinates or Station)	8 SHORE DRIVE
3. DRILLING AGENCY	
4. HOLE NO. (As shown on drawing title and file number)	WL-2
5. NAME OF DRILLER	
6. DIRECTION OF HOLE	[X] VERTICAL [ ] INCLINED _____ DEGREES FROM VERTICAL
7. THICKNESS OF OVERBURDEN	
8. DEPTH DRILLED INTO ROCK	
9. TOTAL DEPTH OF HOLE	30.0'
10. SIZE AND TYPE OF BIT	-
11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	
12. MANUFACTURER'S DESIGNATION OF DRILL	
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED / UNDISTURBED
14. TOTAL NUMBER CORE BOXES	
15. ELEVATION GROUND WATER	
16. DATE HOLE	STARTED 4/4/86 / COMPLETED
17. ELEVATION TOP OF HOLE	184'
18. TOTAL CORE RECOVERY FOR BORING	
19. SIGNATURE OF INSPECTOR	

ELEVATION a.	DEPTH b.	LEGEND c.	CLASSIFICATION OF MATERIALS (Description) d.	SPT BLOWS e.	SAMPLE/ BOX NO. f.	REMARKS (Drilling Time, water loss, etc.) g.
	1'		ROCK BIT THROUGH ROAD			
	2'		DARK ORANGE/BROWN FINE SAND, SOME SILT, LITTLE FINE GRAVEL (SM)	12	S-1	
				12		
	3'			8		
				8		
	4'		DARK ORANGE/BROWN FINE TO COARSE SAND, SOME SILT, LITTLE FINE GRAVEL (SM)	5	S-2	
				3		
	5'			3		
				5		
	6'		SAME	4	S-3	
				3		
	7'			3		
				8		
	8'		SAME	5	S-4	
				3		
	9'			3		
				3		
	10'		DARK ORANGE/BROWN MEDIUM TO VERY COARSE SAND, LITTLE FINE TO COARSE GRAVEL, TRACE SILT (SM)	2	S-5	
				2		
	11'			4		
				5		
	12'		SAME	5	S-6	
				9		
	13'			10		
				10		
	14'					

Hole No. WL-2

DRILLING LOG	DIVISION NORTH ATLANTIC	INSTALLATION NEW YORK DISTRICT	SHEET 2 OE 2 SHEETS

ELEVATION a.	DEPTH b.	LEGEND c.	CLASSIFICATION OF MATERIALS (Description) d.	SPT BLOWS	SAMPLE/ BOX NO. f.	REMARKS (Drilling Time, water loss, etc.) g.
	15'		SAME	6 11 12 12	S-7	
	16'		DARK RED/BROWN SILT (ML)	7 13 13 11	S-8	
	18'		DARK RED/BROWN SILT AND VERY FINE SAND (ML/SM)	8 6 7 8	S-9	
	20'		NO RECOVERY	5 7 7 9	S-10	
	22'		NO RECOVERY	8 5 4 7	S-11	
	24'		DARK RED/BROWN SILT AND VERY FINE TO FINE SAND (ML/SM)	15 14 11 12	S-12	
	25'		DARK GRAY VARVED CLAY AND SILT (ML/CL)			
	26'		SAME	6 8 10 9	S-13	
	28'		SAME	13 14 16 14	S-14	
	30'		BOTTOM OF HOLE = 30.0'			
	31'					
	32'					
	33'					

ENG FORM 1836A
(CADD Facsimilie)

PROJECT PASSAIC RIVER FLOOD PREVENTION, MAIN TUNNEL

HOLE NO. WL-2

Hole No. WL-3

DRILLING LOG	DIVISION NORTH ATLANTIC	INSTALLATION NEW YORK DISTRICT	SHEET 1 OF 3 SHEETS

1. PROJECT PASSAIC RIVER FLOOD PROTECTION, MAIN TUNNEL	10. SIZE AND TYPE OF BIT
2. LOCATION (Coordinates or Station) 90 SHORE DR., WAYNE, NJ	11. DATUM FOR ELEVATION SHOWN (TBM or MSL)
3. DRILLING AGENCY	12. MANUFACTURER'S DESIGNATION OF DRILL
4. HOLE NO. (As shown on drawing title and file number)	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN — DISTURBED / UNDISTURBED
5. NAME OF DRILLER	14. TOTAL NUMBER CORE BOXES
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED _____ DEGREES FROM VERTICAL	15. ELEVATION GROUND WATER
7. THICKNESS OF OVERBURDEN	16. DATE HOLE — STARTED 3/26/86 / COMPLETED
8. DEPTH DRILLED INTO ROCK	17. ELEVATION TOP OF HOLE 185'
9. TOTAL DEPTH OF HOLE 36.0'	18. TOTAL CORE RECOVERY FOR BORING
	19. SIGNATURE OF INSPECTOR

ELEVATION a.	DEPTH b.	LEGEND c.	CLASSIFICATION OF MATERIALS (Description) d.	SPT BLOWS e.	SAMPLE/ BOX NO. f.	REMARKS (Drilling Time, water loss, etc.) g.
	1'		ROLLER BIT THROUGH PAVEMENT			
	2'		DARK ORANGE/BROWN FINE SAND, LITTLE FINE WEATHERED GRAVEL (SM)	18 20 11	S-1	
	3'			9 5	S-2	
	4'			8		
	5'		DARK ORANGE/BROWN FINE TO MEDIUM SAND, LITTLE SILT LITTLE FINE GRAVEL (SW)	6 5 10	S-3	
	6'		MEDIUM BROWN FINE TO COARSE SAND, SOME FINE SUB-ROUND TO ROUND GRAVEL, TRACE SILT (SW)	6 9 12	S-4	
	8'			12 14 12	S-5	
	9'		MEDIUM BROWN, MEDIUM TO COARSE SAND LITTLE GRAVEL TRACE SILT (SW-SM)	11 10 11	S-6	
	11'		MEDIUM BROWN, MEDIUM SAND TRACE SILT (SP)	11 9 12	S-7	
	12'			15		
	13'		MEDIUM BROWN COARSE TO VERY COARSE SAND, SOME FINE GRAVEL, TRACE SILT (SP)	22 14	S-8	
	14'			12	S-9	

ENG FORM 1836
(CADD Facsimilie)

PROJECT PASSAIC RIVER FLOOD PROTECTION, MAIN TUNNEL — HOLE NO. WL-3

Hole No. WL-3

DRILLING LOG	DIVISION NORTH ATLANTIC	INSTALLATION NEW YORK DISTRICT	SHEET 2 OF 3 SHEETS

ELEVATION a.	DEPTH b.	LEGEND c.	CLASSIFICATION OF MATERIALS (Description) d.	SPT BLOWS	SAMPLE/ BOX NO. f.	REMARKS (Drilling Time, water loss, etc.) g.
	15'		SAME	19	S-9	
				18		
				18	S-10	
	16'		MEDIUM BROWN, MEDIUM TO VERY COARSE SAND, LITTLE FINE TO COARSE GRAVEL, TRACE SILT (SW)	11		
				11		
	17'			8	S-11	
				29		
	18'			16		
			MEDIUM BROWN, FINE TO COARSE GRAVEL, SOME MEDIUM TO VERY COARSE SAND (GP)	16	S-12	
	19'			8		
				9		
				8	S-13	
	20'		MEDIUM BROWN, MEDIUM TO VERY COARSE SAND, LITTLE FINE TO COARSE ROUND GRAVEL, LITTLE SILT (SW)	13		
				12		
	21'			14	S-14	
				12		
	22'			10		
			NO RECOVERY	8	S-15	
	23'			7		
				11		
	24'			17	S-16	
				15		
	25'			14		
			MEDIUM RED/BROWN SILT, TRACE CLAY (ML-MH)	7	S-17	
	26'			12		
				14		
	27'			10	S-18	
				8		
	28'			12		
			MEDIUM RED/BROWN VERY FINE SAND, SOME SILT (SM)	14	S-19	
	29'			11		
				7		
	30'			7	S-20	
				5		
	31'			4		
				5	S-21	
	32'			10		
				11		
	33'					

ENG FORM 1836A
(CADD Facsimilie)

PROJECT PASSAIC RIVER FLOOD PREVENTION, -MAIN TUNNEL

HOLE NO. WL-3

Hole No. WL-3

DRILLING LOG	DIVISION NORTH ATLANTIC	INSTALLATION NEW YORK DISTRICT	SHEET 3 OF 3 SHEETS

ELEVATION a.	DEPTH b.	LEGEND c.	CLASSIFICATION OF MATERIALS (Description) d.	SPT BLOWS	SAMPLE/ BOX NO. f.	REMARKS (Drilling Time, water loss, etc.) g.
	34'		MEDIUM RED/BROWN SILT (MH)	8		
				10		
				10	S-22	
	35'			8		
				10		
				12		
	36'		BOTTOM OF HOLE = 36.0'			
	37'					
	38'					
	39'					
	40'					
	41'					
	42'					
	43'					
	44'					
	45'					
	46'					
	47'					
	48'					
	49'					
	50'					
	51'					
	52'					

ENG FORM 1836A
(CADD Facsimilie)

PROJECT PASSAIC RIVER FLOOD PROTECTION, - MAIN TUNNEL

HOLE NO. WL-3

Hole No. WL-4

DRILLING LOG	DIVISION NORTH ATLANTIC	INSTALLATION NEW YORK DISTRICT	SHEET 1 OF 2 SHEETS

1. PROJECT PASSAIC RIVER FLOOD PROTECTION, MAIN TUNNEL	10. SIZE AND TYPE OF BIT
2. LOCATION (Coordinates or Station) LAKE DRIVE, WAYNE, NJ	11. DATUM FOR ELEVATION SHOWN (TBM or MSL)
3. DRILLING AGENCY	12. MANUFACTURER'S DESIGNATION OF DRILL
4. HOLE NO. (As shown on drawing title and file number)	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN — DISTURBED — UNDISTURBED
5. NAME OF DRILLER	14. TOTAL NUMBER CORE BOXES
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED _____ DEGREES FROM VERTICAL	15. ELEVATION GROUND WATER
7. THICKNESS OF OVERBURDEN	16. DATE HOLE — STARTED 3/25/86 — COMPLETED
8. DEPTH DRILLED INTO ROCK	17. ELEVATION TOP OF HOLE 186'
9. TOTAL DEPTH OF HOLE 30.0'	18. TOTAL CORE RECOVERY FOR BORING
	19. SIGNATURE OF INSPECTOR

ELEVATION a.	DEPTH b.	LEGEND c.	CLASSIFICATION OF MATERIALS (Description) d.	SPT BLOWS e.	SAMPLE/ BOX NO. f.	REMARKS (Drilling Time, water loss, etc.) g.
	1'		ROLLER BIT THROUGH PAVEMENT			
	2'		DARK ORANGE MEDIUM SAND, SOME FINE TO COARSE ROUND GRAVEL, LITTLE SILT (SP)	2 2 2	S-1	
	3'		DARK ORANGE/BROWN MEDIUM TO VERY COARSE SAND, SOME FINE TO COARSE ROUND GRAVEL (GW-GM)	15 20 20	S-2	
	4'			16		
	5'			11 20	S-3	
	6'			15		
	7'			18 18	S-4	
	8'		SAME WITH LITTLE FINE TO COARSE ROUND GRAVEL (SW)	11 11 14	S-5	
	9'			12		
	10'			12 12	S-6	
	11'			3 4	S-7	
	12'			7 10		
	13'		MEDIUM BROWN SILT, SATURATED (ML)	17 6	S-8	
	14'			3	S-9	

ENG FORM 1836
(CADD Facsimilie)

PROJECT PASSAIC RIVER FLOOD PROTECTION, MAIN TUNNEL — HOLE NO WL-4

Hole No. WL-4

DRILLING LOG | DIVISION NORTH ATLANTIC | INSTALLATION NEW YORK DISTRICT | SHEET 2 OF 2 SHEETS

ELEVATION a.	DEPTH b.	LEGEND c.	CLASSIFICATION OF MATERIALS (Description) d.	SPT BLOWS	SAMPLE/ BOX NO. f.	REMARKS (Drilling Time, water loss, etc.) g.
	15		SAME	6	S-9	
				5		
	16			4	S-10	
				5		
				5		
	17			5	S-11	
				8		
				8		
	18			4	S-12	
				8		
	19			12		
				8	S-13	
	20		MEDIUM BROWN VERY FINE SAND, LITTLE SILT (SM)	6		
				9		
	21			9	S-14	
			MEDIUM BROWN SILT (ML)	5		
	22			11		
				6	S-15	
	23			8		
				8		
	24			8	S-16	
				4		
	25			5		
				6	S-17	
	26			4		
				3		
	27			7	S-18	
				3		
	28			3		
				6	S-19	
	29			6		
			MEDIUM GRAY CLAY (CL)	6	S-20	
	30		BOTTOM OF HOLE = 30.0'			
	31					
	32					
	33					

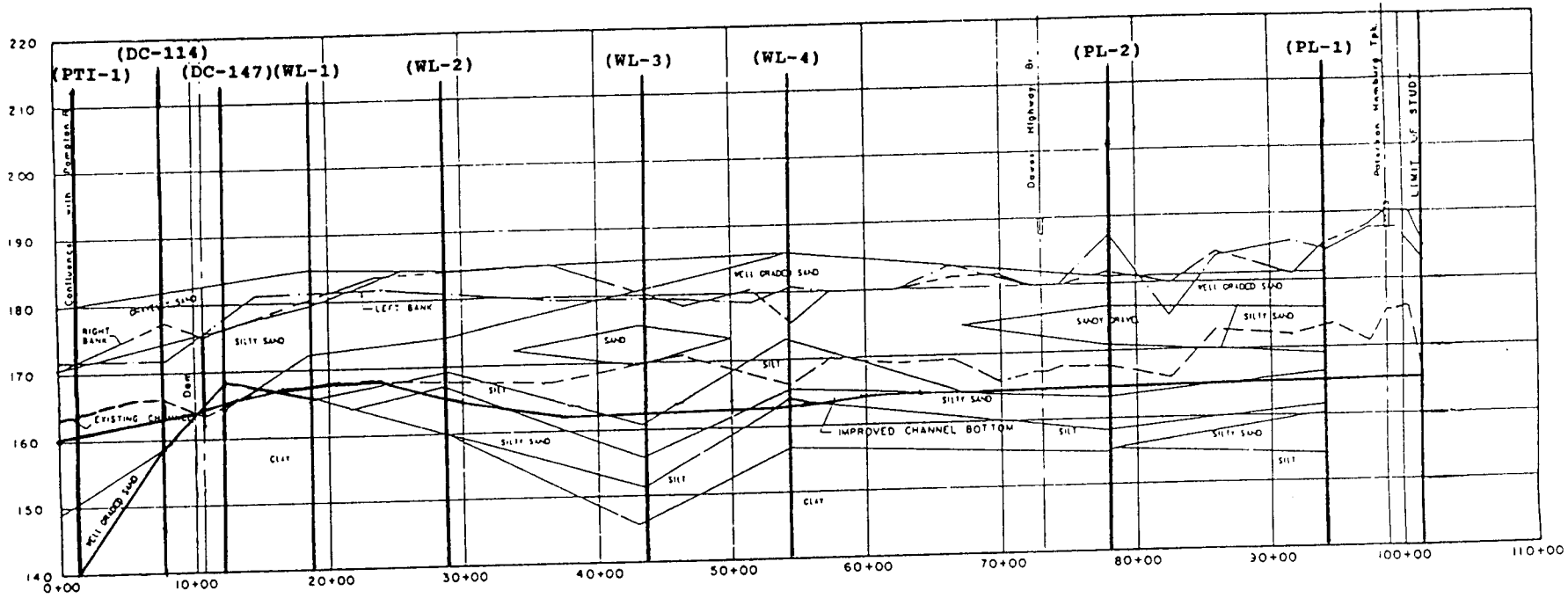
ENG FORM 1836A
(CADD Facsimilie)

PROJECT PASSAIC RIVER FLOOD PREVENTION, MAIN TUNNEL | HOLE NO. WL-4

PASSAIC RIVER FLOOD DAMAGE
REDUCTION PROJECT

SECTION 13
POMPTON LEVEES/FLOODWALLS AND CHANNELS

ATTACHMENT E.13.2
SOIL PROFILE DRAWINGS



PROFILE

SCALE IN FEET

HOR. 500 0 500 1000

VERT 10 0 10 20

Ramapo River

Station 0+00 to 100+15

SOIL PROFILES

AND

BORING LOCATIONS

U.S. ARMY ENGINEER DISTRICT, NEW YORK
PASSAIC RIVER DIVISION
CORPS OF ENGINEERS

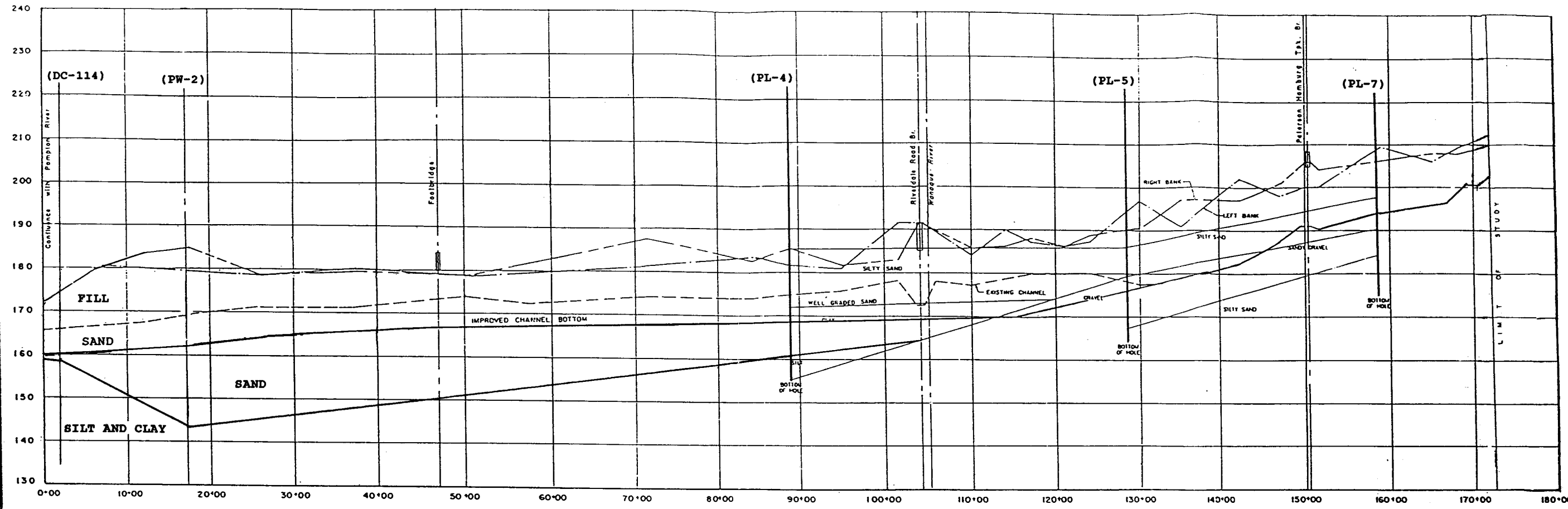
Passaic River Flood Damage Reduction Project
GENERAL DESIGN MEMORANDUM
Ramapo River
SOIL PROFILES

REVISED:

DATE: 7/95 | PREPARED BY: CENAN-PR-TG

ATTACHMENT E.13.2.1

ATTACHMENT E.13.2.1



PROFILE

SCALE IN FEET

HOR. 300 0 300 600

VERT. 10 0 10 20

Pequannock River
Station 0+00 to 171+55

SOIL PROFILES
AND
BORING LOCATIONS

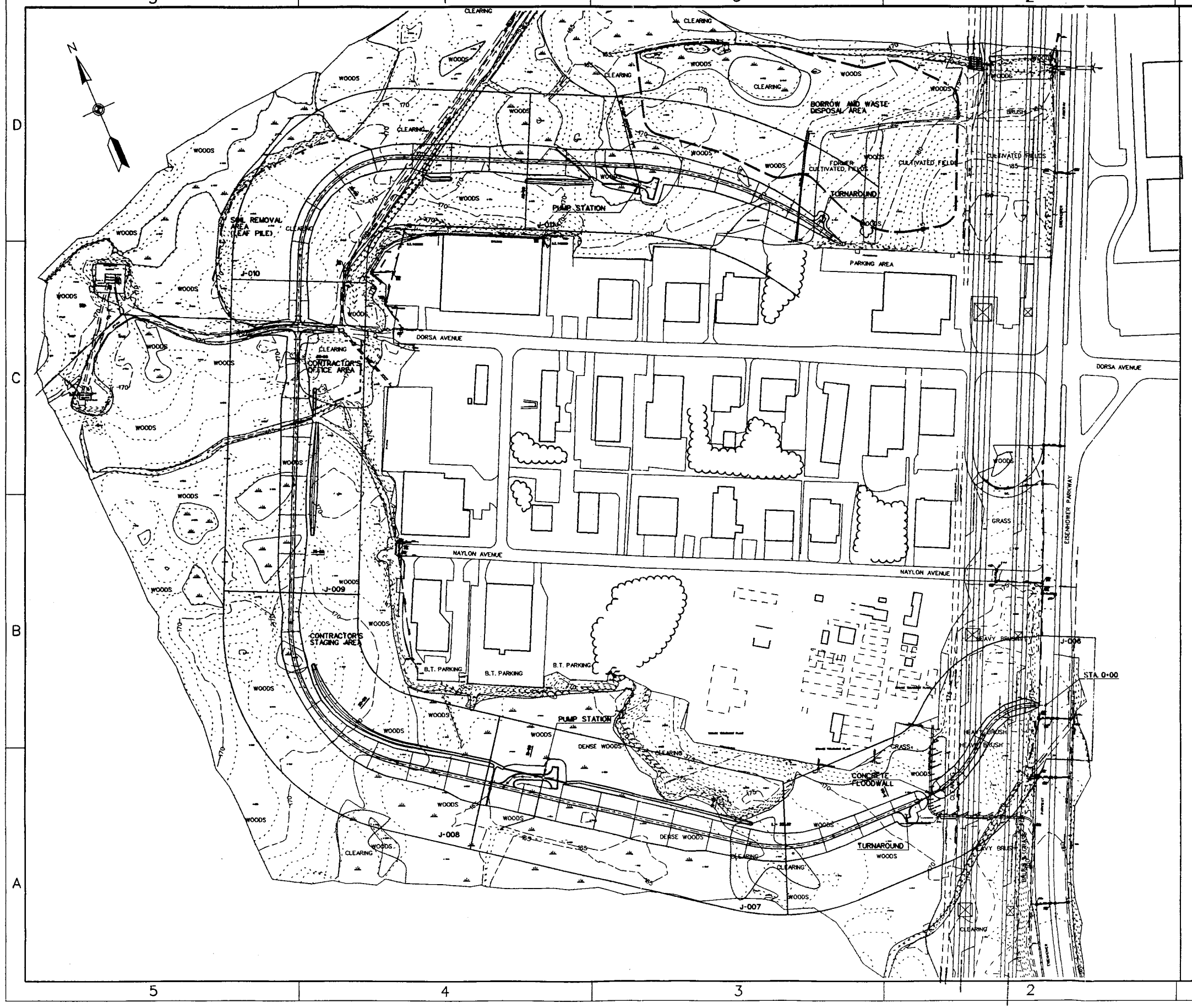
U.S. ARMY ENGINEER DISTRICT, NEW YORK
PASSAIC RIVER DIVISION
CORPS OF ENGINEERS

Passaic River Flood Damage Reduction Project
GENERAL DESIGN MEMORANDUM
Pequannock River
SOIL PROFILES

REVISED:

DATE: 7/95 | PREPARED BY: CENAN-PR-TG

ATTACHMENT E.13.2.2



SHEET LEGEND

- BUILDINGS
- BUILDING UNDER CONSTRUCTION
- UNCURBED ROADS
- ROADS, PARKING AREAS
- DRIVES
- DIRT ROADS
- WATERS EDGE AND SWAMP OUTLINE
- TREE
- STONE FENCE
- FENCE
- BRUSH LINE
- SWAMP SYMBOL
- WOODED AREA
- POWERLINE
- GUIDE RAIL

- SINGLE TREE
- TOWER
- MANHOLE
- CATCH BASIN
- FIRE HYDRANT
- TEL MANHOLE
- FLUSH CB GRATE
- UTILITY POLE
- MONITOR WELL
- LIGHT POLE
- GUY WIRE
- TEST HOLE
- SIGN
- VALVE

CURVE DATA

Δ - DEFLECTION ANGLE
D - DEGREE OF CURVE
R - RADIUS OF CURVE
T - TANGENT LENGTH
L - LENGTH OF CURVE

- PIPE CULVERT W/FES, PRECAST MH W/SLUICE GATE, FLAP GATE (NEW)
- PIPE CULVERT W/FES (NEW)

U.S. ARMY ENGINEER DISTRICT, NEW YORK
PASSAIC RIVER DIVISION
CORPS OF ENGINEERS
US Army Corps of Engineers

Passaic River Flood Damage Reduction Project

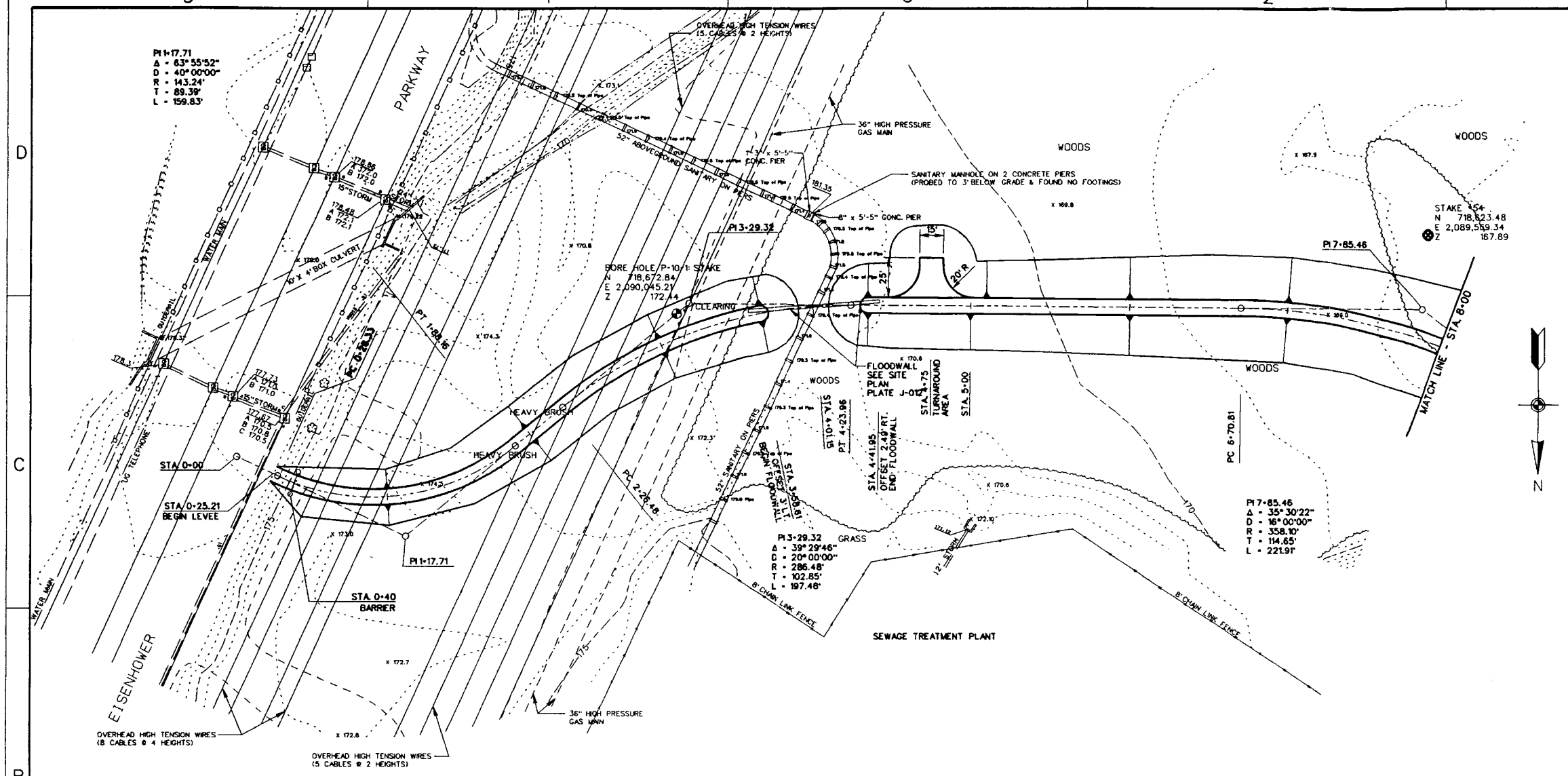
FEATURE DESIGN MEMORANDUM

GENERAL MAP - LEVEE

REVISED:

DATE: 30 JUNE 1995 | PREPARED BY : WILMINGTON DISTRICT

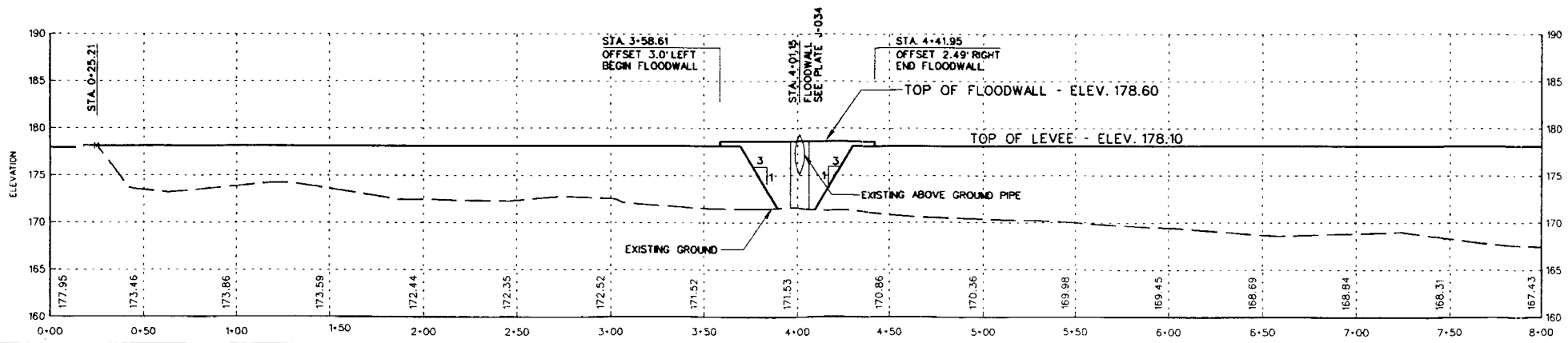
P10GEN.DGN | PLATE NO. J-002



SEE PLATE J-002 FOR LEGEND

SCALE IN FEET

HORZ. 30 0 30 60 90
VERT. 6 0 6 12 18



U.S. ARMY ENGINEER DISTRICT, NEW YORK
PASSAIC RIVER DIVISION
CORPS OF ENGINEERS

US Army Corps of Engineers

Passaic River Flood Damage Reduction Project

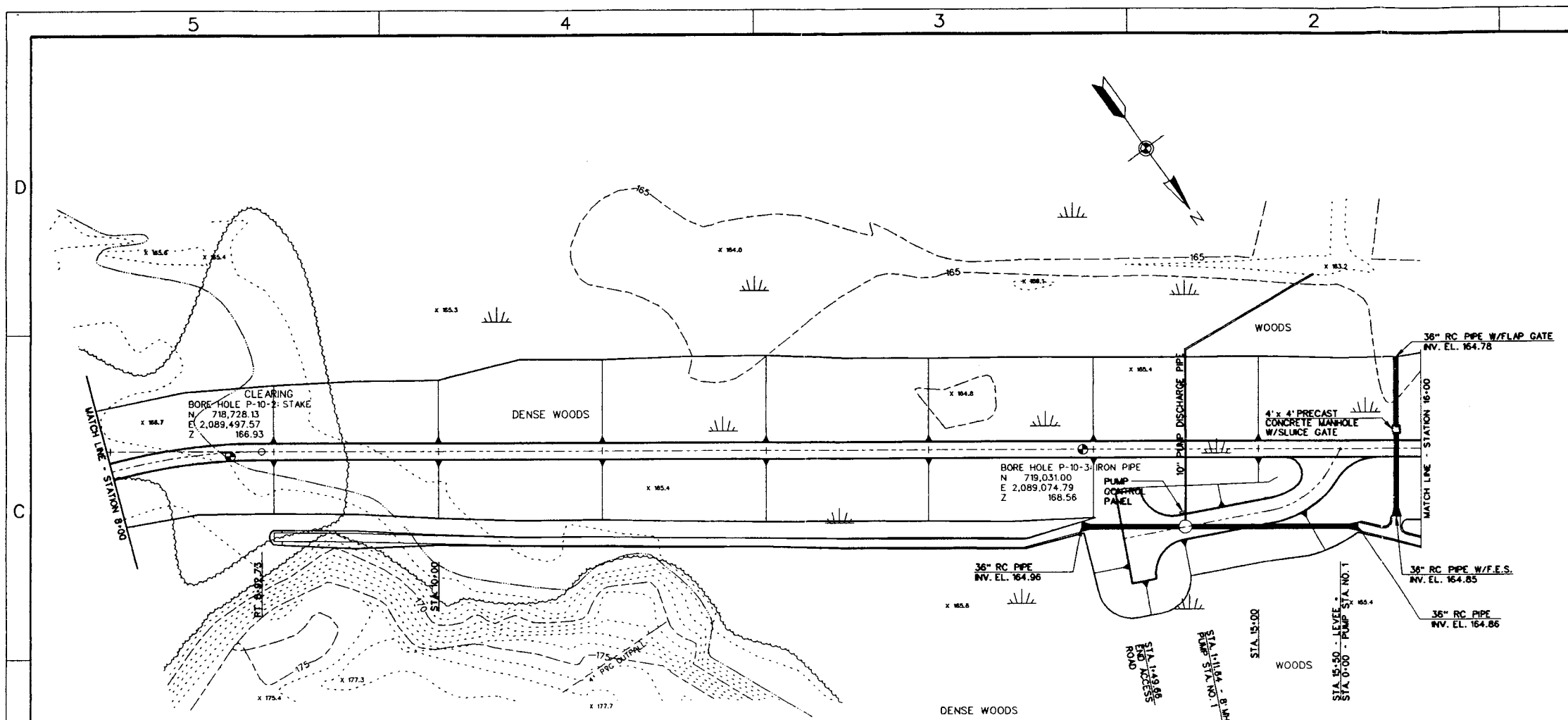
FEATURE DESIGN MEMORANDUM

PLAN AND PROFILE
STA. 0+25.21 TO 8+00

REVISED:

DATE: 30 JUNE 1995 | PREPARED BY: WILMINGTON DISTRICT

PAS10-01.DGN | PLATE NO. J-006



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PASSAIC RIVER DIVISION
CORPS OF ENGINEERS
US Army Corps of Engineers

Passaic River Flood Damage Reduction Project

FEATURE DESIGN MEMORANDUM

PLAN AND PROFILE
STA. 8+00 TO 16+00

REVISED:

DATE: 30 JUNE 1995 | PREPARED BY: WILMINGTON DISTRICT

PAS10-02.DGN | PLATE NO. J-007

STAKE #72
N 719,506.98
E 2,088,419.43
Z 172.12

PI 21+25.49

WOODS

STAKE #73
N 719,730.47
E 2,088,461.61
Z 174.30

BORE HOLE P-10-4 STAKE
N 719,280.56
E 2,088,730.36
Z 167.51

BORE HOLE P-10-5 STAKE
N 719,732.46
E 2,088,606.69
Z 173.15

PC 18+31.84

STA 20+00

CONTRACTOR'S STAGING AREA

PT 23+23.74

MATCH LINE - STA. 16+00

MATCH LINE - STA. 24+00

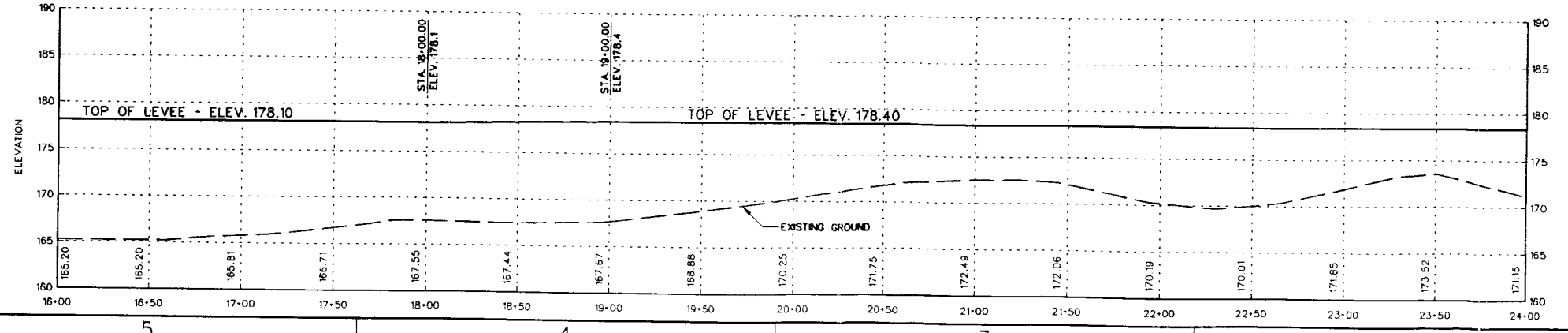
PI 21+25.49
Δ = 78° 42'16"
D = 16° 00'00"
R = 358.10'
T = 293.65'
L = 491.90'

N

SEE PLATE J-002 FOR LEGEND

SCALE IN FEET

HORZ.	30	0	30	60	90
VERT.	6	0	6	12	18



U.S. ARMY ENGINEER DISTRICT, NEW YORK
PASSAIC RIVER DIVISION
CORPS OF ENGINEERS
US Army Corps of Engineers

Passaic River Flood Damage Reduction Project

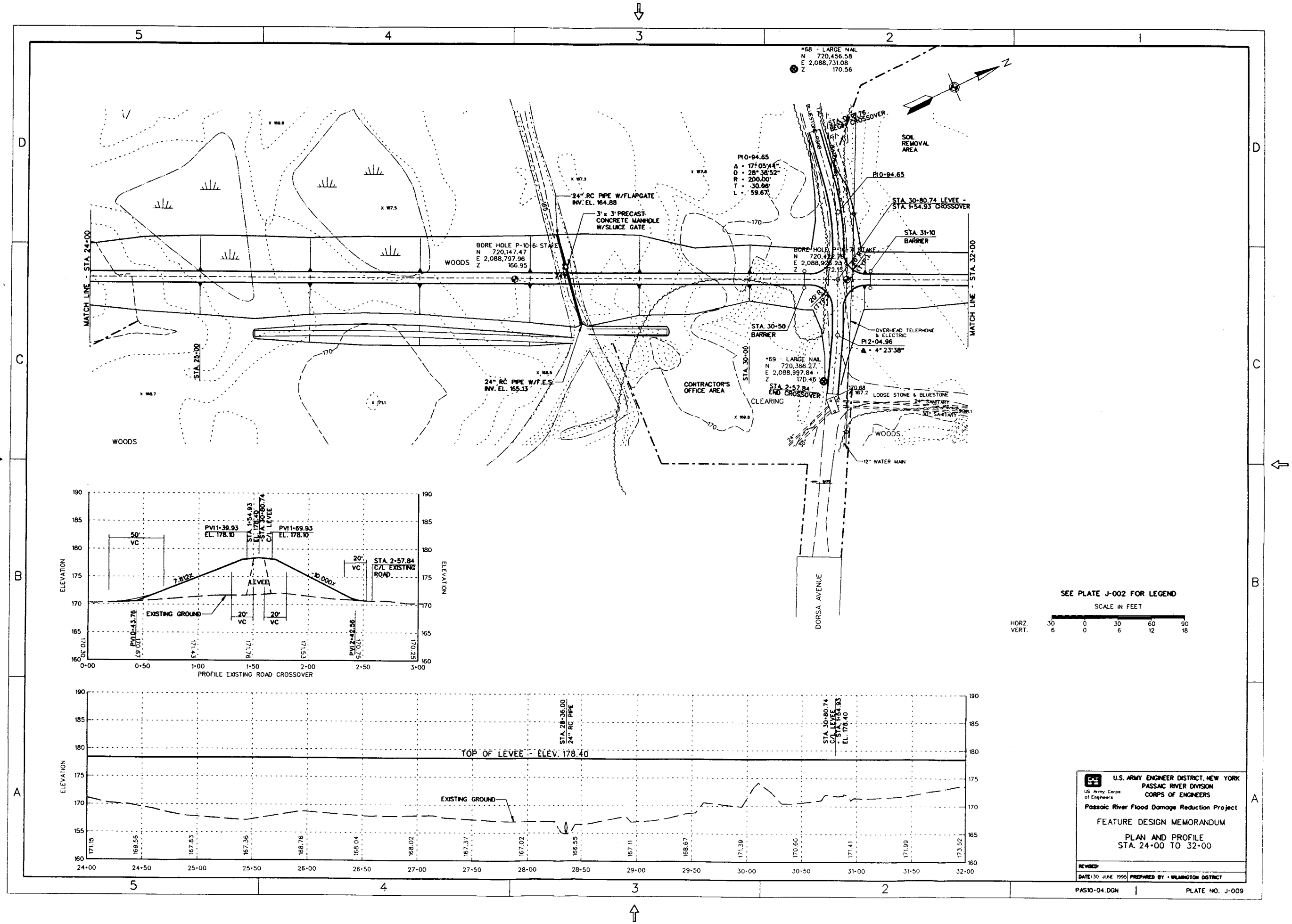
FEATURE DESIGN MEMORANDUM

PLAN AND PROFILE
STA. 16+00 TO 24+00

REVISED

DATE: 30 JUNE 1995 | PREPARED BY : WILMINGTON DISTRICT

PAS10-03.DGN | PLATE NO. J-008



U.S. ARMY ENGINEER DISTRICT, NEW YORK
PASSAIC RIVER DIVISION
CORPS OF ENGINEERS

US Army Corps of Engineers

Passaic River Flood Damage Reduction Project

FEATURE DESIGN MEMORANDUM

PLAN AND PROFILE
STA. 24+00 TO 32+00

REVISED

DATE: 30 JUNE 1995 | PREPARED BY : WILMINGTON DISTRICT

PAS10-04.DGN | 1 | PLATE NO. J-009

PI 35+30.21

SOIL REMOVAL AREA (LEAF PILE)

CLEARING

STAKE #67
N 720,648.25
E 2,089,007.22
Z 174.28

STA. 35+00

PC 32+66.50

MATCH LINE - STA. 32+00

PI 35+30.21
Δ = 90° 43'00"
D = 22° 00'00"
R = 260.44'
T = 263.71'
L = 412.35'

BORE HOLE B-10-8 STAKE
N 720,706.90
E 2,089,354.68
169.97

STAKE #66
N 720,774.49
E 2,089,481.73
Z 169.23

LOOSE STONE & RUBBLE

60' x 58' E.R.C.P. - SANITARY

24" RC PIPE W/FLAPGATE
INV. EL. 165.25

3' x 3' PRECAST CONCRETE MANHOLE W/SLUICE GATE

24" RC PIPE W/F.E.S.
INV. EL. 165.77

WOODS

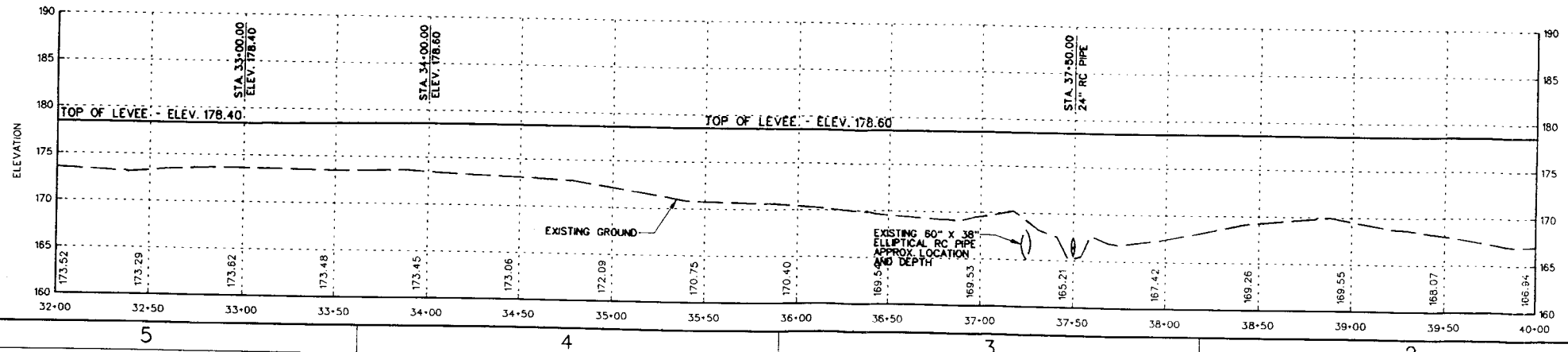
MATCH LINE - STA. 40+00

N

SEE PLATE J-002 FOR LEGEND

SCALE IN FEET

HORZ.	30	0	30	60	90
VERT.	6	0	6	12	18



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PASSAIC RIVER DIVISION
CORPS OF ENGINEERS
US Army Corps of Engineers

Passaic River Flood Damage Reduction Project

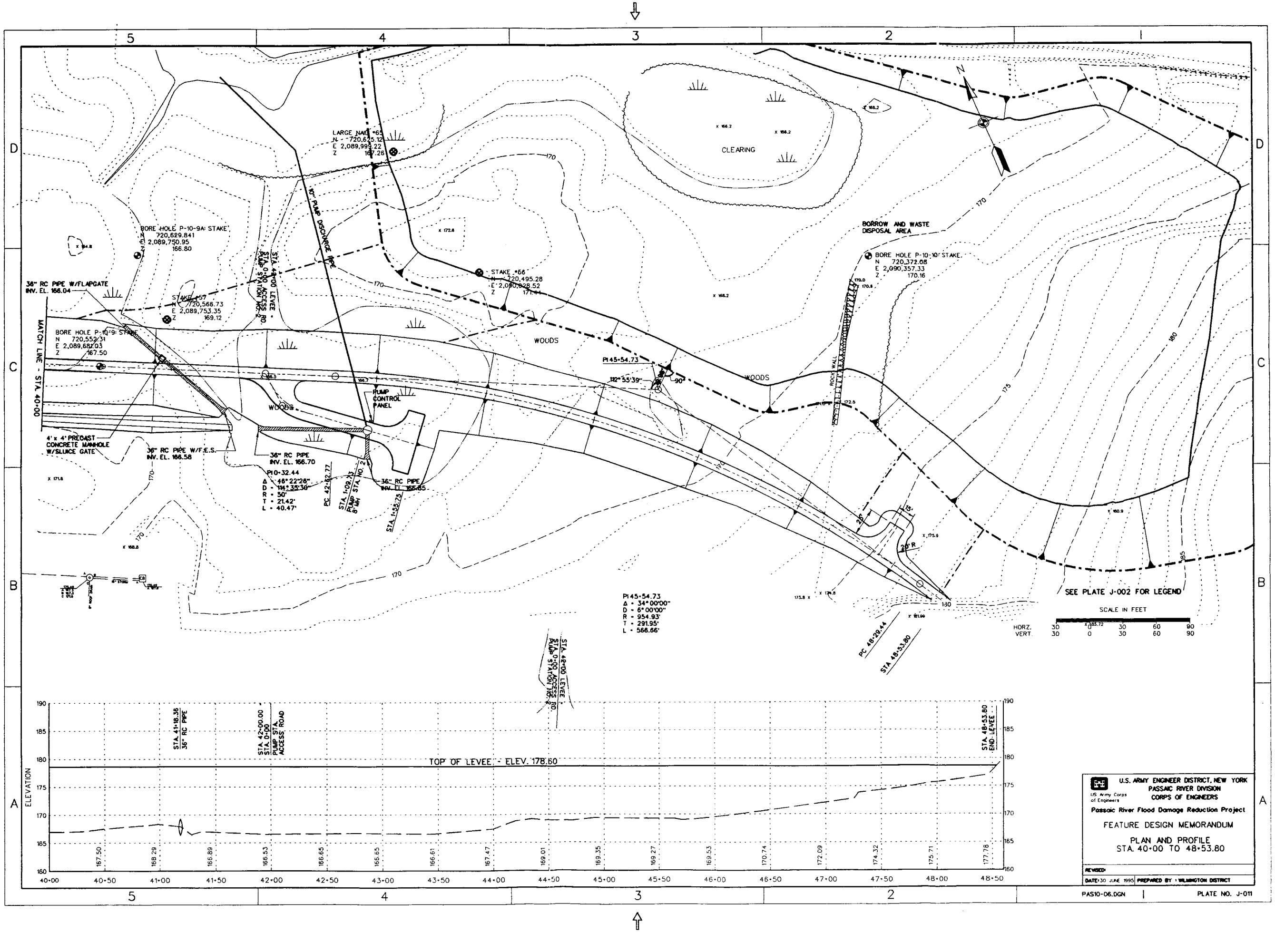
FEATURE DESIGN MEMORANDUM

PLAN AND PROFILE
STA. 32+00 TO 40+00

REVISED:

DATE: 30 JUNE 1995 PREPARED BY: WILMINGTON DISTRICT

PAS10-05.DGN | PLATE NO. J-010

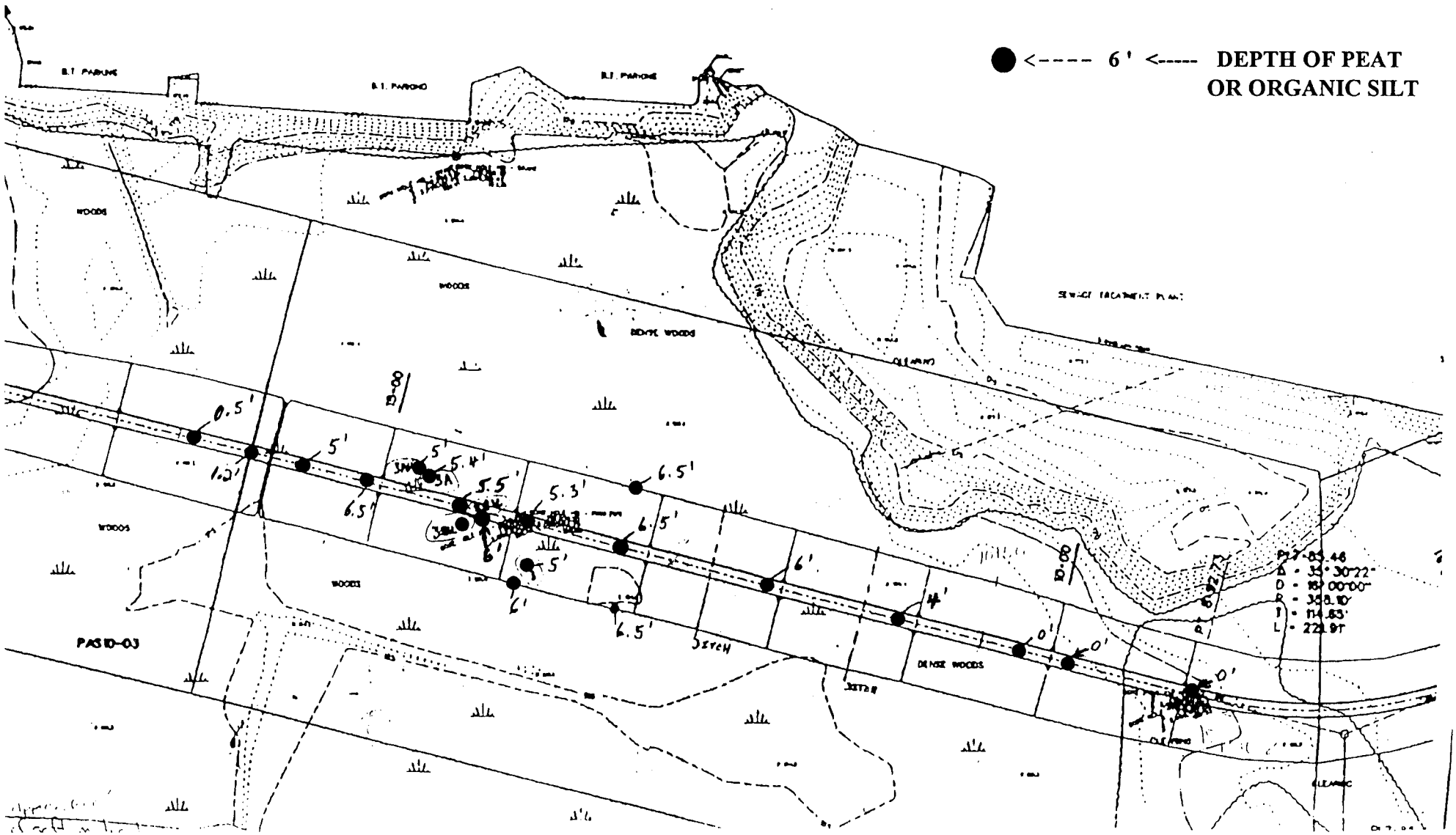

LARGE NAIL #65
N 720,625.12
E 2,089,999.22
Z 167.26
10" PUMP DISCHARGE PIPE
BORE HOLE P-10-9A STAKE
N 720,629.841
E 2,089,750.95
166.80
STA. 42+00 LEVEE
STA. 0+00 PUMP STATION ACCESS RD.
36" RC PIPE W/FLAPGATE
INV. EL. 166.04
STAKE #67
N 720,566.73
E 2,089,753.35
Z 169.12
BORE HOLE P-10-9 STAKE
N 720,552.31
E 2,089,681.03
Z 167.50
MATCH LINE - STA. 40+00
4' x 4' PRECAST CONCRETE MANHOLE W/SLUICE GATE
36" RC PIPE W/F.E.S.
INV. EL. 166.58
36" RC PIPE
INV. EL. 166.70
P10-32.44
Δ = 46°22'26"
D = 114°35'30"
R = 50'
T = 21.42'
L = 40.47'
PC 42+82.77
STA 1+09.21 PUMP STA. 8" MH
36" RC PIPE
INV. EL. 165.65
STA 1+53.25
WOODS
PUMP CONTROL PANEL
STAKE #66
N 720,495.28
E 2,089,948.52
Z 171.44
CLEARING
BORROW AND WASTE DISPOSAL AREA
BORE HOLE P-10-10 STAKE
N 720,372.08
E 2,090,357.33
Z 170.16
P145-54.73
132°55'39"
90°
ROCK WALL
P145-54.73
Δ = 34°00'00"
D = 6°00'00"
R = 954.93'
T = 291.95'
L = 566.66'
PC 48+29.44
STA 48+53.80
SEE PLATE J-002 FOR LEGEND
SCALE IN FEET
HORZ. 30 30 0 30 60 90
VERT. 30 0 30 60 90
STA. 41+18.36 36" RC PIPE
STA. 42+00.00 STA. 0+00 PUMP STA. ACCESS ROAD
STA. 48+53.80 END LEVEE
TOP OF LEVEE - ELEV. 178.60
ELEVATION
190 185 180 175 170 165 160
167.50 168.29 166.89 166.53 166.65 166.65 166.61 167.47 169.01 169.35 169.27 169.53 170.74 172.09 174.32 175.71 177.78
40+00 40+50 41+00 41+50 42+00 42+50 43+00 43+50 44+00 44+50 45+00 45+50 46+00 46+50 47+00 47+50 48+00 48+50
U.S. ARMY ENGINEER DISTRICT, NEW YORK
PASSAIC RIVER DIVISION
CORPS OF ENGINEERS
US Army Corps of Engineers
Passaic River Flood Damage Reduction Project
FEATURE DESIGN MEMORANDUM
PLAN AND PROFILE
STA. 40+00 TO 48+53.80
REVISED
DATE 30 JUNE 1995 PREPARED BY : WILMINGTON DISTRICT
PAS10-06.DGN
PLATE NO. J-011

PASSAIC RIVER FLOOD DAMAGE
REDUCTION PROJECT

SECTION 14
PASSAIC 10 LEVEE SYSTEM

ATTACHMENT E.14.2
AUGER BORING LOCATION MAP

PASSAIC #10 LEVEE
ORGANIC LAYER LOCATION



PASSAIC RIVER FLOOD DAMAGE REDUCTION PROJECT

SECTION 14
PASSAIC 10 LEVEE SYSTEM

ATTACHMENT E.14.3
DETAILED BORING LOGS

Attachment E.14.3

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P-10-4	11-14
P-10-5	15-16
P-10-6	17-18
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P-10-9	24-27
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Hole No. P-10-1

DRILLING LOG	DIVISION NORTH ATLANTIC	INSTALLATION PASSAIC RIVER DIV.	SHEET 1 OF 2 SHEETS
1. PROJECT: PASSAIC 10 LEVEE SYSTEM		10. SIZE AND TYPE OF BIT: 1⅜" ID SPLITSPOON	
2. LOCATION (Coordinates or Station): N 718,672.84 E 2,090,045.21		11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL	
3. DRILLING AGENCY: MOBILE DISTRICT		12. MANUFACTURER'S DESIGNATION OF DRILL: CME-75	
4. HOLE NO. (As shown on drawing title and file number): P-10-1		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 12 / UNDISTURBED 0	
5. NAME OF DRILLER: CARL MOON		14. TOTAL NUMBER CORE BOXES: N/A	
6. DIRECTION OF HOLE: [X] VERTICAL [ ] INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER: SEE NOTE	
		16. DATE HOLE: STARTED 9/2/93 / COMPLETED 9/2/93	
		17. ELEVATION TOP OF HOLE: 72.44 ± (TOPO)	
7. THICKNESS OF OVERBURDEN: N/A		18. TOTAL CORE RECOVERY FOR BORING: N/A %	
8. DEPTH DRILLED INTO ROCK: N/A		19. SIGNATURE OF INSPECTOR: LESLIE (ORD) CHILD (SAW)	
9. TOTAL DEPTH OF HOLE: 18.0'			

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	0		ML- Dark brown, non plastic, slightly organic, dry silt			NOTE: During drilling water level encountered at 12.0' depth. At completion of drilling water level at depth of 11.8' No 24 hour level taken.
	1				1	13
	2					38
	3				2	
	4		CL-Brown, red and yellow, damp, silty lean clay		3	39
			Brown		4	
	5					49
	6				5	
	7					LAB. DATA W=25.6% LL-33 PL=20 PI=13
	8				6	38
	9					28
			CONTINUED ON SHEET 2 SOILS ARE FIELD VISUALLY CLASSIFIED IN ACCORDANCE WITH THE UNIFIED SOIL CLASSIFICATION SYSTEM		7	BLOWS/FOOT: NUMBER REQUIRED TO DRIVE 1⅜" ID SPLITSPOON WITH 140 LB. HAMMER FALLING 30 INCHES

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE.

PROJECT: PASSAIC 10 LEVEE SYS | HOLE NO.: P-10-1

DRILLING LOG (Cont Sheet) | ELEVATION TOP OF HOLE 172.44 | Hole No. P-10-1

PROJECT: PASSAIC 10 LEVEE SYSTEM | INSTALLATION: PASSAIC RIVER DIV. | SHEET 2 OF 2 SHEETS

ELEVATION (a)	DEPTH (b)	LEGEND (c)	CLASSIFICATION OF MATERIALS (Description) (d)	% CORE RECOVERY (e)	BOX OR SAMPLE NO. (f)	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) (g)
	9		ML- Brown, wet, silt with trace of sand			
	10				8	34
			Moist, clayey, silt			LAB. DATA W=25.1% LL-23 PL=19 PI=4
	11				9	40
	12		SC-Brown, moist, medium to coarse grain, clayey sand.		10	
					11	40
	13					
	14				12	30
	15					
	16				13	37
						NOTE: Soils were visually classified and some descriptions modified by Tom Child, Civil Engineer, CESAW.
	17		SM-Brown, moist, medium to coarse grain silty sand.		14	46
						NOTE: HOLE TERMINATED AT PREDETERMINED DEPTH OF 18.0'.
	18		BOTTOM OF HOLE @ 18.0'			

ENG FORM 1836-A PREVIOUS EDITIONS ARE OBSOLETE. MAR 71

PROJECT: PASSAIC 10 LEVEE SYS | HOLE NO. P-10-1

Hole No. P-10-2

DRILLING LOG	DIVISION NORTH ATLANTIC	INSTALLATION PASSAIC RIVER DIV.	SHEET 1 OF 2 SHEETS
1. PROJECT: PASSAIC 10 LEVEE SYSTEM		11. SIZE AND TYPE OF BIT: 1⅜" ID SPLITSPOON	
2. LOCATION (Coordinates or Station): N 718,728.13 E 2,089,197.57		12. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL	
3. DRILLING AGENCY: MOBILE DISTRICT		13. MANUFACTURER'S DESIGNATION OF DRILL: CME-75	
4. HOLE NO. (As shown on drawing title and file number): P-10-2		14. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN: DISTURBED 12 / UNDISTURBED 0	
5. NAME OF DRILLER: CARL MOON		15. TOTAL NUMBER CORE BOXES: N/A	
6. DIRECTION OF HOLE: [X] VERTICAL [ ] INCLINED _____ DEG. FROM VERT.		16. DATE HOLE: STARTED 8/28/93 / COMPLETED 8/30/93	
7. THICKNESS OF OVERBURDEN: N/A		17. ELEVATION TOP OF HOLE: 166.93 ± (TOPO)	
8. DEPTH DRILLED INTO ROCK: N/A		18. TOTAL CORE RECOVERY FOR BORING: N/A %	
9. TOTAL DEPTH OF HOLE: 18.0'		19. SIGNATURE OF INSPECTOR: LESLIE (ORD) CHILD (SAW)	

ELEVATION (a)	DEPTH (b)	LEGEND (c)	CLASSIFICATION OF MATERIALS (Description) (d)	% CORE RECOVERY (e)	BOX OR SAMPLE NO. (f)	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) (g)
	0		ML-Black, slightly damp organic, low plastic silt with roots.			NOTE: Hole was dry during and at completion of drilling. No 24 hour level taken. 9
	2		CL-Red, brown, iron stain, dry nonplastic silty clay.		1	62
	3				2	LAB DATA W=9.6% LL=33 PL=15 PI=18
	4				3	75
	5		Brown, slightly silty		4	59
	6				5	63
	7					
	8				6	42
	9		CONTINUED ON SHEET 2			BLOWS/FOOT: NUMBER REQUIRED TO DRIVE 1⅜" ID SPLITSPOON WITH 140 LB. HAMMER FALLING 30 INCHES

SOILS ARE FIELD VISUALLY CLASSIFIED IN ACCORDANCE WITH THE UNIFIED SOIL CLASSIFICATION SYSTEM

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PROJECT: PASSAIC 10 LEVEE SYS | HOLE NO.: P-10-2

DRILLING LOG (Cont Sheet) | ELEVATION TOP OF HOLE 166.93 | Hole No. P-10-2

PROJECT: PASSAIC 10 LEVEE SYSTEM | INSTALLATION: PASSAIC RIVER DIV. | SHEET 2 OF 2 SHEETS

ELEVATION (a)	DEPTH (b)	LEGEND (c)	CLASSIFICATION OF MATERIALS (Description) (d)	% CORE RECOVERY (e)	BOX OR SAMPLE NO. (f)	REMARKS (Drilling time, water loss, depth of weathering, etc. If significant) (g)
	9		CL-Brown, dry, nonplastic slightly silty clay.		7	24
	10					
	11				8	LAB DATA W=22.5% LL=36 PL=19 PI=17 17
	12		Very silty, more plastic			
	13				9	21
	14				10	16
	15					
	16				11	34
	17		CH-Brown, silty, wet fat, plastic clay.		12	NOTE: Soils were visually classified and some descriptions modified by Tom Child, Civil Engineer, CESAW 24 NOTE: Hole Terminated at Predetermined depth of 18.0'.
	18		BOTTOM OF HOLE @ 18.0'			

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PROJECT: PASSAIC 10 LEVEE SYS | HOLE NO. P-10-2

Hole No. P-10-3

DRILLING LOG	DIVISION NORTH ATLANTIC	INSTALLATION PASSAIC RIVER DIV.	SHEET 1 of 2 SHEETS
1. PROJECT PASSAIC 10 LEVEE SYSTEM		10. SIZE AND TYPE OF BIT 1⅜" ID SPLITSPOON	
2. LOCATION (Coordinates or Station) N 719,031.00 E 2,089,074.79		11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MSL	
3. DRILLING AGENCY MOBILE DISTRICT		12. MANUFACTURER'S DESIGNATION OF DRILL CME-75	
4. HOLE NO. (As shown on drawing title and file number) P-10-3		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 12	UNDISTURBED 0
5. NAME OF DRILLER CARL MOON		14. TOTAL NUMBER CORE BOXES N/A	
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER SEE NOTE	
		16. DATE HOLE: STARTED 8/28/93	COMPLETED 8/30/93
7. THICKNESS OF OVERBURDEN N/A		17. ELEVATION TOP OF HOLE 168.56 + (TOPO)	
8. DEPTH DRILLED INTO ROCK N/A		18. TOTAL CORE RECOVERY FOR BORING N/A %	
9. TOTAL DEPTH OF HOLE 18.0'		19. SIGNATURE OF INSPECTOR LESLIE (ORD) CHILD (SAW)	

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	0		OL-Black, organic, slightly damp, silt.		1	NOTE: Water Level during drilling at 6.0' depth. 24 hour Water Level at 2.5' depth. 1
	2				2	1
	4				3	1
	5		OH-Black, organic, moist fat clay.		4	
			MH-Dark grey and brown damp plastic silt.		5	12
	6		SM-Brown, fine grain silty sand, damp with trace of clay.		6	
	7				7	8
	8				8	LAB CLASS=SM W=15.1% LL=15 PL=14 PI=1 16
	9		See next page-MH		9	
			CONTINUED ON SHEET 2			BLOWS/FOOT: NUMBER REQUIRED TO DRIVE 1⅜" ID SPLITSPOON WITH 140 LB. HAMMER FALLING 30 INCHES

SOILS ARE FIELD VISUALLY CLASSIFIED IN ACCORDANCE WITH THE UNIFIED SOIL CLASSIFICATION SYSTEM

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE.

PROJECT PASSAIC 10 LEVEE SYS | HOLE NO. P-10-3

DRILLING LOG (Cont Sheet) | ELEVATION TOP OF HOLE 168.56 | Hole No. P-10-3

PROJECT: PASSAIC 10 LEVEE SYSTEM | INSTALLATION: PASSAIC RIVER DIV. | SHEET 2 OF 2 SHEETS

ELEVATION (g)	DEPTH	LEGEND (c)	CLASSIFICATION OF MATERIALS (Description) (d)	% CORE RECOVERY (e)	BOX OR SAMPLE NO. (f)	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) (g)
	9		MH-Brown, grey, moist, plastic silt.			
	10				10	
	11				11	
	12		CH-Brown, wet, plastic, silty clay.		12	
	13		SC-Brown, wet fine to medium grain, clayey sand		13	LAB. CLASS =SM-SC W=14.4% LL=17 PL=13 PI=4
	14				14	NOTE: Soils were visually classified and some descriptions modified by Tom Child, Civil Engineer, CESAW.
	15					
	16					
	17		CH/SC-Brown, moist, plastic clay and clayey sand		15	NOTE: Hole Terminated at Predetermined depth of 18.0'.
	18		BOTTOM OF HOLE @ 18.0'			

15 16 4 13 27 26

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PROJECT: PASSAIC 10 LEVEE SYS | HOLE NO.: P-10-3

Hole No. P 10 3A

DRILLING LOG	DIVISION NORTH ATLANTIC
1. PROJECT PASSAIC 10 LEVEE SYSTEM	
2. LOCATION (Coordinates or Station)	
3. DRILLING AGENCY MOBILE DISTRICT	
4. HOLE NO. (As shown on drawing title and file number)	P-10-3A
5. NAME OF DRILLER JAMES KNOX	
6. DIRECTION OF HOLE [X] VERTICAL [ ] INCLINED ____ DEG. FROM VERT.	
7. THICKNESS OF OVERBURDEN	N/A
8. DEPTH DRILLED INTO ROCK	N/A
9. TOTAL DEPTH OF HOLE	7.5'
INSTALLATION PASSAIC RIVER DIV.	SHEET 1 of 1 SHEETS
10. SIZE AND TYPE OF BIT 1 3/8" ID SPLITSPOON	
11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MSL	
12. MANUFACTURER'S DESIGNATION OF DRILL CME-75	
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED 5 / UNDISTURBED 0
14. TOTAL NUMBER CORE BOXES	N/A
15. ELEVATION GROUND WATER	SEE NOTE
16. DATE HOLE	STARTED 9/11/93 / COMPLETED 9/11/93
17. ELEVATION TOP OF HOLE 167 ± (TOPO)	
18. TOTAL CORE RECOVERY FOR BORING	N/A %
19. SIGNATURE OF INSPECTOR LESLIE (ORD) CHILD (SAW)	

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	0					NOTE: Water Level on 9/13/93 was 1.7' depth.
	1		ML/OH-Black, damp, organic silts with plant roots		1	
	2		MH/OH-Black, damp, organic plastic silt.		2	
	3		Moist		3	
	4				4	
	5					
	6		CH-Gray, moist, medium plastic clay		5	NOTE: Field logs transcribed into final logs by CESAW-EN-GS.
	7				6	NOTE: Hole Terminated at a depth of 7.5'.
	7.5		BOTTOM OF HOLE @ 7.5' SOILS ARE FIELD VISUALLY CLASSIFIED IN ACCORDANCE WITH THE UNIFIED SOIL CLASSIFICATION SYSTEM			BLOWS/FOOT: NUMBER REQUIRED TO DRIVE 1 3/8" ID SPLITSPOON WITH 140 LB. HAMMER FALLING 30 INCHES

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE.

PROJECT PASSAIC 10 LEVEE SYS | HOLE NO. P-10-3A

Hole No. P-10-3AU

DRILLING LOG	DIVISION NORTH ATLANTIC	INSTALLATION PASSAIC RIVER DIV.	SHEET 1 OF 1 SHEETS
1. PROJECT: PASSAIC 10 LEVEE SYSTEM		10. SIZE AND TYPE OF BIT: HOLLOW STEM AUGER AND	
2. LOCATION (Coordinates or Station)		11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL	SHELLBY TUBES
3. DRILLING AGENCY: MOBILE DISTRICT		12. MANUFACTURER'S DESIGNATION OF DRILL: CME-75	
4. HOLE NO. (As shown on drawing title and file number): P-10-3AU		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 3	UNDISTURBED 0
5. NAME OF DRILLER: JAMES KNOX		14. TOTAL NUMBER CORE BOXES: N/A	
6. DIRECTION OF HOLE: [X] VERTICAL [ ] INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER: SEE NOTE	
		16. DATE HOLE: STARTED 9/2/93	COMPLETED 9/2/93
7. THICKNESS OF OVERBURDEN: N/A		17. ELEVATION TOP OF HOLE: 167 ± (TOPO)	
8. DEPTH DRILLED INTO ROCK: N/A		18. TOTAL CORE RECOVERY FOR BORING: N/A %	
9. TOTAL DEPTH OF HOLE: 7.0'		19. SIGNATURE OF INSPECTOR: LESLIE (ORD) CHILD (SAW)	

ELEVATION (a)	DEPTH (b)	LEGEND (c)	CLASSIFICATION OF MATERIALS (Description) (d)	% CORE RECOVERY (e)	BOX OR SAMPLE NO. (f)	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) (g)
	0					
	1		OL/ML-Black, damp, low plasticity, organic silt.			NOTE: Shelby Tube 3"x 2.5'
	2		LAB. DATA UD-1 Depth 1.5' to 2.3' CLASS. OL - Organic Silt LOI=29.3%		TUBE 1 OF 3	Started at 0.5' Pushed 2.0' REC. 1.0' LOSS 1.0'
					JAR 1	
	3					
	4		LAB DATA UD-2 Depth 4.4' to 4.8' CLASS = OH Peaty muck LOI= 32.6%		TUBE 2 OF 3	Started at 3.0' Pushed 2.0' REC. 0.6'
	5		CH-Gray, moist, highly plastic clay		JAR 2	LOSS 1.4'
			LAB. DATA UD-3 CLASS. CH- Fat clay LL=60 PL=24 PI=36 W+45.8% G_s =2.66		TUBE 3 OF 3	Started at 5.0' Pushed 2.0' REC. 2.0'
	6					NOTE: Hole Terminated at a depth of 7.0'.
	7				JAR 3	NOTE: Field logs transcribed into final logs by CESAW-EN-GS.
			BOTTOM OF HOLE @ 7.0' SOILS ARE FIELD VISUALLY CLASSIFIED IN ACCORDANCE WITH THE UNIFIED SOIL CLASSIFICATION SYSTEM			

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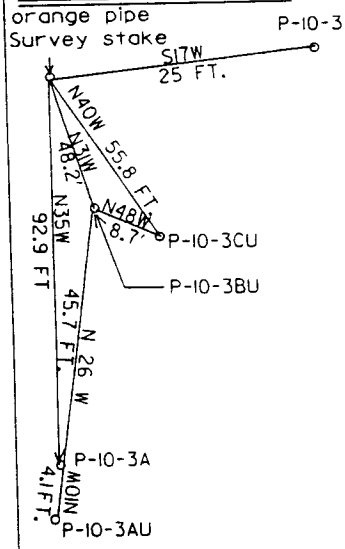
PROJECT: PASSAIC 10 LEVEE SYS | HOLE NO.: P-10-3AU

Hole No. P-10-3BU

DRILLING LOG	DIVISION NORTH ATLANTIC
1. PROJECT PASSAIC 10 LEVEE SYSTEM	
2. LOCATION (Coordinates or Station)	
3. DRILLING AGENCY MOBILE DISTRICT	
4. HOLE NO. (As shown on drawing title and file number) P-10-3BU	
5. NAME OF DRILLER JAMES KNOX	
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.	
7. THICKNESS OF OVERBURDEN N/A	
8. DEPTH DRILLED INTO ROCK N/A	
9. TOTAL DEPTH OF HOLE 3.2'	
INSTALLATION PASSAIC RIVER DIV.	SHEET 1 OF 1 SHEETS
10. SIZE AND TYPE OF BIT 3" X 2.5" SHELBY TUBE	
11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MSL	
12. MANUFACTURER'S DESIGNATION OF DRILL CME-75	
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 1 / UNDISTURBED	
14. TOTAL NUMBER CORE BOXES N/A	
15. ELEVATION GROUND WATER SEE NOTE	
16. DATE HOLE: STARTED 9/13/93 / COMPLETED 9/13/93	
17. ELEVATION TOP OF HOLE 167 ± (TOPO)	
18. TOTAL CORE RECOVERY FOR BORING N/A %	
19. SIGNATURE OF INSPECTOR LESLIE (ORD) CHILD (SAW)	

ELEVATION a	DEPTH (b)	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	1		LAB. DATA UD-1 Depth 1.3' to 3.0' CLASS. = OH LL=432 PL=194 PI=238 W=355.8% G_S =1.60			Started at 0.7' Pushed 2.5' REC. 1.9' LOSS 0.6'
	2				TUBE 1 OF 1	NOTE: Field logs transcribed into final logs by CESAW-EN-GS.
	3				JAR 1	NOTE: Hole terminated at a depth of 3.2'.
	3.2		BOTTOM OF HOLE @ 3.2' SOILS ARE FIELD VISUALLY CLASSIFIED IN ACCORDANCE WITH THE UNIFIED SOIL CLASSIFICATION SYSTEM			

MAP OF P-10-3 BORINGS



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PROJECT PASSAIC 10 LEVEE SYS | HOLE NO. P-10-3BU

Hole No. P-10-3CU

DRILLING LOG	DIVISION NORTH ATLANTIC	INSTALLATION PASSAIC RIVER DIV.	SHEET 1 OF 1 SHEETS
1. PROJECT PASSAIC 10 LEVEE SYSTEM		10. SIZE AND TYPE OF BIT 3" X 5.0' SHELBY TUBE	
2. LOCATION (Coordinates or Station)		11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MSL	
3. DRILLING AGENCY MOBILE DISTRICT		12. MANUFACTURER'S DESIGNATION OF DRILL CME-75	
4. HOLE NO. (As shown on drawing title and file number)	P-10-3CU	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 1	UNDISTURBED 1
5. NAME OF DRILLER JAMES KNOX		14. TOTAL NUMBER CORE BOXES N/A	
6. DIRECTION OF HOLE [X] VERTICAL [ ] INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER SEE NOTE	
		16. DATE HOLE STARTED 9/13/93	COMPLETED 9/13/93
		17. ELEVATION TOP OF HOLE	
7. THICKNESS OF OVERBURDEN N/A		18. TOTAL CORE RECOVERY FOR BORING N/A %	
8. DEPTH DRILLED INTO ROCK N/A		19. SIGNATURE OF INSPECTOR LESLIE (ORD) CHILD (SAW)	
9. TOTAL DEPTH OF HOLE 6.2'			

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc. if significant) g
	0		OL/ML- Black, moist, organic silt.			
	1					
	2					
	3					
	4				TUBE 1 OF 1	Started at 1.2' Pushed 5.0' REC. 2.4' LOSS 2.6' NOTE: Field logs transcribed into finallogs by CESAW-EN-GS
	5					
	6		CL- Gray, damp, lean clay		JAR 1	
	6.2		BOTTOM OF HOLE @ 6.2' SOILS ARE FIELD VISUALLY CLASSIFIED IN ACCORDANCE WITH THE UNIFIED SOIL CLASSIFICATION SYSTEM			

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PROJECT PASSAIC 10 LEVEE SYS | HOLE NO. P-10-3CU

Hole No. P 10 4

DRILLING LOG	DIVISION NORTH ATLANTIC	INSTALLATION PASSAIC RIVER DIV.	SHEET 1 OF 4 SHEETS
1. PROJECT PASSAIC 10 LEVEE SYSTEM		10. SIZE AND TYPE OF BIT 1 3/8" ID SPLITSPOON AND	
2. LOCATION (Coordinates or Station) N 719,280.56 E 2,088,730.36		11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MSL	HOLLOW STEM AUGER
3. DRILLING AGENCY MOBILE DISTRICT		12. MANUFACTURER'S DESIGNATION OF DRILL CME-75	
4. HOLE NO. (As shown on drawing title and file number) P-10-4		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED 20 / UNDISTURBED 0
5. NAME OF DRILLER CARL MOON		14. TOTAL NUMBER CORE BOXES N/A	
6. DIRECTION OF HOLE [X] VERTICAL [ ] INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER SEE NOTE	
		16. DATE HOLE	STARTED 8/30/93 / COMPLETED 9/1/93
7. THICKNESS OF OVERBURDEN N/A		17. ELEVATION TOP OF HOLE 167.51 + (TOPO)	
8. DEPTH DRILLED INTO ROCK N/A		18. TOTAL CORE RECOVERY FOR BORING N/A %	
9. TOTAL DEPTH OF HOLE 51.5'		19. SIGNATURE OF INSPECTOR LESLIE (ORD) CHILD (SAW)	

ELEVATION a	DEPTH (b)	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g	
	1		ML-Dark brown, dry, organic nonplastic silt with plant roots			NOTE: During Drilling the water level was encountered at 9.0' of depth. Water level at completion of drilling was at a depth of 28.1 feet. 24 hr Water Level at 7.3' depth.	13
	2		Light brown and iron stained, red, dry, low plasticity, silt with trace of clay and sand		1		42
	3				2		37
	4		Light gray and brown with clay		3		
	5		With sand and clay		4	LAB CLASS (CL-ML) W=13.3% LL=21 PL=15 PI=6	33
	6		Reddish brown		5		40
	7						
	8		SM-Brownish, medium to fine grained, damp, silty, sand		6		32
	9		CONTINUED ON SHEET 2 SOILS ARE FIELD VISUALLY CLASSIFIED IN ACCORDANCE WITH THE UNIFIED SOIL CLASSIFICATION SYSTEM			BLOWS/FOOT: NUMBER REQUIRED TO DRIVE 1 3/8" ID SPLITSPOON WITH 140 LB. HAMMER FALLING 30 INCHES	

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PROJECT PASSAIC 10 LEVEE SYS | HOLE NO. P-10-4

DRILLING LOG (Cont Sheet) | ELEVATION TOP OF HOLE 167.51 | Hole No. P-10-4

PROJECT: PASSAIC 10 LEVEE SYSTEM | INSTALLATION: PASSAIC RIVER DIV. | SHEET 2 OF 4 SHEETS

ELEVATION	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX OR SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
	9					
	10		SM-Brown, medium to coarse grained, silty sand		7	27
	11				8	29
	12				9	61
	13					
	14				10	42
	15		CH-Brown, moist, sandy, fat clay.		11	
	16		SM-Brown, medium to coarse silty sand with some clay		12	61
	17		CH-Brown, moist, sandy, fat clay.		13	31
	18		CONTINUED ON SHEET 3			

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PROJECT: PASSAIC 10 LEVEE SYS | HOLE NO. P-10-4

DRILLING LOG (Cont Sheet) | ELEVATION TOP OF HOLE 167.51 | Hole No. P-10-4

PROJECT: PASSAIC 10 LEVEE SYSTEM | INSTALLATION: PASSAIC RIVER DIV. | SHEET 3 OF 4 SHEETS

ELEVATION (a)	DEPTH	LEGEND (c)	CLASSIFICATION OF MATERIALS (Description) (d)	% CORE RECOVERY (e)	BOX OR SAMPLE NO. (f)	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) (g)	
	18		CH- Brown, moist, sandy fat clay			NOTE: Scale changed at 18.0' to 1" = 2'	
					14	LAB CLASS W=22.6% LL=31 PL=18 PI=13	33
	20		Augered to 25.0' No sample taken				
	22						
	24						
	26		CL-Brown, moist, sandy lean clay with some plastic clay		15	NOTE: Splitspooned from 25.0' to 26.5'.	39
			Augered from 26.5' to 30.0' No sample taken			LAB CLASS W=31.2% LL=35 PL=20 PI=15	
	28						
	30		CH-Brown, moist, hard fat clay		16	NOTE: Splitspooned from 30.0' to 31.5'	54
	32		Augered from 31.5' to 35.0' No sample taken				
	34						
	36		CH-Brown, moist, hard, fat clay with black shell, coarse grained gravel, approx. 1" in diameter		17	NOTE: Splitspooned from 35.0' to 36.5'.	84
			Augered from 36.5' to 38.0'				
	38		CONTINUED ON SHEET 4				

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PROJECT: PASSAIC 10 LEVEE SYS | HOLE NO. P-10-4

DRILLING LOG (Cont Sheet) | ELEVATION TOP OF HOLE 167.51 | Hole No. P-10-4

PROJECT: PASSAIC 10 LEVEE SYSTEM | INSTALLATION: PASSAIC RIVER DIV. | SHEET 4 OF 4 SHEETS

ELEVATION	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX OR SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
	38		Augered from 38.0' to 40.0'			
	40		SM-Brown, dense, moist, medium grain, silty sand		18	NOTE: Splitspooned from 40.0' to 41.5' 40
	42		Augered from 41.5' to 42.0' No sample taken			100/.6
			SC-Brown, fine grained, clayey sand, moist		19	NOTE: This interval accidently sampled because of a miscalculation
	44		Augered from 42.6' to 45.0' No sample taken			
	46		SC-Brown, fine, clayey, fine grained sand, moist		20	NOTE: Splitspooned from 45.8' to 46.5' 38
	48		Augered from 46.5' to 50.0' No sample taken			LAB CLASS W=24.3% LL=20 PL=20 PI=NP
	50		ML-Brown, gray, moist, silt with some plastic silt		21	NOTE: Hole terminated at Predetermined depth of 51.5' 28
	51.5		BOTTOM OF HOLE @ 51.5'			

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PROJECT: PASSAIC 10 LEVEE SYS | HOLE NO. P-10-4

Hole No. P-10-5

DRILLING LOG	DIVISION NORTH ATLANTIC	INSTALLATION PASSAIC RIVER DIV.	SHEET 1 OF 2 SHEETS

1. PROJECT PASSAIC 10 LEVEE SYSTEM.	10. SIZE AND TYPE OF BIT 1 3/8" ID SPLITSPOON
2. LOCATION (Coordinates or Station) N 719,732.46 E 2,088,606.69	11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MSL
3. DRILLING AGENCY MOBILE DISTRICT	12. MANUFACTURER'S DESIGNATION OF DRILL CME-75
4. HOLE NO. (As shown on drawing title and file number) P-10-5	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN DISTURBED 14 UNDISTURBED 0
5. NAME OF DRILLER CARL MOON	14. TOTAL NUMBER CORE BOXES N/A
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.	15. ELEVATION GROUND WATER SEE NOTE
7. THICKNESS OF OVERBURDEN N/A	16. DATE HOLE STARTED 9/1/93 COMPLETED 9/2/93
8. DEPTH DRILLED INTO ROCK N/A	17. ELEVATION TOP OF HOLE 173 ± (TOPO)
9. TOTAL DEPTH OF HOLE 18.0'	18. TOTAL CORE RECOVERY FOR BORING N/A %
	19. SIGNATURE OF INSPECTOR LESLIE (ORD) CHILD (SAW)

ELEVATION	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX OR SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)	
	0		ML-Brown and yellow non-plastic, dry, loose silt with plant roots				7
	1				1		
	2		No plant roots, slightly sandy				23
	3				2		
	4				3		42
	5				4	LAB CLASS W=7.8% LL=18 PL=18 PI=NP	54
	6						
	7				5		35
	7.5		CONTINUED ON SHEET 2				

SOILS ARE FIELD VISUALLY CLASSIFIED IN ACCORDANCE WITH THE UNIFIED SOIL CLASSIFICATION SYSTEM

BLOWS/FOOT: NUMBER REQUIRED TO DRIVE 1 3/8" ID SPLITSPOON WITH 140 LB. HAMMER FALLING 30 INCHES

DRILLING LOG (Cont Sheet) | ELEVATION TOP OF HOLE 173 | Hole No. P-10-5

PROJECT: PASSAIC 10 LEVEE SYSTEM | INSTALLATION: PASSAIC RIVER DIV. | SHEET 2 OF 2 SHEETS

ELEVATION (a)	DEPTH (b)	LEGEND (c)	CLASSIFICATION OF MATERIALS (Description) (d)	% CORE RECOVERY (e)	BOX OR SAMPLE NO. (f)	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) (g)
	7.5		SM-Brownish red, medium to fine grained silty sand with some clay.			
	8				6	29
	9					
	10				7	17
	11					37
					8	
	12		CL-Brown, damp, very stiff low plasticity, silty, lean clay.		9	
					10	CLASS. DATA W=18.1% LL=32 PL=19 PI=13
	13					28
	14				11	33
	15		With some coarse gravel			
					12	43
	16					
	17				13	NOTE: Hole terminated at predetermined depth of 18.0'. 42
	18				14	
			BOTTOM OF HOLE @ 18.0'			

ENG FORM 1836-A PREVIOUS EDITIONS ARE OBSOLETE. MAR 71

PROJECT: PASSAIC 10 LEVEE SYS | HOLE NO. P-10-5

Hole No. P-10-6

DRILLING LOG	DIVISION SOUTH ATLANTIC	INSTALLATION PASSAIC RIVER DIVI	SHEET 1 OF 2 SHEETS

1. PROJECT: PASSAIC 10 LEVEE SYSTEM	10. SIZE AND TYPE OF BIT: 1 3/8" SPLITSPOON & HSA
2. LOCATION (Coordinates or Station): N 720,147.47 E 2,088,797.96	11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL
3. DRILLING AGENCY: MOBILE DISTRICT	12. MANUFACTURER'S DESIGNATION OF DRILL: CME-75
4. HOLE NO. (As shown on drawing title and file number): P-10-6	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 17 UNDISTURBED 0
5. NAME OF DRILLER: CARL MOON	14. TOTAL NUMBER CORE BOXES: N/A
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.	15. ELEVATION GROUND WATER: SEE NOTE
7. THICKNESS OF OVERBURDEN: > 18.0'	16. DATE HOLE: STARTED 8-26-93 COMPLETED 8-27-93
8. DEPTH DRILLED INTO ROCK: 0	17. ELEVATION TOP OF HOLE: 167 ± (TOPO)
9. TOTAL DEPTH OF HOLE: 18.0'	18. TOTAL CORE RECOVERY FOR BORING: N/A %
	19. SIGNATURE OF INSPECTOR: LESLIE

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	0		OL-Dark brown, and black non plastic organic silt plant roots, slightly damp			NOTE: Water Level at a depth of 12.6' after drilling
	1				1	16
	2					
					2	28
	3		CL-Grey, nonplastic, very stiff, dry, lean clay.		3	
					4	46
	4		Brown, slightly damp, medium plasticity		5	
						CLASS DATA W=19.5% LL=46 PL=24 PI=22
	5					
					6	52
	6					
						59
	7				7	
	8				8	
						67
	9				9	
			CONTINUED ON SHEET 2			BLOWS/FOOT: NUMBER REQUIRED TO DRIVE 1 3/8" ID SPLITSPOON WITH 140 LB. HAMMER FALLING 30 INCHES
			SOILS ARE FIELD VISUALLY CLASSIFIED IN ACCORDANCE WITH THE UNIFIED SOIL CLASSIFICATION SYSTEM			

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE. PROJECT HOLE NO.

DRILLING LOG (Cont Sheet) | ELEVATION TOP OF HOLE 167 ± (TOPO) | Hole No. P-10-6

PROJECT: PASSAIC 10 LEVEE SYSTEM | INSTALLATION: PASSAIC RIVER DIVISION | SHEET 2 OF 2 SHEETS

ELEVATION (a)	DEPTH (b)	LEGEND (c)	CLASSIFICATION OF MATERIALS (Description) (d)	% CORE RECOVERY (e)	BOX OR SAMPLE NO. (f)	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) (g)
	10		CL-Brown, hard, slightly damp, medium plastic, clay		10	
					11	50
	11					
					12	CLASS DATA W=19.5% LL=29 PL=18 PI=11 33
	12					
					13	28
	13					
			CH-Brown, very stiff, damp, plastic, silty, fat clay.		14	23
	14					
					15	16
	15					
					16	
	16					
					17	NOTE: Hole Terminated at predetermined depth of 18.0' 26
	17					
	18		BOTTOM OF HOLE @ 18.0'			

ENG FORM 1836-A PREVIOUS EDITIONS ARE OBSOLETE. MAR 71 | PROJECT | HOLE NO.

Hole No. P-10-7

DRILLING LOG	DIVISION SOUTH ATLANTIC	INSTALLATION PASSAIC RIVER DIVI	SHEET 1 OF 3 SHEETS
1. PROJECT: PASSAIC 10 LEVEE SYSTEM		10. SIZE AND TYPE OF BIT: 1 3/8" SPLITSPOON & HSA	
2. LOCATION (Coordinates or Station): N 720,422.79 E 2,088,923.23		11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL	
3. DRILLING AGENCY: MOBILE DISTRICT		12. MANUFACTURER'S DESIGNATION OF DRILL: CME-75	
4. HOLE NO. (As shown on drawing title and file number): P-10-7		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 17 / UNDISTURBED 0	
5. NAME OF DRILLER: CARL MOON		14. TOTAL NUMBER CORE BOXES: N/A	
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER: SEE NOTE	
		16. DATE HOLE: STARTED 8-25-93 / COMPLETED 8-26-93	
		17. ELEVATION TOP OF HOLE: 172 ± (TOPO)	
7. THICKNESS OF OVERBURDEN: > 24.0'		18. TOTAL CORE RECOVERY FOR BORING: N/A %	
8. DEPTH DRILLED INTO ROCK: 0		19. SIGNATURE OF INSPECTOR: LESLIE	
9. TOTAL DEPTH OF HOLE: 24.0'			

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	0		ML-Light and dark brown, dry, sandy, slightly clayey, nonplastic silt			NOTE: Water Level encountered at a depth of 4.5' during drilling
	1				1	35
	2		Tan			
	3				2	72
	4		Not-sampled Augered with/ 5" Diameter hollow stem.		3	
	5		SM-SC, Brown, fine grained, damp, silty sand and clayey sand.		4	CLASS DATA W=12.5% LL=23 PL=16 PI=7 48
	6					
	7				5	67
	8				6	28
	9		CONTINUED ON SHEET 2			BLOWS/FOOT: NUMBER REQUIRED TO DRIVE 1 3/8" ID SPLITSPOON WITH 140 LB. HAMMER FALLING 30 INCHES

SOILS ARE FIELD VISUALLY CLASSIFIED IN ACCORDANCE WITH THE UNIFIED SOIL CLASSIFICATION SYSTEM

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE. PROJECT HOLE NO.

DRILLING LOG (Cont Sheet) | ELEVATION TOP OF HOLE 172 ± (TOPO) | Hole No. P-10-7

PROJECT: PASSAIC 10 LEVEE SYSTEM | INSTALLATION: PASSAIC RIVER DIVISION | SHEET 2 OF 3 SHEETS

ELEVATION (a)	DEPTH (b)	LEGEND (c)	CLASSIFICATION OF MATERIALS (Description) (d)	% CORE RECOVERY (e)	BOX OR SAMPLE NO. (f)	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) (g)	
	9		SM-SC, Brown, fine grained, damp, silty and clayey sand		7		26
	10		CL-Brown, damp, very stiff, medium plasticity, lean clay		8		
	11					CLASS DATA W=18.9% LL=31 PL=17 PI=14	41
	12				9		
	13		CH-Brown, damp, very stiff, fat clay with some sand		10		32
	14						
					11		18
	15		CL-Brown, damp, very stiff, lean clay				
	16				12	CLASS DATA W=23.9% LL=28 PL=17 PI=11	26
	17				13		26
	18		CONTINUED ON SHEET 3				

ENG FORM 1836-A PREVIOUS EDITIONS ARE OBSOLETE. MAR 71

PROJECT | HOLE NO.

DRILLING LOG (Cont Sheet)

ELEVATION TOP OF HOLE: 172 ± (TOPO)

Hole No. P-10-7

PROJECT: PASSAIC 10 LEVEE SYSTEM

INSTALLATION: PASSAIC RIVER DIVISION

SHEET 3 OF 3 SHEETS

ELEVATION (a)	DEPTH (b)	LEGEND (c)	CLASSIFICATION OF MATERIALS (Description) (d)	% CORE RECOVERY (e)	BOX OR SAMPLE NO. (f)	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) (g)
	18					28
	19		CL- Brown, damp, very stiff, lean clay		14	
	20					CLASS DATA W=19.5% LL=29 PL=18 PI=11 19
	21				15	
	22		CH-Brown, damp, stiff to very stiff, silty, fat clay		16	21
	23				17	14
	24		BOTTOM OF HOLE @ 24.0'			

ENG FORM 1836-A PREVIOUS EDITIONS ARE OBSOLETE. MAR 71

PROJECT

HOLE NO.

DRILLING LOG	DIVISION SOUTH ATLANTIC	INSTALLATION PASSAIC RIVER DIVI	SHEET 1 OF 2 SHEETS
1. PROJECT PASSAIC 10 LEVEE SYSTEM		10. SIZE AND TYPE OF BIT 1⅜" SPLITSPOON & HSA	
2. LOCATION (Coordinates or Station) N 720,706.90 E 2,089,354.68		11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MSL	
3. DRILLING AGENCY MOBILE DISTRICT		12. MANUFACTURER'S DESIGNATION OF DRILL CME-75	
4. HOLE NO. (As shown on drawing title and file number) P-10-8		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN DISTURBED 16 UNDISTURBED 0	
5. NAME OF DRILLER JAMES KNOX		14. TOTAL NUMBER CORE BOXES N/A	
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER SEE NOTE	
		16. DATE HOLE STARTED 9-11-93 COMPLETED 9-13-93	
7. THICKNESS OF OVERBURDEN > 18.0'		17. ELEVATION TOP OF HOLE 169 ± (TOPO)	
8. DEPTH DRILLED INTO ROCK 0		18. TOTAL CORE RECOVERY FOR BORING N/A %	
9. TOTAL DEPTH OF HOLE 18.0'		19. SIGNATURE OF INSPECTOR LESLIE	

ELEVATION a	DEPTH	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	0		ML-Black and brown, low plasticity, organic slightly damp silt with plant roots			NOTE: Water Level encountered at 7.5' during drilling
	1				1	40
	2					6
	3		Tree root		2	
	4		SM-Brown, very loose, slightly damp, subangular fine, silty sand with wood		3	LAB CLASS DATA=SM W=34.0% LL=37 PL=28 PI=9 8
	5		No wood		4	3
	6		OL/CL-Organic, medium, plastic clay, black		5	
			ML-Brown and black, low plasticity silt with some organics		6	40
	7		CH-Grey, gravelly, sandy, fat clay (boulder)		7	
	8		SM-Grey, loose, medium grain, silty sand		8	11
	9		CH-Brown & Grey fat clay		9	
			CONTINUED ON SHEET 2			BLOWS/FOOT: NUMBER REQUIRED TO DRIVE 1⅜" ID SPLITSPOON WITH 140 LB. HAMMER FALLING 30 INCHES
			SOILS ARE FIELD VISUALLY CLASSIFIED IN ACCORDANCE WITH THE UNIFIED SOIL CLASSIFICATION SYSTEM			

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE. PROJECT HOLE NO.

DRILLING LOG (Cont Sheet) | ELEVATION TOP OF HOLE 169 ± (TOPO) | Hole No. P-10-8

PROJECT: PASSAIC 10 LEVEE SYSTEM | INSTALLATION: PASSAIC RIVER DIVISION | SHEET 2 OF 2 SHEETS

ELEVATION	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX OR SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
	9		CH-Brown and grey, stiff to very stiff plastic, fat clay			
	10				10	29
						CLASS DATA W=19.9% LL=26 PL=17 PI=9
	11				11	38
	12				12	32
	13				13	34
	14				14	21
	15				15	
	16				16	24 NOTE: Hole Terminated at predetermined depth of 18.0'
	17					
	18		BOTTOM OF HOLE @ 18.0'			

ENG FORM 1836-A PREVIOUS EDITIONS ARE OBSOLETE. MAR 71

PROJECT | HOLE NO.

Hole No. P-10-9

DRILLING LOG	DIVISION SOUTH ATLANTIC	INSTALLATION PASSAIC RIVER DIVI	SHEET 1 OF 4 SHEETS
1. PROJECT: PASSAIC 10 LEVEE SYSTEM		10. SIZE AND TYPE OF BIT: 1 3/8" SPLITSPOON & HSA	
2. LOCATION (Coordinates or Station): N 720,552.31 E 2,089,681.03		11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL	
3. DRILLING AGENCY: MOBILE DISTRICT		12. MANUFACTURER'S DESIGNATION OF DRILL: CME-75	
4. HOLE NO. (As shown on drawing title and file number): P-10-9		13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN: DISTURBED 21; UNDISTURBED 0	
5. NAME OF DRILLER: JAMES KNOX		14. TOTAL NUMBER CORE BOXES: N/A	
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER: SEE NOTE	
7. THICKNESS OF OVERBURDEN: > 51.5'		16. DATE HOLE: STARTED 9-7-93; COMPLETED 9-11-93	
8. DEPTH DRILLED INTO ROCK: 0		17. ELEVATION TOP OF HOLE: 167.5 ± (TOPO)	
9. TOTAL DEPTH OF HOLE: 51.5'		18. TOTAL CORE RECOVERY FOR BORING: N/A %	
		19. SIGNATURE OF INSPECTOR: LESLIE	

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	0		ML-Dark brown, sandy non plastic silt with some organics and plant roots		1	NOTE: Water Level at completion of drilling at 29.4'; 9-10-93 on 9-11-93 W.L. 6.1' 29
	1					
	2					41
	3		Yellow		2	
	4				3	17
			SM-Yellow brown, damp, medium to coarse grain subrounded, silty sand		4	
	5		some clay		5	23
	6					LAB CLASS DATA=SM W=14.3% LL=18 PL=15 PI=3
	7				6	24
			CL-Grey, slightly damp, medium plasticity, lean clay		7	
	8				8	34
	9		CONTINUED ON SHEET 2			BLOWS/FOOT: NUMBER REQUIRED TO DRIVE 1 3/8" ID SPLITSPOON WITH 140 LB. HAMMER FALLING 30 INCHES
			SOILS ARE FIELD VISUALLY CLASSIFIED IN ACCORDANCE WITH THE UNIFIED SOIL CLASSIFICATION SYSTEM			

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE. PROJECT HOLE NO.

DRILLING LOG (Cont Sheet) | ELEVATION TOP OF HOLE 167.5 ± (TOPO) | Hole No. P-10-9

PROJECT: PASSAIC 10 LEVEE SYSTEM | INSTALLATION: PASSAIC RIVER DIVISION | SHEET 2 OF 4 SHEETS

ELEVATION	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX OR SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)	
	9		CL-Grey, slightly damp, medium plasticity, lean clay		JAR		23
	10		CH-Grey, damp, plastic, fat clay		9		
	11				10		35
	12						
	13				11		32
	14				12	CLASS DATA W=17.5% LL=30 PL=17 PI=13	27
	15						
	16				13		28
	17				14		46
	18		CONTINUED ON SHEET 3				

ENG FORM 1836-A PREVIOUS EDITIONS ARE OBSOLETE. MAR 71 | PROJECT | HOLE NO.

DRILLING LOG (Cont Sheet) | ELEVATION TOP OF HOLE 167.5 ± (TOPO) | Hole No. P-10-9

PROJECT: PASSAIC 10 LEVEE SYSTEM | INSTALLATION: PASSAIC RIVER DIVISION | SHEET 3 OF 4 SHEETS

ELEVATION (a)	DEPTH (b)	LEGEND (c)	CLASSIFICATION OF MATERIALS (Description) (d)	% CORE RECOVERY (e)	BOX OR SAMPLE NO. (f)	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) (g)
	18		Augered from 18.0' to 20.0'.			NOTE: Scale changed at 18.0' to 1"=2'
	20		CH-Grey, slightly sandy, silty fat clay		15	14
	22		Not Sampled-Augered to 25.0'			CLASS DATA W=26.3% LL=29 PL=18 PI=11
	24					
	26		CH-Grey with brown and reddish shale gravel, fat clay.		16	23
	28		Not Sampled-Augered to 30.0'			
	30		CH-Grey with brown, fat clay		17	18
	32		Not Sampled-Augered to 35.0'			
	34					
	36		CH-Grey with brown, fat clay		18	12
			CONTINUED ON SHEET 4			

ENG FORM 1836-A PREVIOUS EDITIONS ARE OBSOLETE. MAR 71

PROJECT | HOLE NO.

DRILLING LOG (Cont Sheet) | ELEVATION TOP OF HOLE 167.5 ± (TOPO) | Hole No. P-10-9

PROJECT: PASSAIC 10 LEVEE SYSTEM | INSTALLATION: PASSAIC RIVER DIVISION | SHEET 4 OF 4 SHEETS

ELEVATION	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX OR SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc. if significant)
	36		CH-Grey with brown fat clay		18	12
	38		Not Sampled-Augered to 40.0'			CLASS DATA W=19.5% LL=29 PL=18 PI=11
	40		CH-Grey with brown fat clay		19	25
	42		Not Sampled-Augered to 45.0'			
	44					
	46		CH-Grey, slightly sandy, fat clay		20	48
	48		Not Sampled-Augered to 50.0'			
	50		CH-Grey, slightly sandy, fat clay		21	NOTE: Hole terminated at a predetermined depth of 51.5'. 19
	51.5		BOTTOM OF HOLE @ 51.5'			

ENG FORM 1836-A PREVIOUS EDITIONS ARE OBSOLETE. MAR 71

PROJECT | HOLE NO.

Hole No. P 10 9A

DRILLING LOG	DIVISION SOUTH ATLANTIC	INSTALLATION PASSAIC RIVER DIVI	SHEET 1 OF 2 SHEETS
1. PROJECT: PASSAIC 10 LEVEE SYSTEM		10. SIZE AND TYPE OF BIT: 1⅜" SPLITSPOON & HSA	
2. LOCATION (Coordinates or Station): N 720,552.31 E 2,089,681.03		11. DATUM FOR ELEVATION SHOWN (GM or MSL): MSL	
3. DRILLING AGENCY: MOBILE DISTRICT		12. MANUFACTURER'S DESIGNATION OF DRILL: CME-75	
4. HOLE NO. (As shown on drawing title and file number): P-10-9A		13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN: DISTURBED 15; UNDISTURBED 0	
5. NAME OF DRILLER: JAMES KNOX		14. TOTAL NUMBER CORE BOXES: N/A	
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER: SEE NOTE	
7. THICKNESS OF OVERBURDEN: > 18.0'		16. DATE HOLE: STARTED 9-9-93; COMPLETED 9-11-93	
8. DEPTH DRILLED INTO ROCK: 0		17. ELEVATION TOP OF HOLE: 167.5 ± (TOPO)	
9. TOTAL DEPTH OF HOLE: 18.0'		18. TOTAL CORE RECOVERY FOR BORING: N/A %	
		19. SIGNATURE OF INSPECTOR: LESLIE	

ELEVATION a	DEPTH	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	0					NOTE: Water Level encountered at 7.0' during drilling Water Level at end drilling at a depth of 6.1' (9-11-93).
	1		OL-Black, dry, medium plastic organic silt, with roots		1	25
	2		ML-Grey and brown, dry sandy silt		2	
	3				3	45
	4				4	33
	5		SM-Reddish brown, damp, fine to medium, silty sand		5	LAB CLASS =SM W=13.7% LL=16 PL=16 PI=NP
	6		Medium grained, loose		6	17
	7				7	18
	8		CL-Grey, brown, damp, medium plastic clay		8	
	9				9	38
			CONTINUED ON SHEET 2			BLOWS/FOOT: NUMBER REQUIRED TO DRIVE 1⅜" ID SPLITSPOON WITH 140 LB. HAMMER FALLING 30 INCHES

SOILS ARE FIELD VISUALLY CLASSIFIED IN ACCORDANCE WITH THE UNIFIED SOIL CLASSIFICATION SYSTEM

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE.

PROJECT | HOLE NO.

DRILLING LOG (Cont Sheet) | ELEVATION TOP OF HOLE 107.5 ± (TOPO) | Hole No. P-10-9A

PROJECT: PASSAIC 10 LEVEE SYSTEM | INSTALLATION: PASSAIC RIVER DIVISION | SHEET 2 OF 2 SHEETS

ELEVATION	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX OR SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)	
	9						23
	10		CL-Grey brown, damp, medium plastic clay		10		
	11		SC-Grey, medium grain, moist to wet, clayey sand with some sand		11	CLASS DATA W=19.5% LL=29 PL=18 PI=11	27
	12		CH-Brown, damp, medium plastic fat clay		12		25
	13						
	14				13	LAB CLASS W=22.1% LL=28 PL=18 PI=10	27
	15						
	16				14		19
	17		Slightly gravelly		15	NOTE: Hole terminated at a predetermined depth of 18.0'.	23
	18		BOTTOM OF HOLE @ 18.0'				

ENG FORM 1836-A PREVIOUS EDITIONS ARE OBSOLETE. MAR 71

PROJECT | HOLE NO.

Hole No. P 10-10

DRILLING LOG	DIVISION SOUTH ATLANTIC	INSTALLATION PASSAIC RIVER DIVI	SHEET 1 OF 2 SHEETS
1. PROJECT PASSAIC 10 LEVEE SYSTEM		10. SIZE AND TYPE OF BIT 1 3/8" SPLITSPOON & HSA	
2. LOCATION (Coordinates or Station) N 720,372.08 E 2,090,357.33		11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MSL	
3. DRILLING AGENCY MOBILE DISTRICT		12. MANUFACTURER'S DESIGNATION OF DRILL CME-75	
4. HOLE NO. (As shown on drawing title and file number) P-10-10		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN DISTURBED 14 UNDISTURBED 0	
5. NAME OF DRILLER CARL MOON		14. TOTAL NUMBER CORE BOXES N/A	
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER NOT ENCOUNTERED	
7. THICKNESS OF OVERBURDEN > 18.0'		16. DATE HOLE STARTED 8-27-93 COMPLETED 8-30-93	
8. DEPTH DRILLED INTO ROCK 0		17. ELEVATION TOP OF HOLE 170 + (TOPO)	
9. TOTAL DEPTH OF HOLE 18.0'		18. TOTAL CORE RECOVERY FOR BORING N/A %	
		19. SIGNATURE OF INSPECTOR LESLIE	

ELEVATION a	DEPTH	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	0		ML-brown and black, dry, slightly organic silt with roots and leaves			NOTE: Water Level not encountered during drilling At 48 hours (8-30-93) hole was dry.
	1				1	37
	2		No organics		2	63
	3		Tan, brown & white/w cobbles		3	
			CL-Yellow brown, damp, hard, clay			54
	4				4	
	5				5	CLASS DATA W=17.2% LL=52 PL=22 PI=30 87+
	6		Augered-clean out to 6.0'			
			CL-Yellow brown, damp, hard, clay			86
	7				6	
	8				7	62
	9		CONTINUED ON SHEET 2			BLOWS/FOOT: NUMBER REQUIRED TO DRIVE 1 3/8" ID SPLITSPOON WITH 140 LB. HAMMER FALLING 30 INCHES

SOILS ARE FIELD VISUALLY CLASSIFIED IN ACCORDANCE WITH THE UNIFIED SOIL CLASSIFICATION SYSTEM

PROJECT HOLE NO.

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE.

DRILLING LOG (Cont Sheet) | ELEVATION TOP OF HOLE 170 ± (TOPO) | Hole No. P-10-10

PROJECT: PASSAIC 10 LEVEE SYSTEM | INSTALLATION: PASSAIC RIVER DIVISION | SHEET 2 OF 2 SHEETS

ELEVATION	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX OR SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
	9		CL-Yellow brown, damp hard, clay			
	10				8	44
	11					
					9	42
	12		CH-Brown, damp, very stiff, fat clay		10	22
	13				11	
			CL-Brown, moist, silty lean clay		12	CLASS DATA W=32.8% LL=34 PL=20 PI=14 16
	14					
	15					24
	16				13	
	17					
			SC-Brown, damp, fine silty, clayey sand		14	NOTE: Hole Terminated at predetermined depth of 18.0' 36
	18		BOTTOM OF HOLE @ 18.0'			

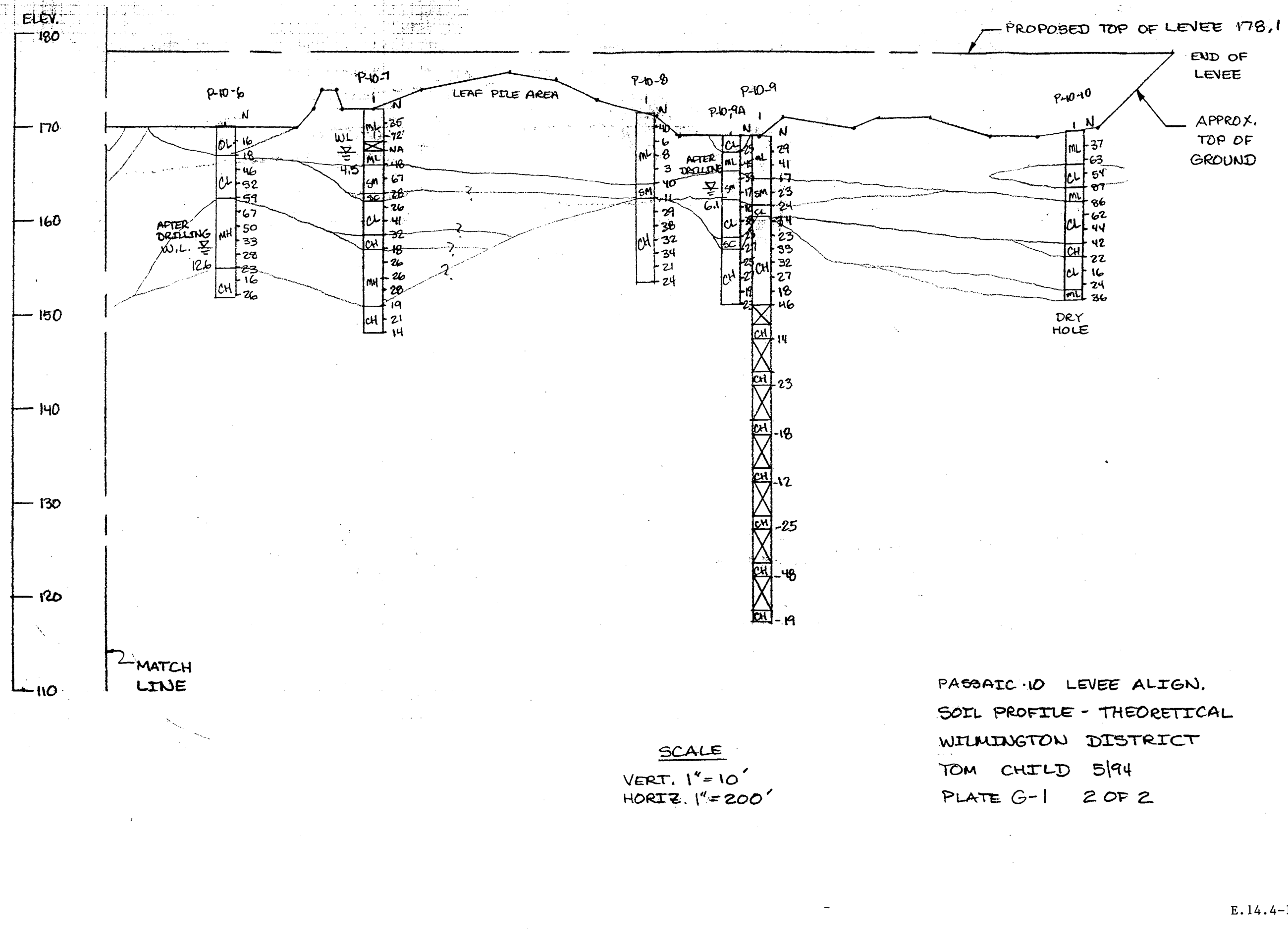
ENG FORM 1836-A PREVIOUS EDITIONS ARE OBSOLETE. MAR 71

PROJECT | HOLE NO.

PASSAIC RIVER FLOOD DAMAGE REDUCTION PROJECT

SECTION 14
PASSAIC 10 LEVEE SYSTEM

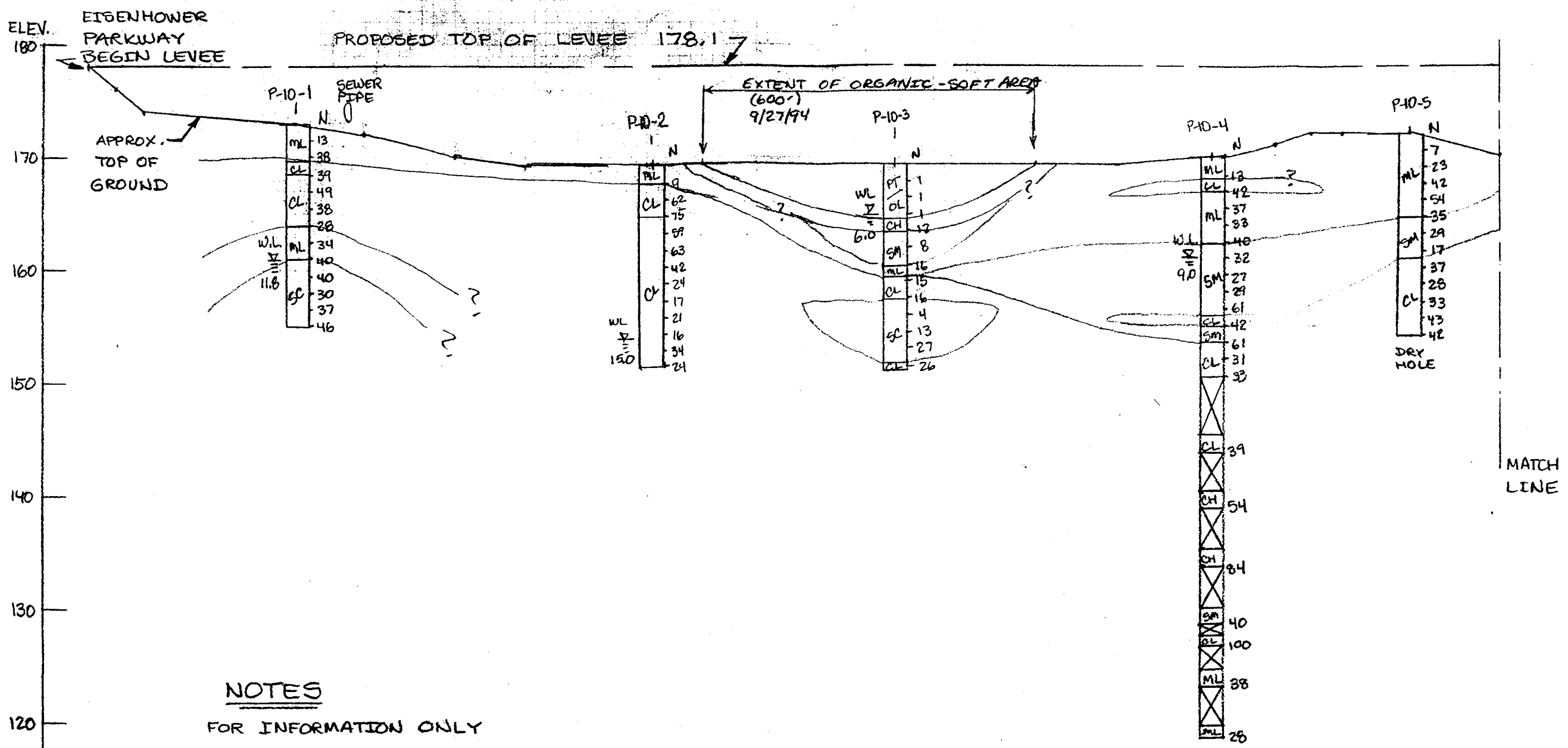
ATTACHMENT E.14.4
SOIL PROFILE SHEETS



SCALE

VERT. 1" = 10'
HORIZ. 1" = 200'

PASSAIC-10 LEVEE ALIGN.
SOIL PROFILE - THEORETICAL
WILMINGTON DISTRICT
TOM CHILD 5/94
PLATE G-1 2 OF 2



NOTES

FOR INFORMATION ONLY

HOLES ELEVATION AND LOCATION ARE APPROXIMATE

TOP OF GROUND CONTOUR IS APPROXIMATE

WATER LEVEL (W.L) IS DURING DRILLING

SOILS DATA FROM 9/9/93 BORINGS.

X-INTERVAL - AUGER CLEAN OUT

SCALE

VERT. 1" = 10'

HORIZ. 1" = 200'

PASSAIC-10 LEVEE ALIGN.

SOIL PROFILE - THEORETICAL

WILMINGTON DISTRICT

TOM CHILD 5/94

PLATE G-1 1 OF 2

PASSAIC RIVER FLOOD DAMAGE REDUCTION PROJECT

SECTION 14
PASSAIC 10 LEVEE SYSTEM

ATTACHMENT E.14.5
DETAILED LABORATORY SOILS TESTING DATA

Attachment E.14.5

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Boring P-10-5 Tests	8
Boring P-10-7 Tests	9
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Boring P-10-3Bu	18-22

SOUTH ATLANTIC DIVISION LABORATORY

GENERAL TEST RESULTS

PROJECT: Passic River
Levee System - Dike #10

REQN. NO: CESAW-EN-GS-94-0003
W. O. NO: 7118

Lab No.	Hole No.	Sample Number	Depth(Ft)	Loss on Ignition %	Visual Classification
264/554	P-10-3AU	1	1.5-2.3	29.3	Black very organic Silt (OL)
/555	P-10-3AU	2	4.4-4.8	32.6	Black Peaty Muck (OH) w/hair roots

SOUTH ATLANTIC DIVISION LABORATORY
U.S. ARMY CORPS OF ENGINEERS
611 SOUTH COBB DRIVE
MARIETTA, GEORGIA

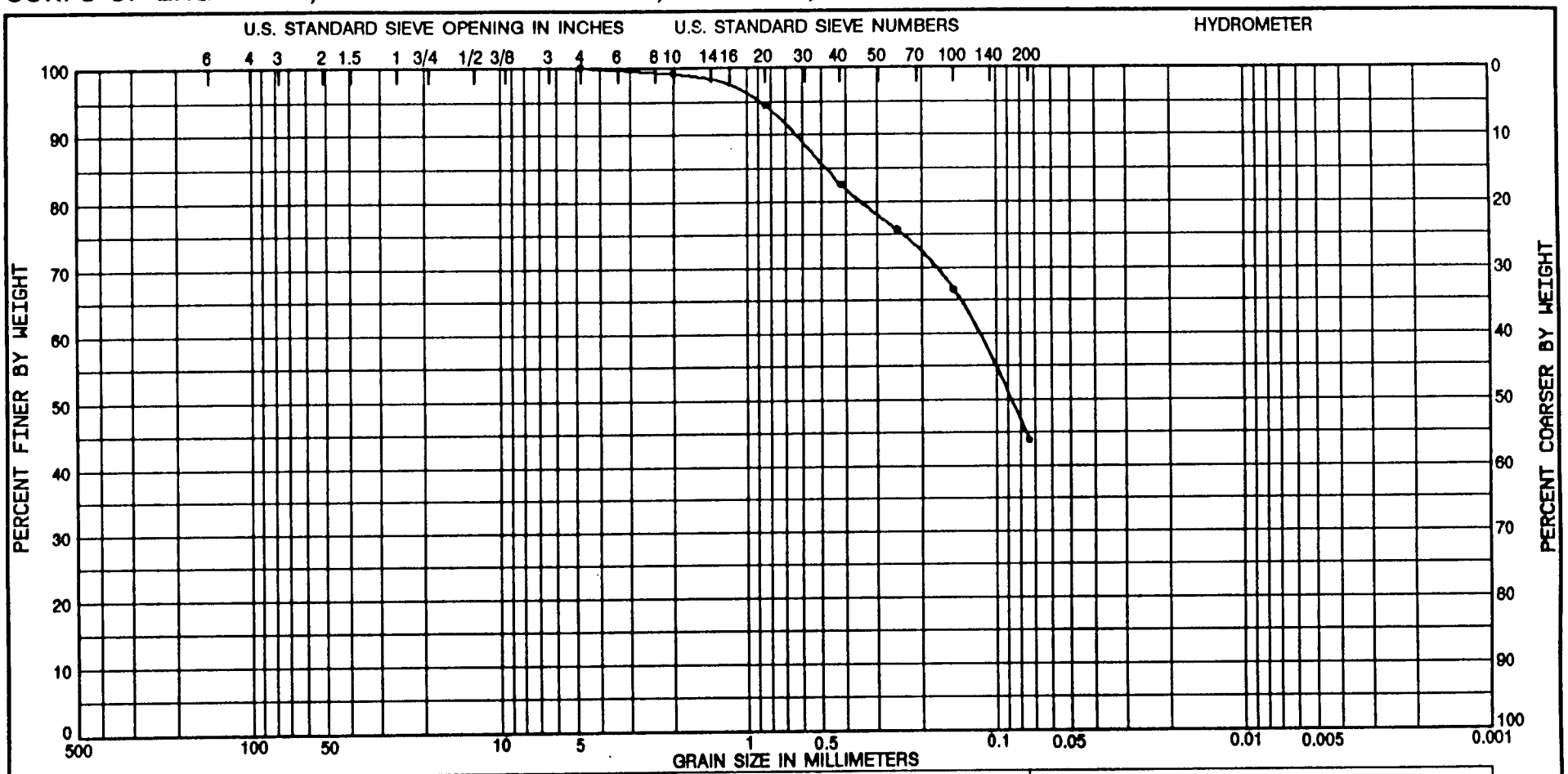
Project: PASSIAC RIVER
Location: FLOOD CONTROL "Passaic 10"
Description: JAR SAMPLES

District: Wilmington
W. O. No: 7118
Req'n No: CESAW-EN-GS-94-0003
Date Rec'd 27 OCT 93
Date Rpt'd 13 JAN 94

Lab No.	Hole No.	Sample No.	Depth (ft)	Percent Moist	Atterberg Limits ll	pl	pi
264/558	P-10-1	6	6.4 to 7.2	25.6	33	20	13
559		9	10.8 to 11.8	25.1	23	19	4
560	P-10-2	2	2.3 to 3.0	9.6	33	15	18
561		8	10.6 to 11.9	22.5	36	19	17
562	P-10-3	8	8.0 to 8.8	15.1	15	14	1
563		13	13.8 to 14.7	14.4	17	13	4
564	P-10-4	4	4.5 to 5.8	13.3	21	16	5
565		7	9.3 to 10.5	14.1	np	np	np
566		14	18.9 to 19.5	22.6	31	18	13
567		15	25.5 to 26.5	31.2	35	20	15
568		20	45.8 to 46.5	24.3	20	20	np
569	P-10-5	4	5.0 to 6.0	7.8	18	18	np
570		10	12.4 to 13.2	18.1	32	19	13
571	P-10-6	6	4.8 to 6.0	19.5	46	24	22
572		12	10.7 to 11.7	19.5	29	18	11
573	P-10-7	5	6.6 to 7.2	12.5	23	16	7
574		9	10.8 to 12.0	18.9	31	17	14
575		12	15.0 to 16.5	23.9	28	17	11
576	P-10-8	3	3.7 to 4.5	34.0	37	28	9
577		11	11.0 to 12.0	19.9	26	17	9
578	P-10-9	6	6.5 to 7.5	14.3	18	15	3
579		12	14.0 to 15.0	17.5	30	17	13
580		18	35.5 to 36.5	26.3	29	18	11
581	P-10-9A	6	5.0 to 6.0	13.7	16	16	np
582		10	9.5 to 10.5	24.3	32	19	13
583		13	14.0 to 15.0	22.1	28	18	10
584	P-10-10	5	5.2 to 5.9	17.2	52	22	30
585		12	13.5 to 14.5	32.8	34	20	14

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE, MARIETTA, GA. 30060

WORK ORDER: 7118
REQUISITION: CESAW-EN-GS-003



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

Sample No.	Depth	Classification	Nat w%	LL	PL	PI
8	8.0-8.8'	DK. BROWN, SILTY SAND (SM),	15.1	15	14	1

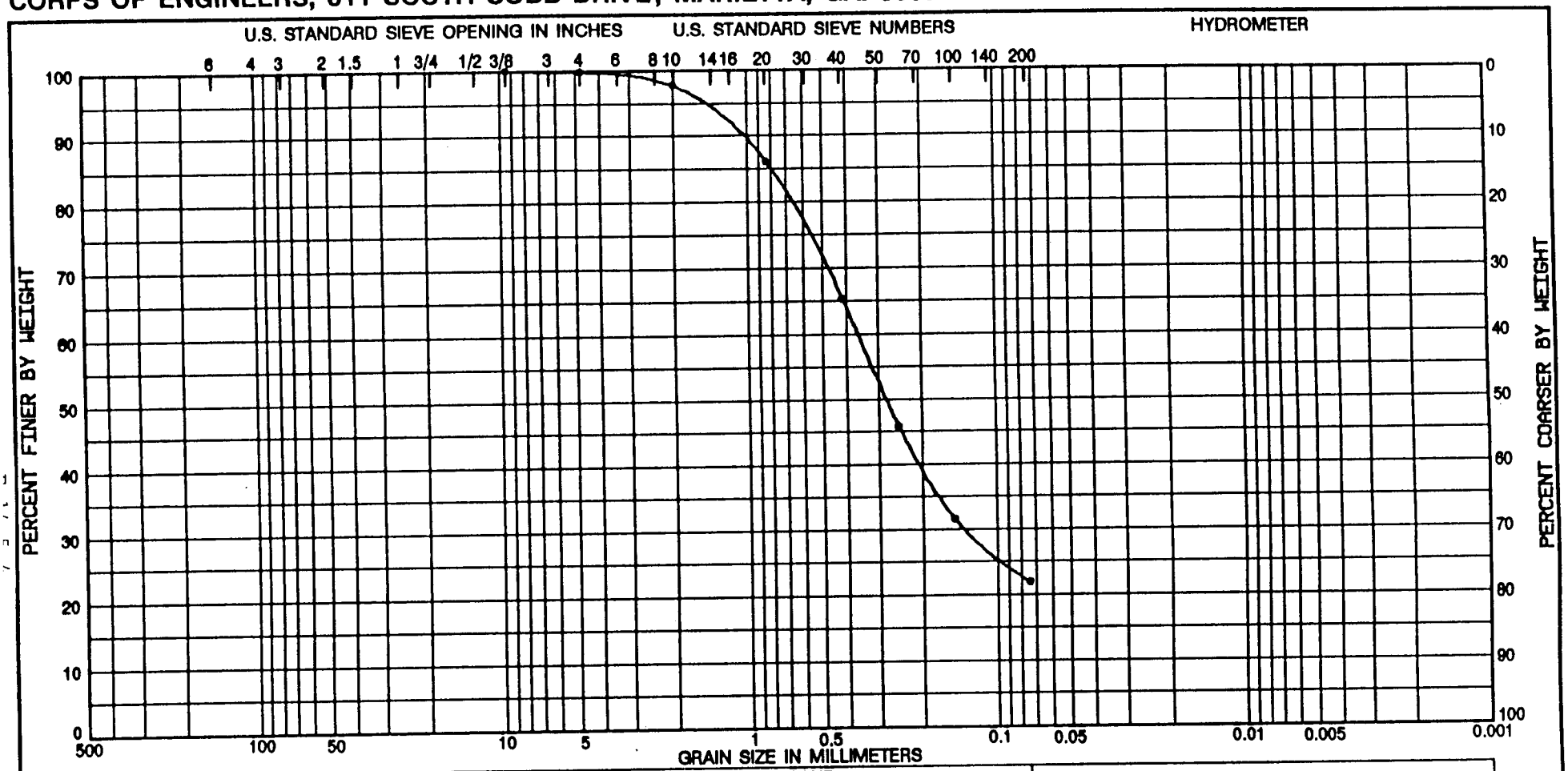
Project PASSAIC RIVER
FLOOD CONTROL "Passaic 10"
Lab No. 264/582
Boring No. P-10-3
Date 01/18/94

GRADATION CURVES

E.14.5-3

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE, MARIETTA, GA. 30060

WORK ORDER: 7118
REQUISITION: CESAW-EN-GS-003



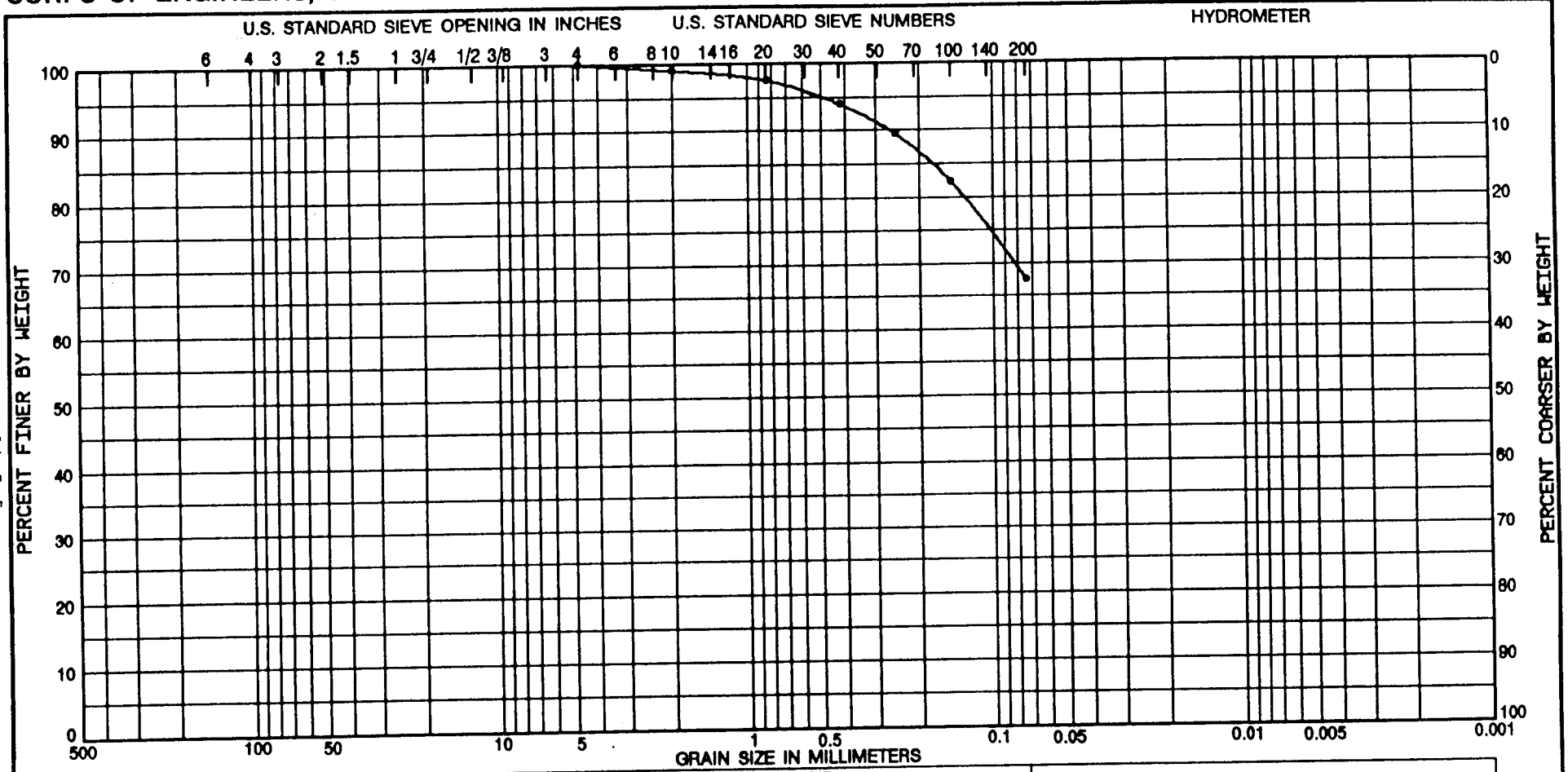
Sample No.	Depth	Classification	Nat w%	LL	PL	PI
13	13.8-14.7'	DK. BROWN, SILTY CLAYEY SAND (SM-SC), WITH A TRACE OF GRAVEL SIZES.	14.4	17	13	4

GRADATION CURVES

Project PASSAIC RIVER
FLOOD CONTROL "Passaic 10"
Lab No. 264/583
Boring No. P-10-3
Date 01/18/94

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE, MARIETTA, GA. 30060

WORK ORDER: 7118
REQUISITION: CESAW-EN-GS-003



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

Sample No.	Depth	Classification	Nat w%	LL	PL	PI
4	4.5-5.8'	BROWN, LEAN CLAY INORGANIC SILT LOW LL (CL-ML), WITH SOME SAND SIZES.	13.3	21	16	5

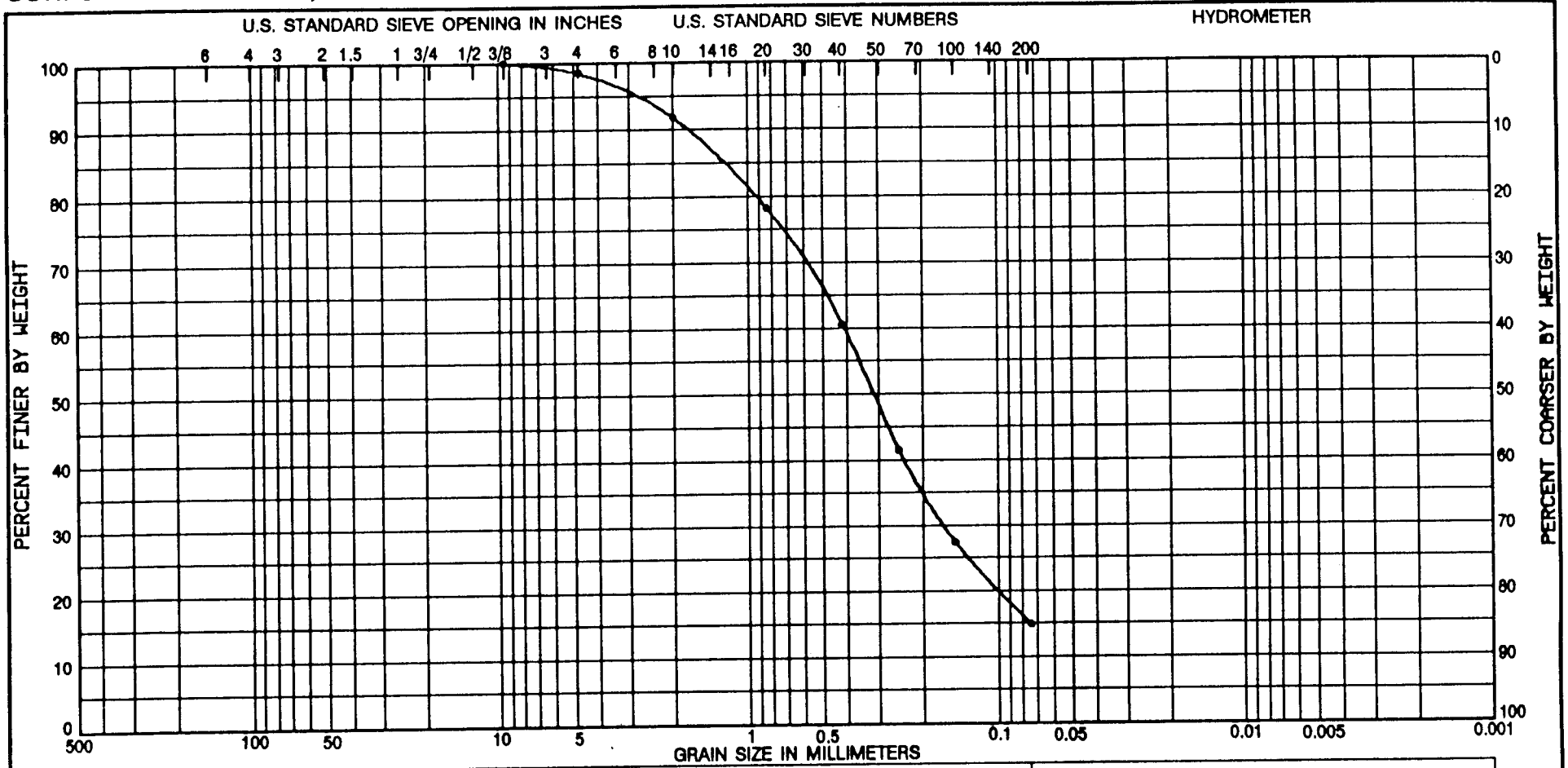
Project PASSAIC RIVER
FLOOD CONTROL "Passaic 10"
Lab No. 264/564
Boring No. P-10-4
Date 01/18/94

GRADATION CURVES

E.14.5-5

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE, MARIETTA, GA. 30060

WORK ORDER: 7118
REQUISITION: CESAW-EN-GS-003



Sample No.	Depth	Classification	Nat w%	LL	PL	PI
7	9.3-10.5'	BROWN, SILTY SAND (SM), WITH A TRACE OF GRAVEL SIZES.	14.1	NP	NP	NP

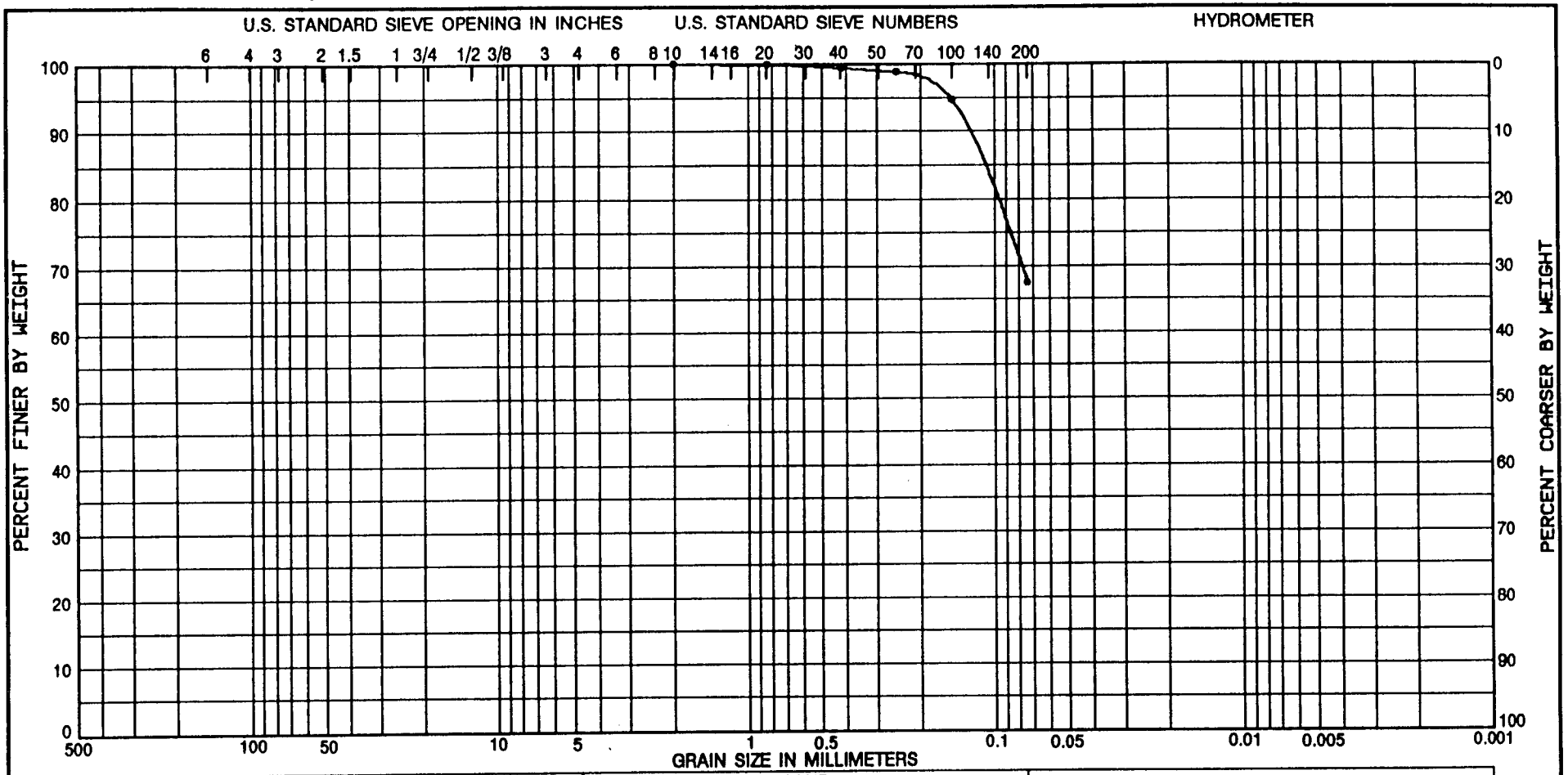
Project PASSAIC RIVER
FLOOD CONTROL "Passic 10"
Lab No. 264/565
Boring No. P-10-4
Date 01/18/94

GRADATION CURVES

E.14.5-6

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE, MARIETTA, GA. 30060

WORK ORDER: 7118
REQUISITION: CESAW-EN-GS-003



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

Sample No.	Depth	Classification	Nat w%	LL	PL	PI
20	45.8-46.5'	DK. GRAY, INORGANIC SILT LOW LL (ML), WITH SOME SAND SIZES.	24.3	20	20	NP

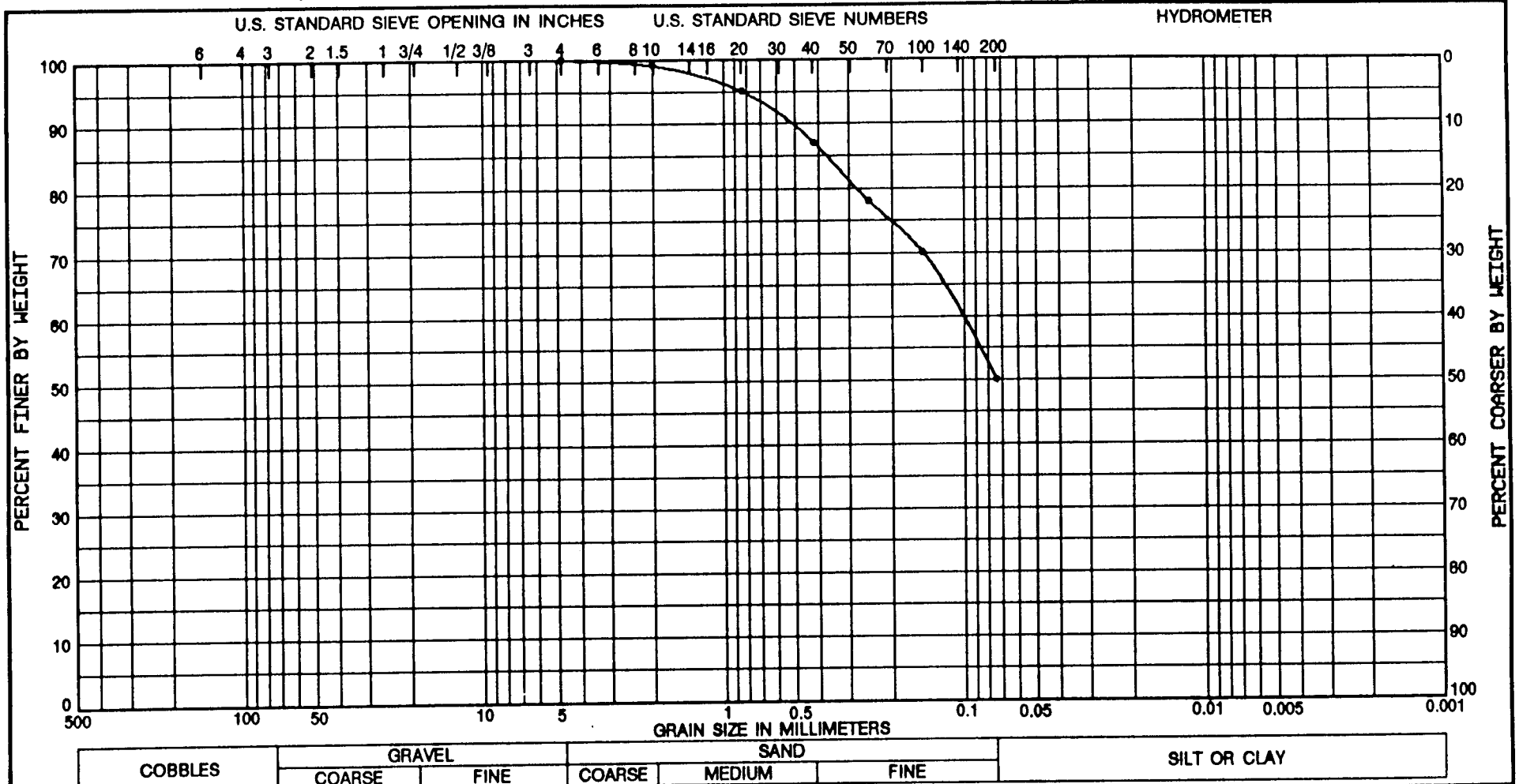
Project PASSAIC RIVER FLOOD CONTROL "Passic 10"
Lab No. 264/568
Boring No. P-10-4
Date 01/21/94

GRADATION CURVES

E.14.5-7

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE, MARIETTA, GA. 30060

WORK ORDER: 7118
REQUISITION: CESAW-EN-GS-003



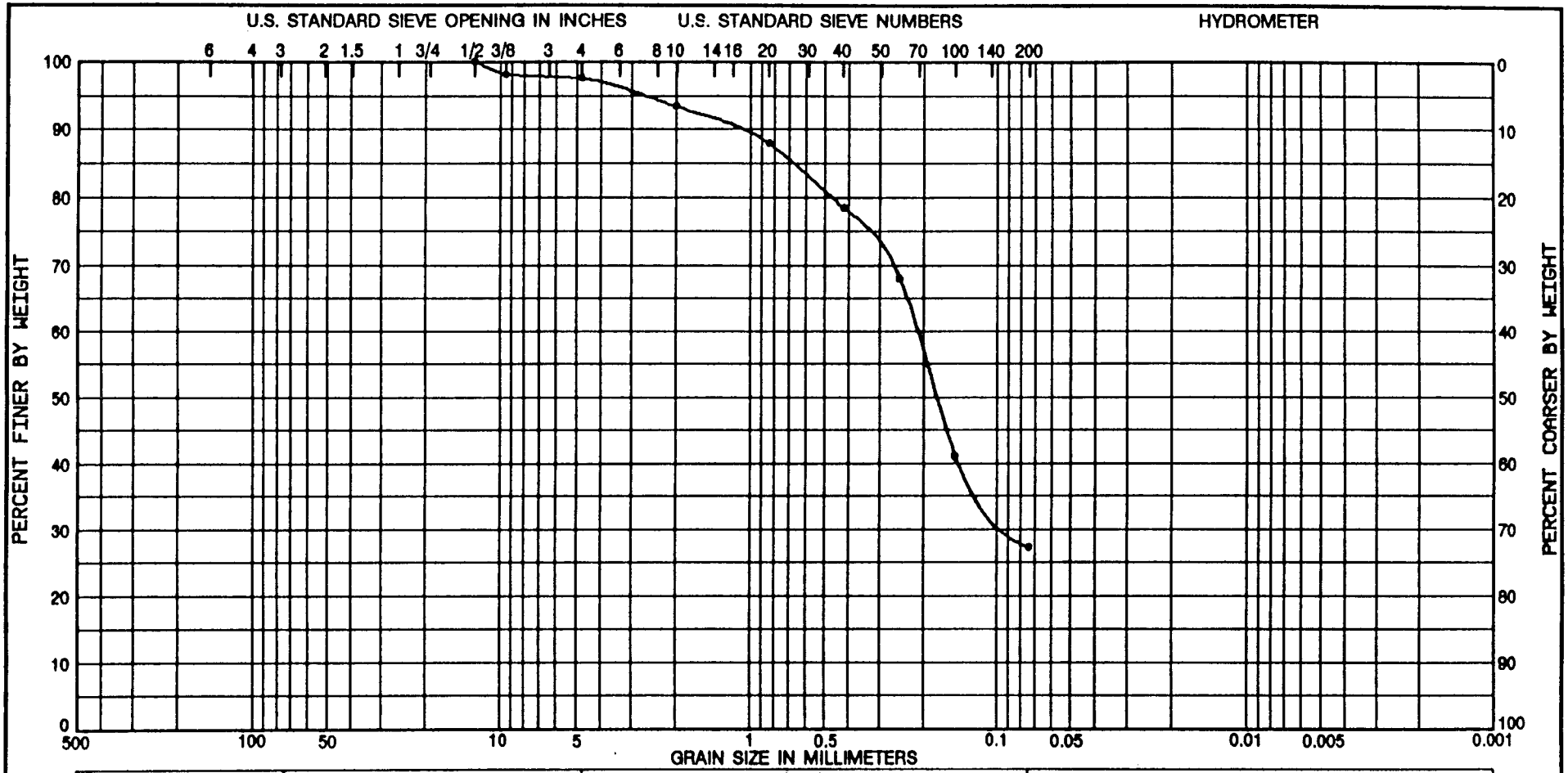
Sample No.	Depth	Classification	Nat w%	LL	PL	PI
4	5.0-6.0'	LT. BROWN, SANDY INORGANIC SILT LOW LL (ML).	7.8	18	18	NP

Project PASSAIC RIVER FLOOD CONTROL "Passaic 10"
Lab No. 264/589
Boring No. P-10-5
Date 01/18/94

GRADATION CURVES

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE, MARIETTA, GA. 30060

WORK ORDER: 7118
REQUISITION: CESAW-EN-GS-003



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

Sample No.	Depth	Classification	Nat w%	LL	PL	PI
5	6.6-7.2'	BROWN, SILTY CLAYEY SAND (SM-SC),	12.5	23	16	7
		WITH A TRACE OF GRAVEL SIZES.				

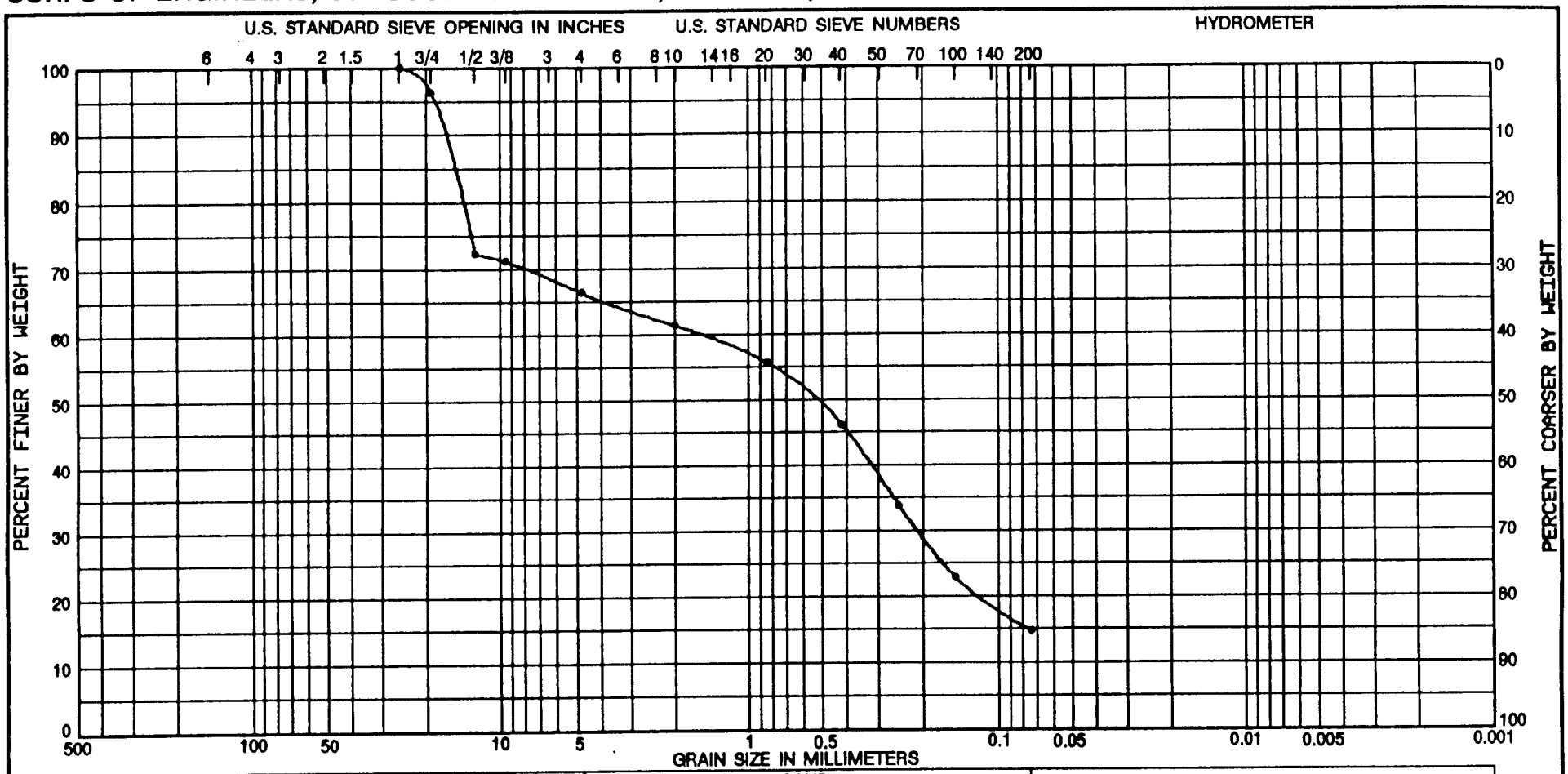
Project PASSAIC RIVER
FLOOD CONTROL "Passaic 10"
Lab No. 264/573
Boring No. P-10-7
Date 01/18/94

GRADATION CURVES

E.14.5-9

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE, MARIETTA, GA. 30060

WORK ORDER: 7118
REQUISITION: CESAW-EN-GS-003



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

Sample No.	Depth	Classification	Nat w%	LL	PL	PI
3	3.7-4.5'	DK. BROWN, SILTY SAND (SM), WITH SOME GRAVEL SIZE WOOD FRAGMENTS AND A TRACE OF SAND SIZE WOOD FRAGMENTS.	34.0	37	28	9

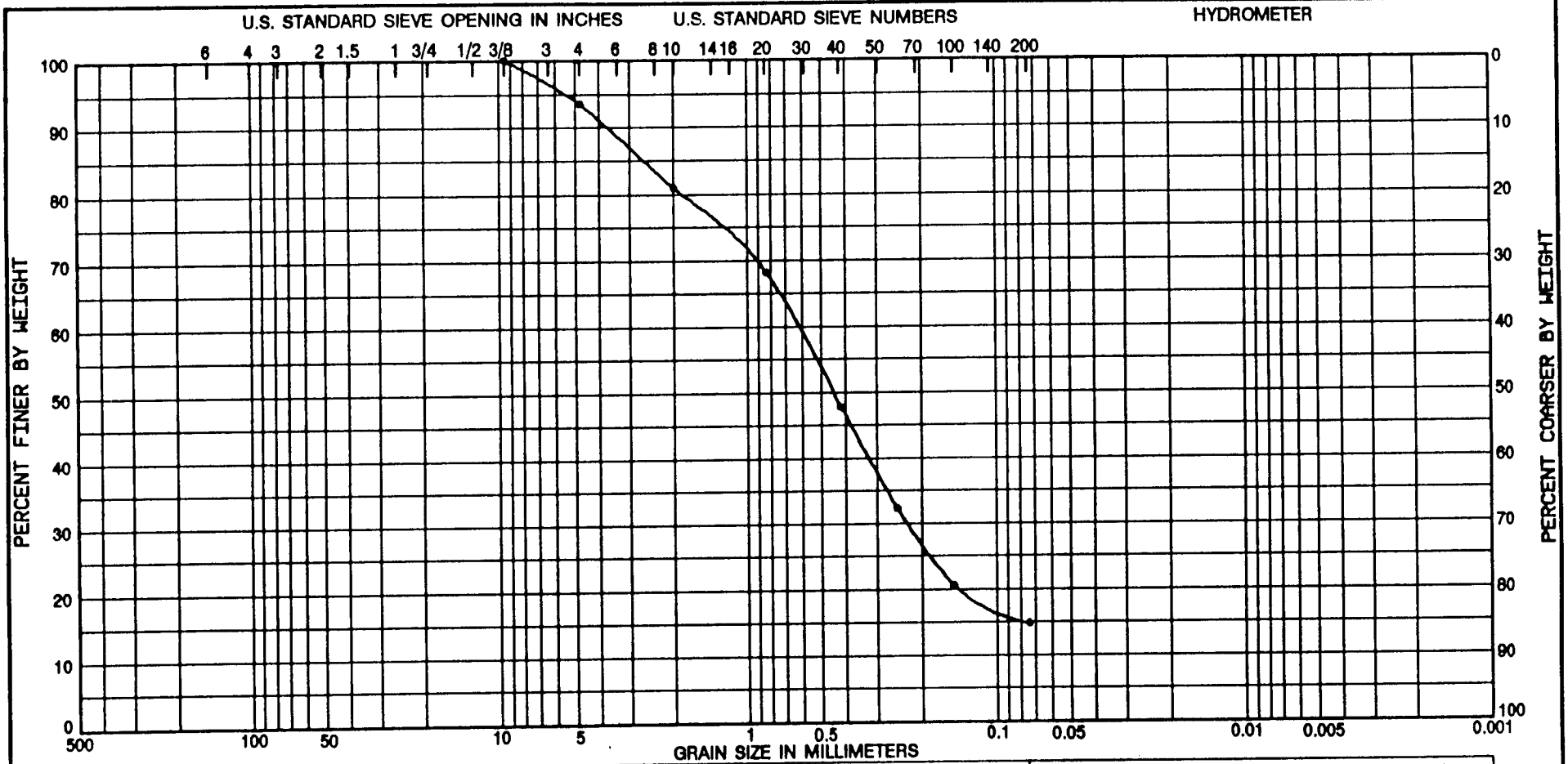
Project PASSAIC RIVER FLOOD CONTROL "Passaic 10"
Lab No. 264/576
Boring No. P-10-8
Date 01/18/94

GRADATION CURVES

E.14.5-10

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE, MARIETTA, GA. 30060

WORK ORDER: 7118
REQUISITION: CESAW-EN-GS-003



Sample No.	Depth	Classification	Nat w%	LL	PL	PI
6	6.5-7.5'	BROWN, SILTY SAND (SM), WITH A TRACE OF GRAVEL SIZES.	14.3	18	15	3

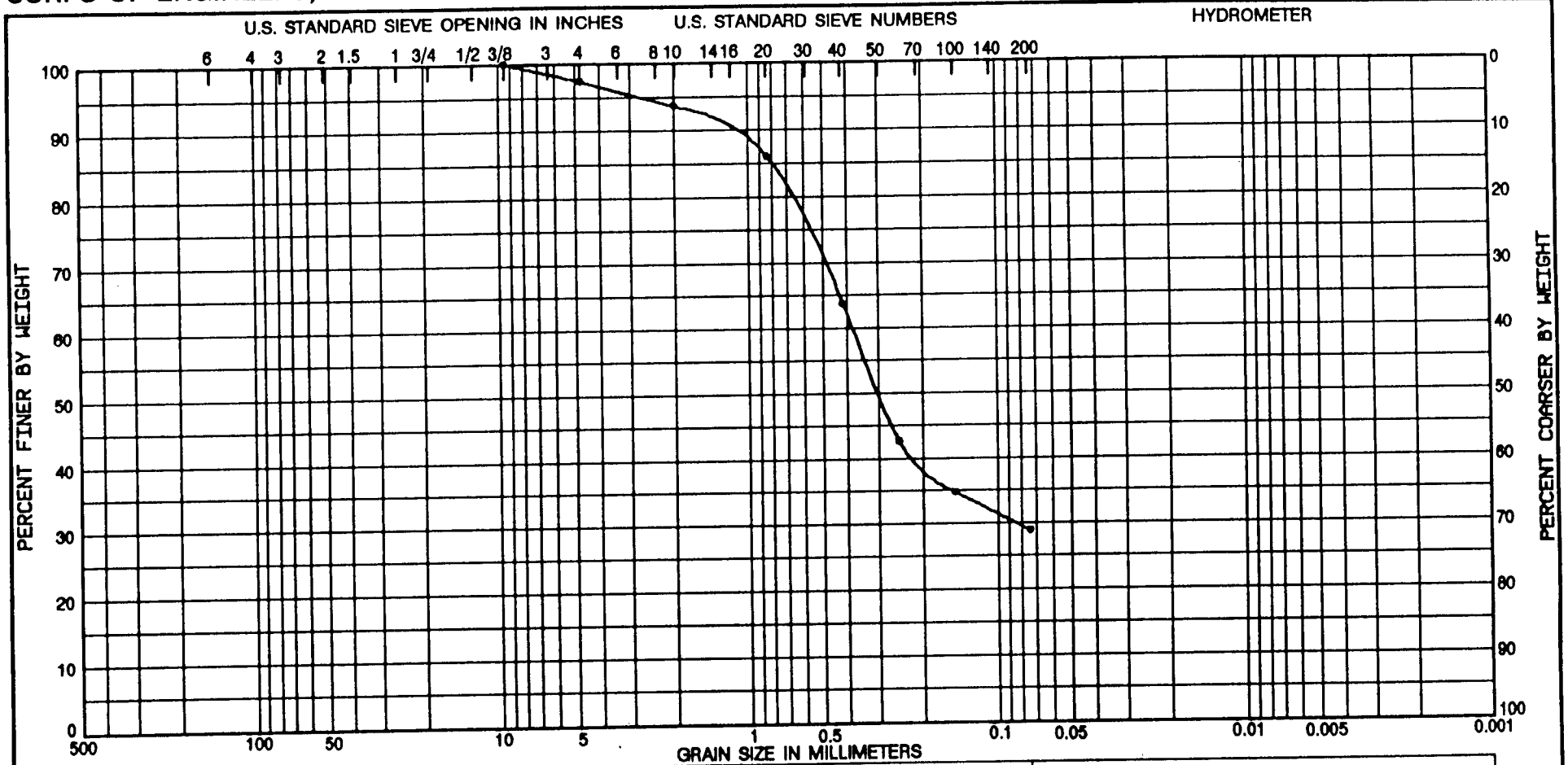
Project PASSAIC RIVER
FLOOD CONTROL "Passaic 10"
Lab No. 264/578
Boring No. P-10-9
Date 01/18/94

GRADATION CURVES

E.14.5-11

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE, MARIETTA, GA. 30060

WORK ORDER: 7118
REQUISITION: CESAW-EN-GS-003



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

Sample No.	Depth	Classification	Nat w%	LL	PL	PI
6	5.0-6.0'	BROWN, SILTY SAND (SM), WITH A TRACE OF GRAVEL SIZES.	13.7	16	16	NP

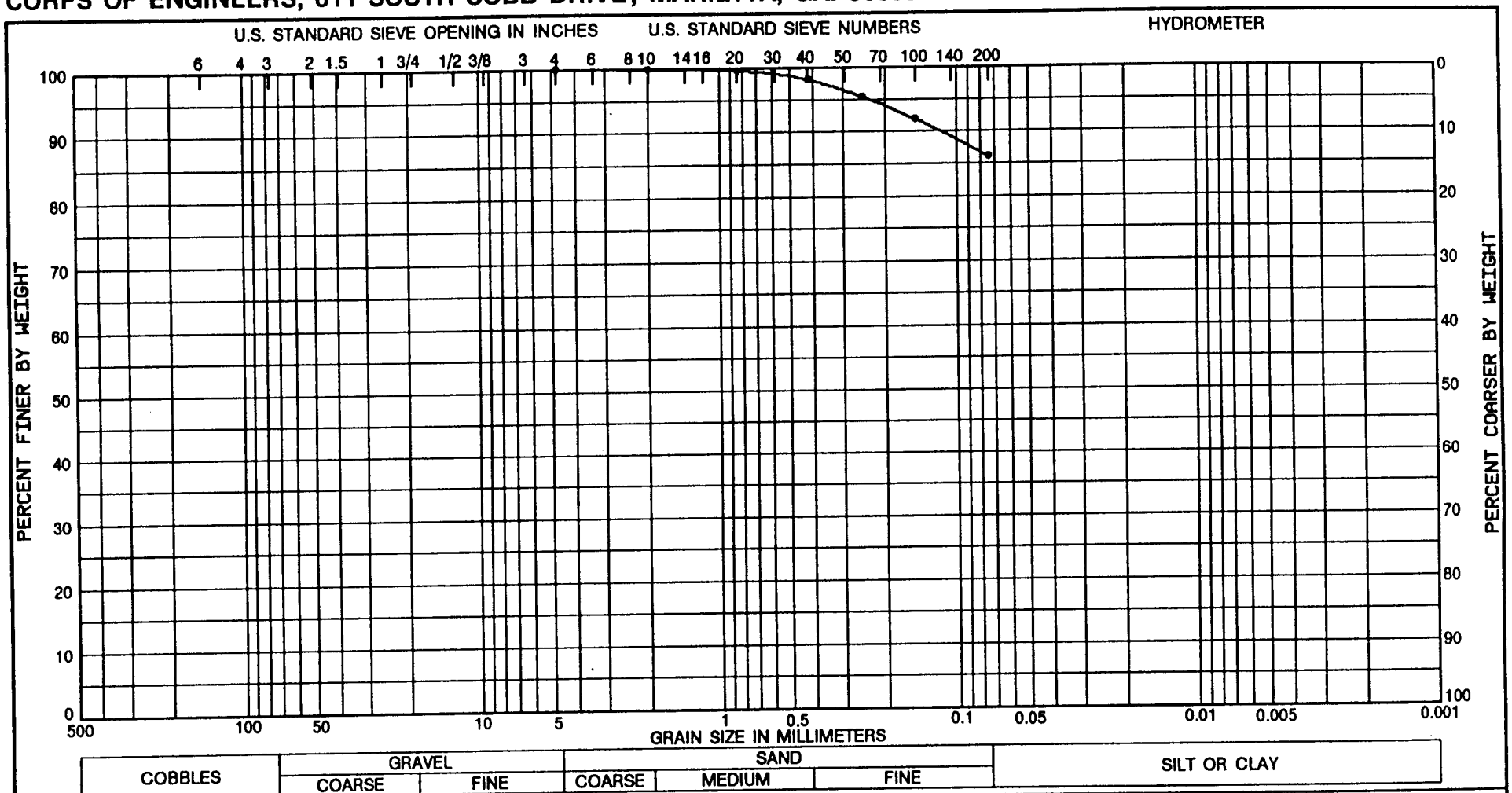
Project PASSAIC RIVER
FLOOD CONTROL "Passaic 10"
Lab No. 284/581
Boring No. P-10-9A
Date 01/18/94

GRADATION CURVES

E.14.5-12

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE, MARIETTA, GA. 30060

WORK ORDER: 7118
REQUISITION: CESAW-EN-GS-94-0003



Sample No.	Depth	Classification	Nat w%	LL	PL	PI
3	5.0-6.8'	GRAY, FAT CLAY (CH), WITH A LITTLE SAND SIZES.	45.8	60	24	36

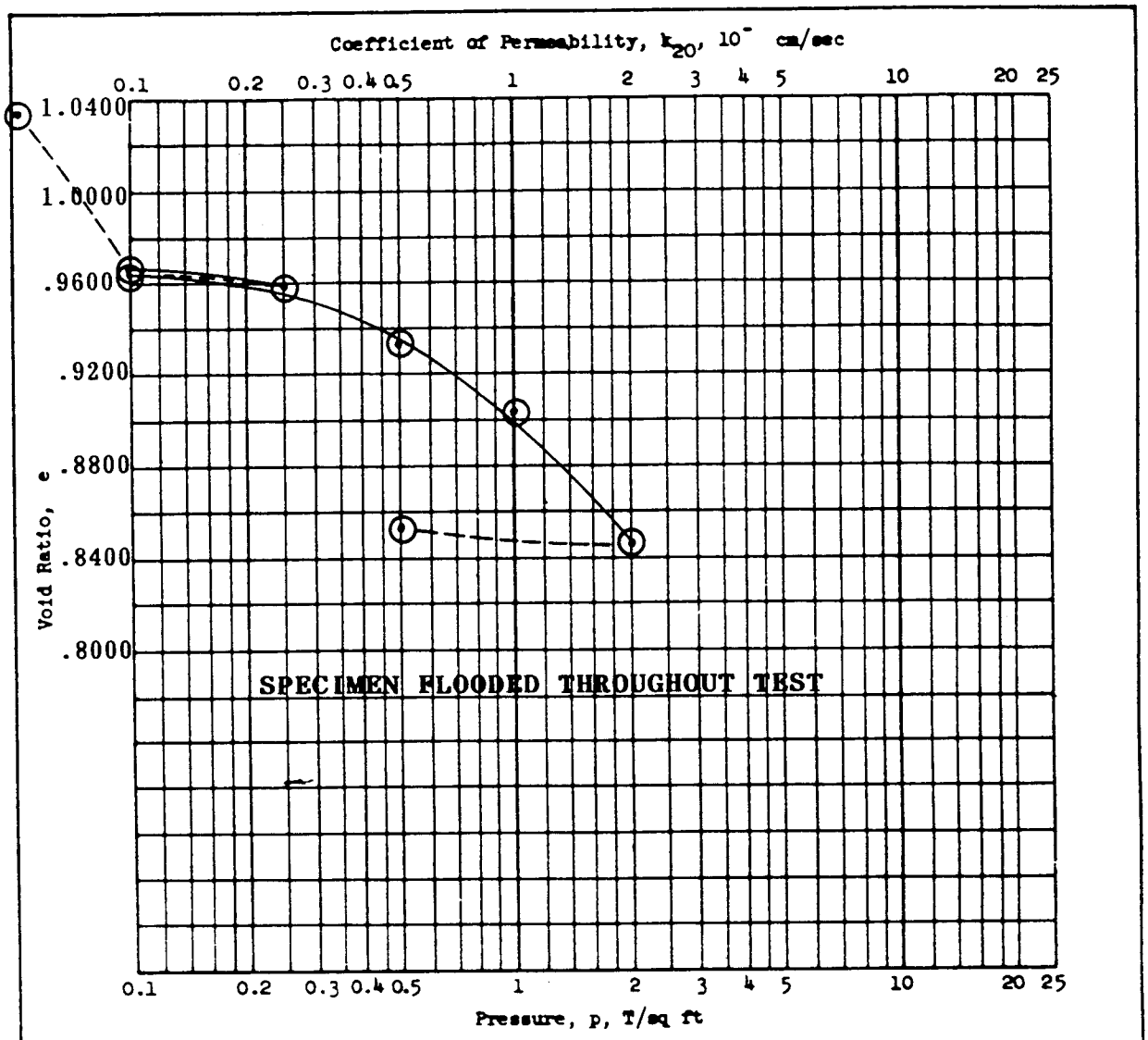
Project PASSAIC RIVER
LEVEE SYSTEM - DIKE # 10
Lab No. 264/556
Boring No. P-10-3AU
Date 02/02/94

GRADATION CURVES

E.14.5-13

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE, MARIETTA, GA. 30061

WORK ORDER NO. 7118
REQ. NO. CESAW-EN-GS-94-0003



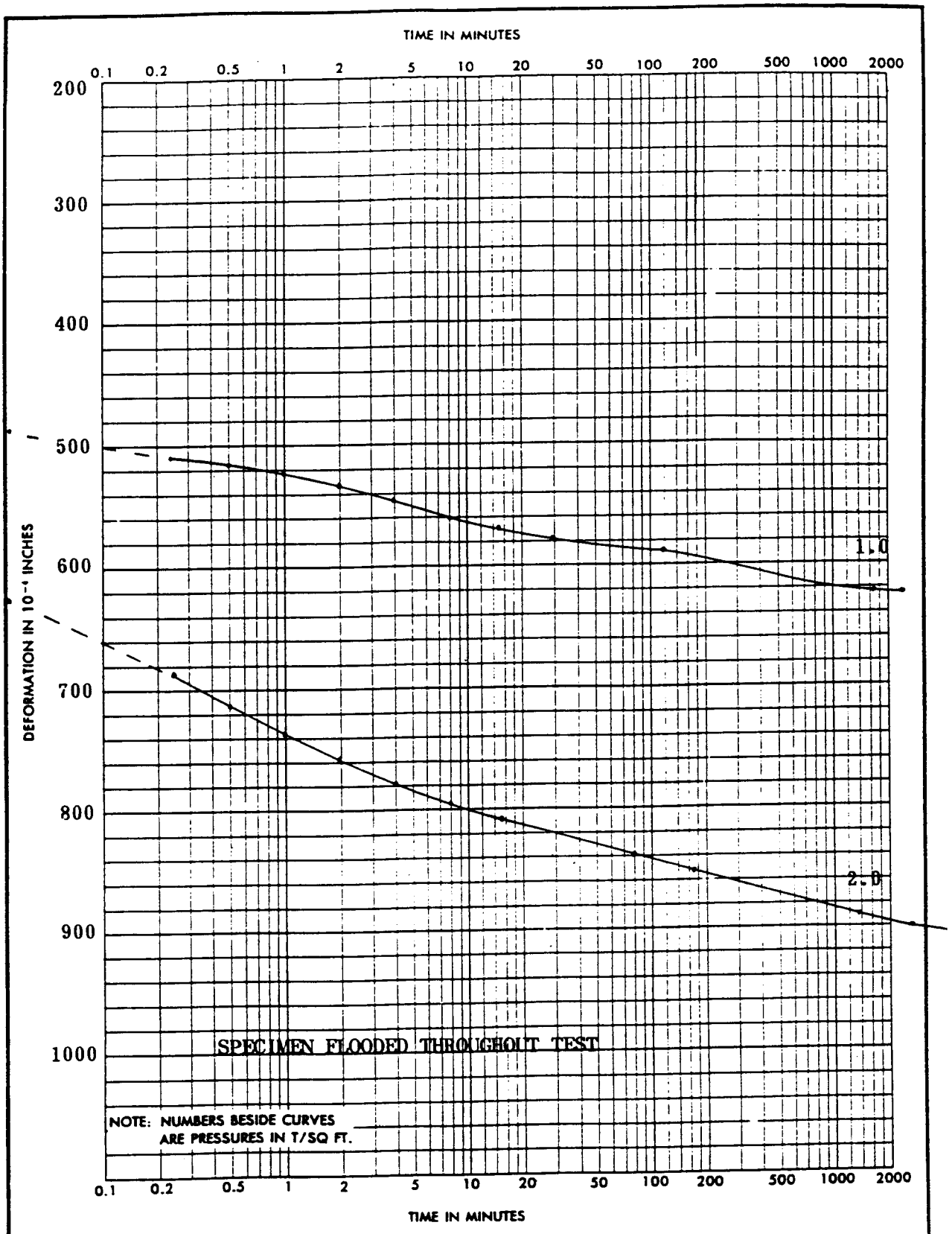
Type of Specimen Undisturbed		Before Test		After Test	
Diam 2.49 in.	Ht 1.00 in.	Water Content, w_o	38.9 %	w_f	32.1 %
Overburden Pressure, p_o T/sq ft		Void Ratio, e_o	1.034	e_f	.853
Preconsol. Pressure, p_c T/sq ft		Saturation, S_o	100.0 %	S_f	100.0 %
Compression Index, C_c		Dry Density, γ_d	81.6 lb/ft^3		
Classification Gray, Fat Clay with a little sand sizes		k_{20} at e_o =	x 10^{-} cm/sec		
LL 60	G_s 2.66	Project Passic River			
PL 24	D_{10} -	Lab No. 264/556			
Remarks		Area Levee System - Dike #10			
		Boring No. P-10-3AU		Sample No. 3	
		Depth El 5.0 - 6.8'		Date 8 February 1994	

CONSOLIDATION TEST REPORT

ENG FORM 2090 1 MAY 63 PREVIOUS EDITIONS ARE OBSOL

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE, MARIETTA, GA. 30060

WORK ORDER NO. 7118
Req. No. CESAW-EN-GS-94-0003



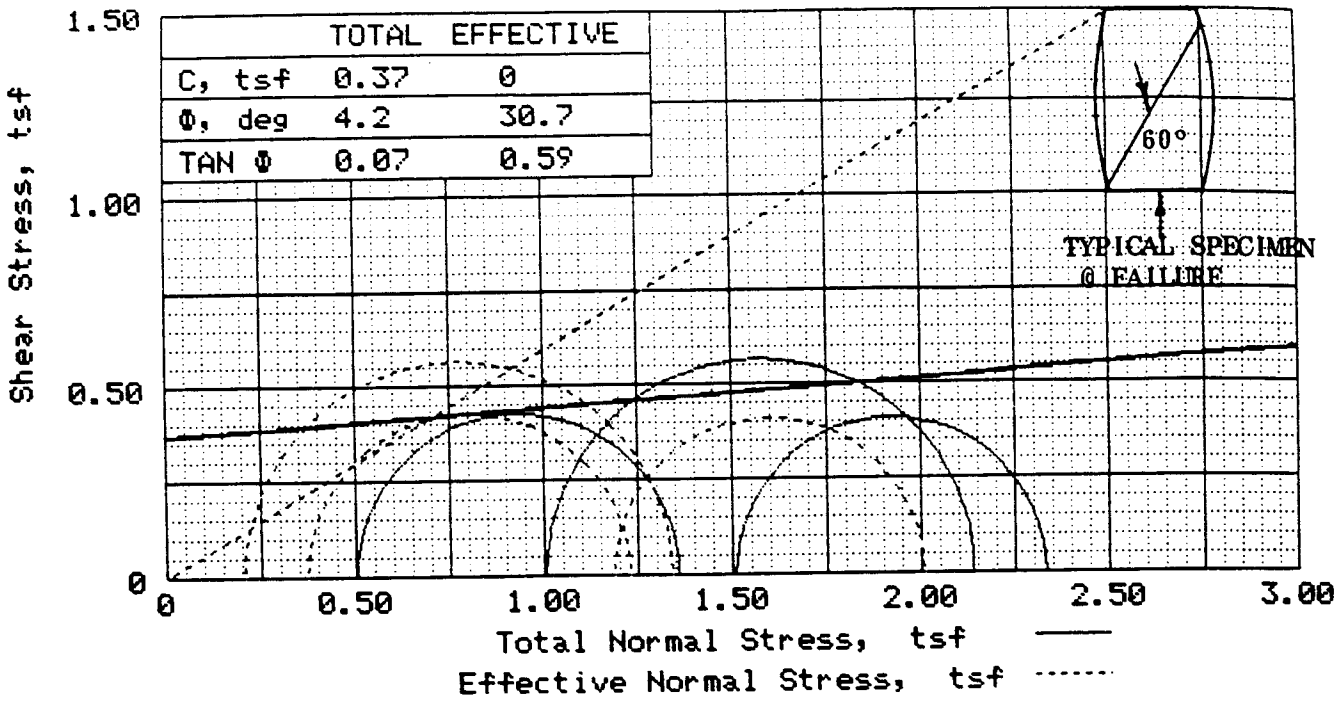
PROJECT	Passaic River			
AREA	Levee System - Dike #10		Lab No. 264/556	(CH)
BORING NO. P-10-3AU	SAMPLE NO. 3	DEPTH 5.0-6.8'	DATE 31 Mar 94	

ENG FORM 2088 1 MAY 63 PREVIOUS EDITIONS ARE OBSOLETE.

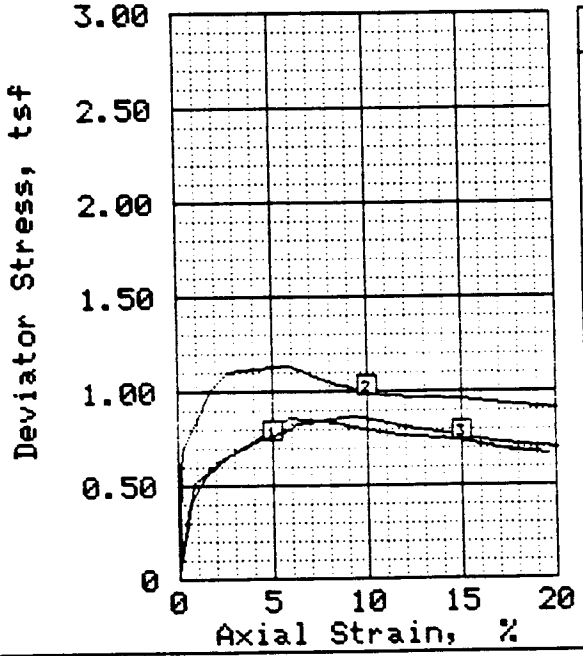
CONSOLIDATION TEST—TIME CURVES (TRANSLUCENT)

* GPO : 1964 OF—715-965

SOUTH ATLANTIC DIVISION LABORATORY, CORPS OF ENGINEERS - MARIETTA, GEORGIA
Requisition No. CESAW-EN-GS-94-0003 Work Order No. 7117



	TOTAL	EFFECTIVE
C, tsf	0.37	0
Φ, deg	4.2	30.7
TAN Φ	0.07	0.59



SAMPLE NO.		1	2	3
INITIAL	WATER CONTENT, %	47.3	47.6	42.6
	DRY DENSITY, pcf	73.5	71.8	77.8
	SATURATION, %	100.0	96.4	100.0
	VOID RATIO	1.259	1.314	1.134
	DIAMETER, in	1.38	1.38	1.38
	HEIGHT, in	3.08	3.08	3.08
@ TESTING	WATER CONTENT, %	47.3	42.1	40.2
	DRY DENSITY, pcf	73.5	78.3	80.3
	SATURATION, %	100.0	100.0	100.0
	VOID RATIO	1.259	1.121	1.069
	DIAMETER, in	1.39	1.34	1.36
	HEIGHT, in	3.05	2.99	3.05
BACK PRESSURE, tsf		6.05	5.04	6.05
INIT. EFF. STR., tsf		0.50	1.01	1.51
MAX. DEV. STRESS, tsf		0.86	1.13	0.82
PORE PRESSURE, tsf		0.13	0.80	0.32
TIME TO FAILURE, min.		70	60	90
RATE, %/min.		0.08	0.10	0.07
ULT. DEV. STRESS, tsf		0.74	0.96	0.76

DESCRIPTION GRAY, FAT CLAY (CH), WITH A LITTLE SAND SIZES.

LL= 60	PL= 24	PI= 36	Gs= 2.66	CONTROLLED STRAIN TEST
TYPE OF SPECIMEN UNDISTURBED				TYPE OF TEST R w/pore pressures

REMARKS 1. Insufficient similiar material for additional specimens.

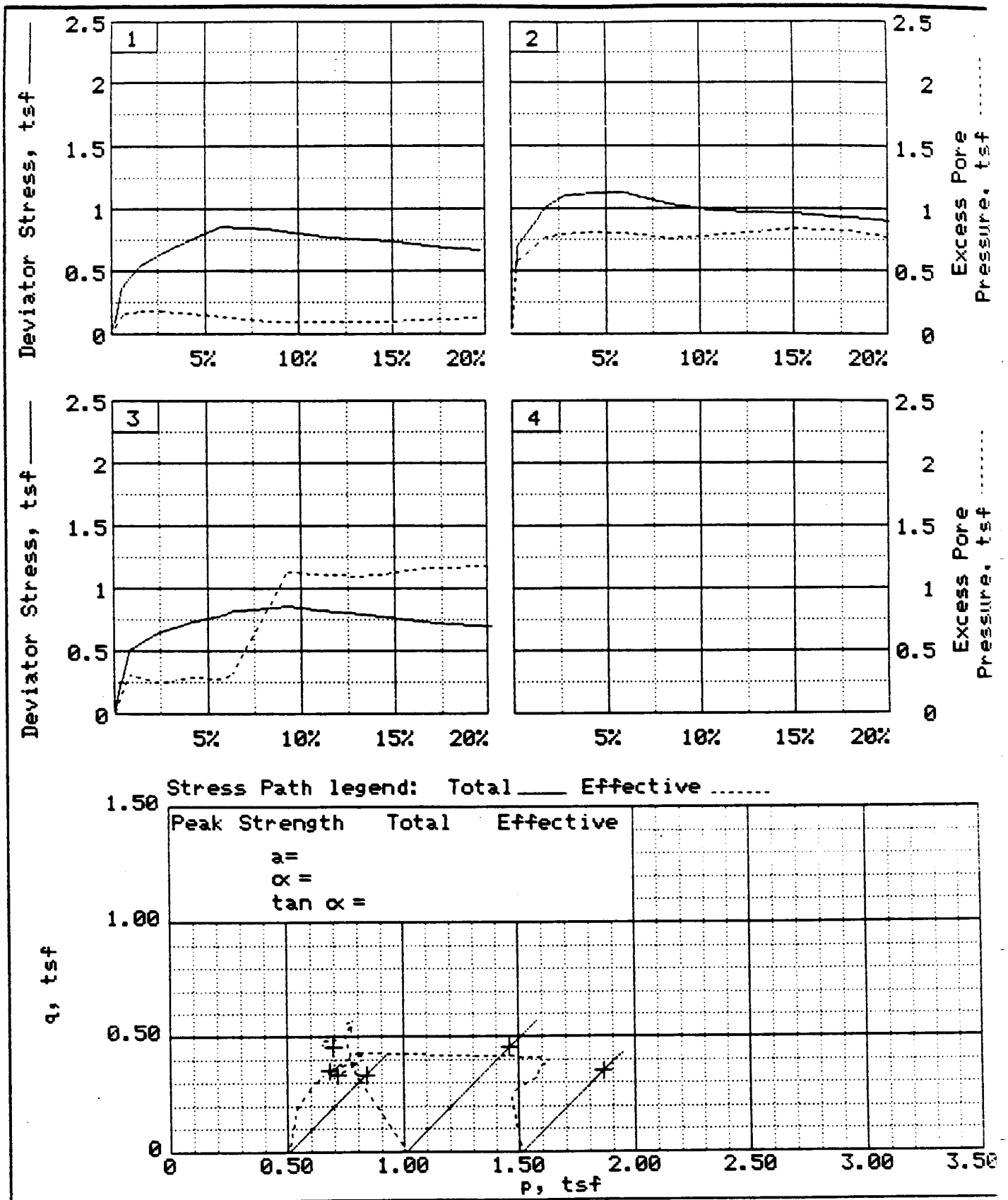
PROJECT PASSAIC RIVER
LEVEE SYSTEM - DIKE #10
AREA

LAB NO. 264/556

BORING NO. P-10-3AU
SAMPLE NO. 3
DEPTH/ELEV 5.0 - 6.8'
LABORATORY CESAD-EN-FL DATE 8 FEB. 19S

Pg 1 of 2 TRIAXIAL COMPRESSION TEST

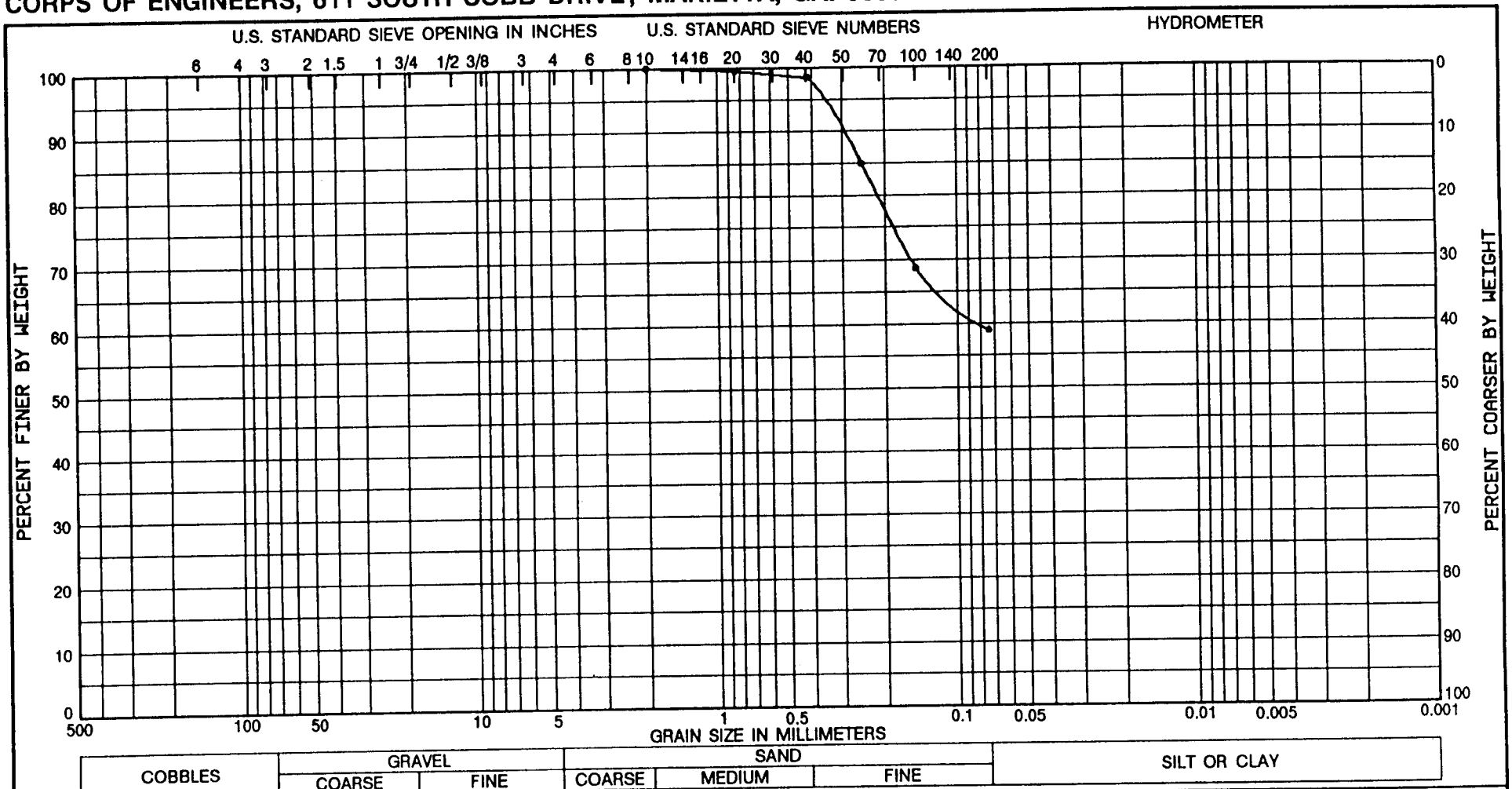
SOUTH ATLANTIC DIVISION LABORATORY, CORPS OF ENGINEERS - MARIETTA, GEORGIA
Requisition No. CESAW-EN-GS-94-0003 Work Order No. 7117



PROJECT PASSAIC RIVER LEVEE SYSTEM - DIKE #10
BORING P-10-3AU SAMPLE 3 DEPTH/ELEV 5.0 - 6.8'
TYPE OF TEST R w/pore pressures LAB NO. 264/556
LABORATORY CESAD-EN-FL PAGE 2/2 DATE 8 FEB. 1994

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE, MARIETTA, GA. 30060

WORK ORDER: 7118
REQUISITION: CESAW-EN-GS-003



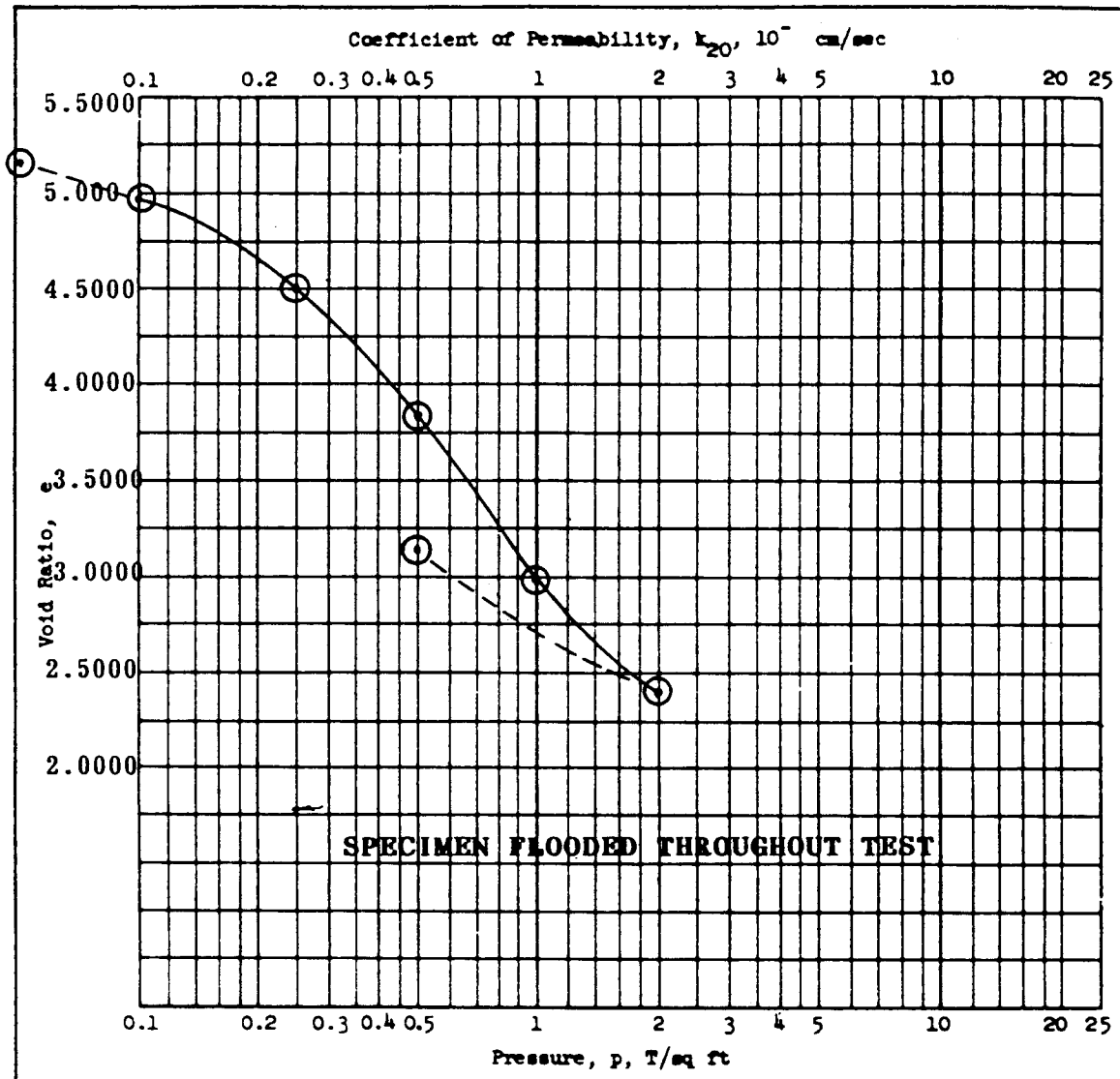
Sample No.	Depth	Classification	Nat w%	LL	PL	PI
1	1.3-3.0'	(VISUAL) BLACK ORGANIC SILT HIGH LL	355.8	432	194	238
		(OH), SANDY.				
		NOTE: THE PLUS NO. 200 SIEVE SIZES ARE				
		MOSTLY ORGANIC PARTICLES RATHER THAN				
		SAND.				

GRADATION CURVES

Project PASSAIC RIVER
LEVEE SYSTEM - DIKE # 10
Lab No. 264/557
Boring No. P-10-3BU
Date 01/31/94

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE, MARIETTA, GA. 30061

WORK ORDER NO. 7118
REQ. NO. CESAW-EN-GS-94-0003



Type of Specimen: Undisturbed		Before Test		After Test	
Diam 2.47 in.	Ht 1.00 in.	Water Content, w_o	321.3 %	w_f	197.6 %
Overburden Pressure, p_o T/sq ft		Void Ratio, e_o	5.141	e_f	3.161
Preconsol. Pressure, p_c T/sq ft		Saturation, S_o	100.0 %	S_f	100.0 %
Compression Index, C_c		Dry Density, γ_d	16.3 lb/ft^3		
		Swivet e_o =	x 10^{-} cm/sec		

Classification (Visual) Black Organic Silt High LL (OH), Sandy. NOTE: The plus 200 sieve sizes are mostly organic particles rather than sand.

LL 432	G_s 1.60
PL 194	D_{10} -

Remarks

Project Passic River

Lab. No. 264/557

Area Levee System - Dike #10

Boring No. P-10-3BU | Sample No. 1

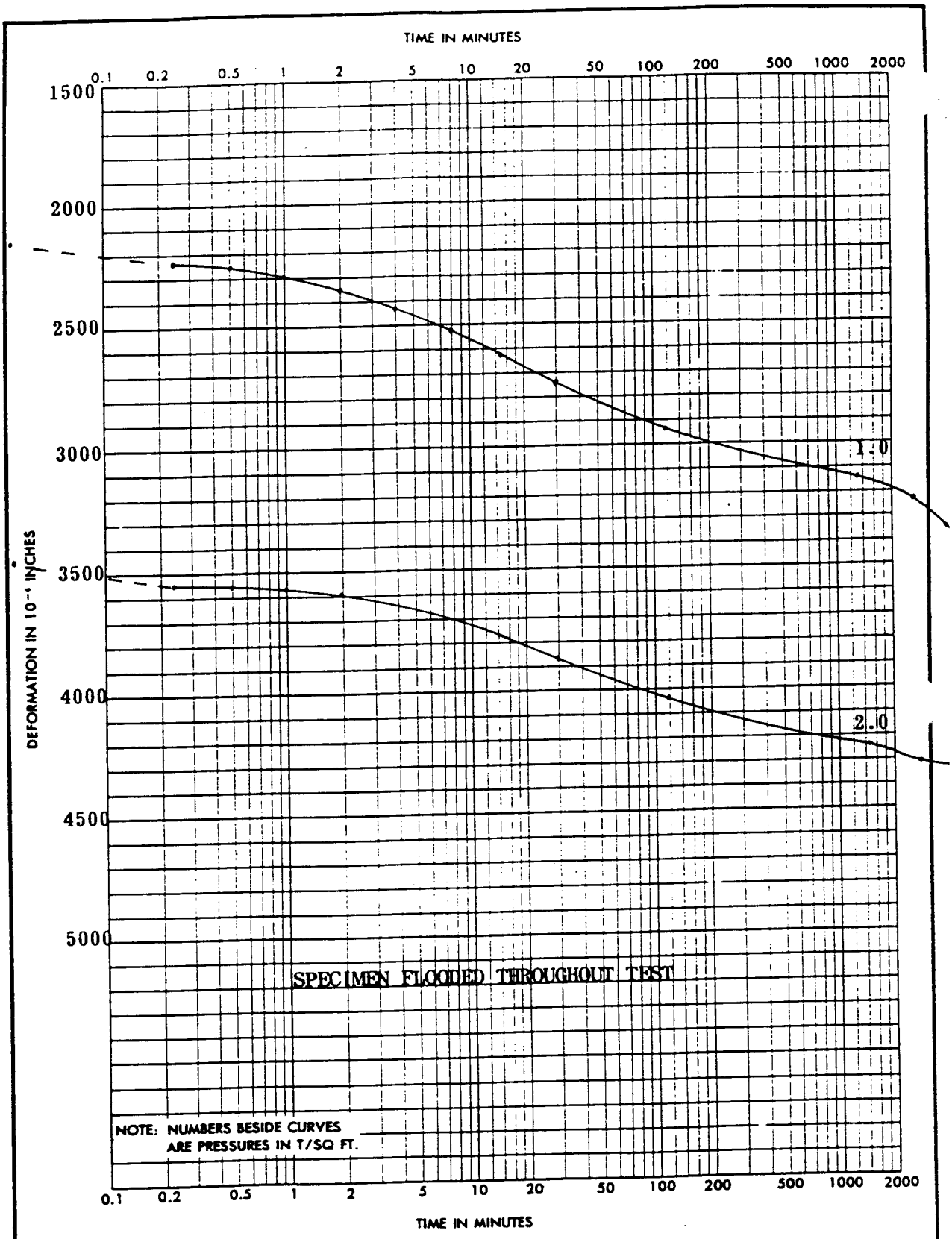
Depth El 1.3 - 3.0' | Date 8 Feb 94

CONSOLIDATION TEST REPORT

ENG FORM 1 MAY 63 2090 PREVIOUS EDITIONS ARE OBSOLE

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE, MARIETTA, GA. 30060

WORK ORDER NO. 7118
Req. No. CESAW-EN-GS-0003



PROJECT Passaic River

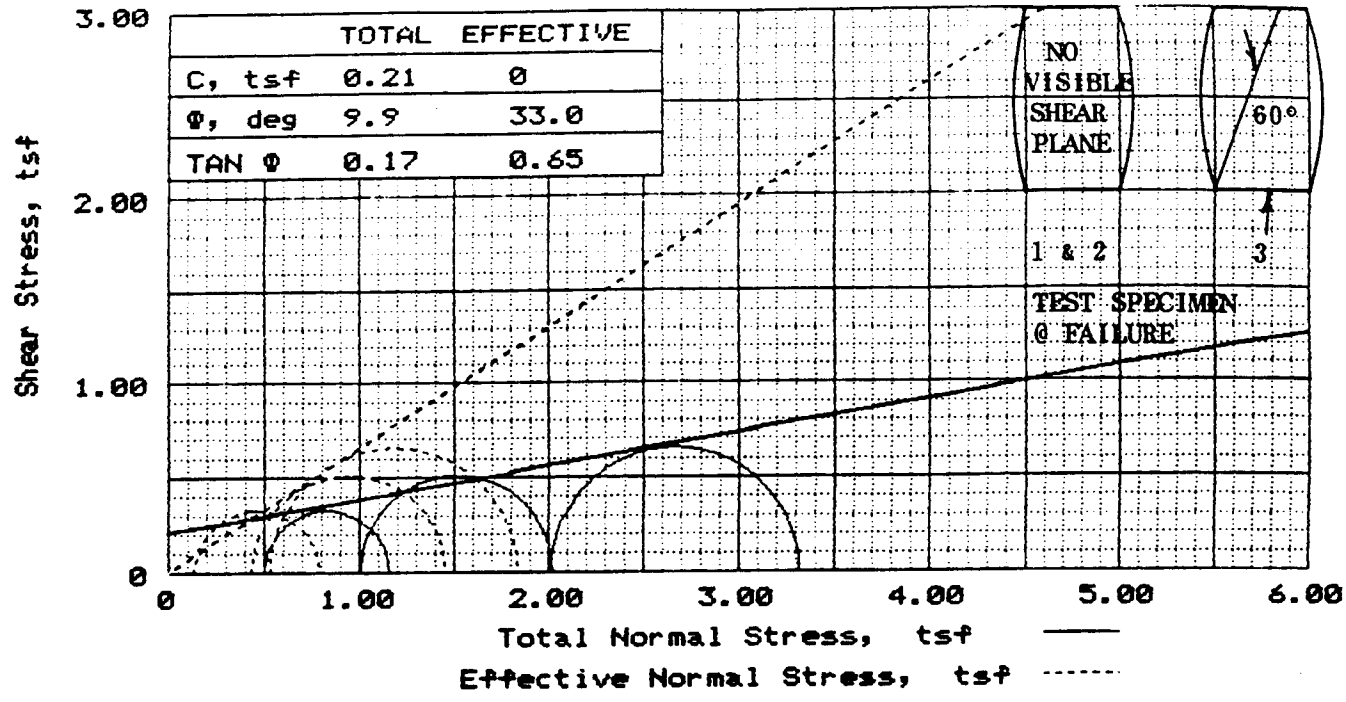
AREA Levee System Dike #10 Lab No. 264/557

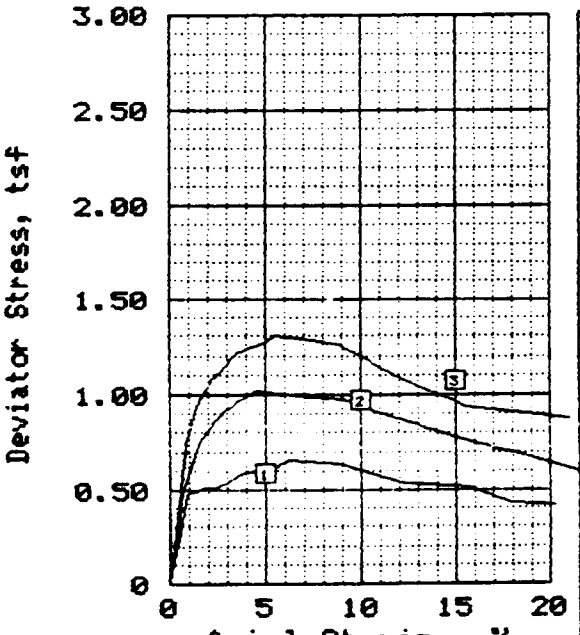
BORING NO. P-10-3BU SAMPLE NO. 1 DEPTH 1.3-3.0' DATE 31 Mar 94

ENG FORM 2088 1 MAY 63 PREVIOUS EDITIONS ARE OBSOLETE. **CONSOLIDATION TEST—TIME CURVES** (TRANSLUCENT)

• GPO : 1964 OF—715-965

SOUTH ATLANTIC DIVISION LABORATORY, CORPS OF ENGINEERS - MARIETTA, GEORGIA
Requisition No. CESAW-EN-GS-94-0003 Work Order No. 7118





SAMPLE NO.		1	2	3
INITIAL	WATER CONTENT, %	389.4	396.7	315.6
	DRY DENSITY, pcf	12.5	12.5	16.5
	SATURATION, %	89.3	91.0	100.0
	VOID RATIO	6.973	6.973	5.050
	DIAMETER, in	1.38	1.38	1.38
	HEIGHT, in	3.08	3.08	3.08
@ TESTING	WATER CONTENT, %	309.9	294.8	258.3
	DRY DENSITY, pcf	16.8	17.5	19.5
	SATURATION, %	100.0	100.0	100.0
	VOID RATIO	4.957	4.717	4.134
	DIAMETER, in	1.25	1.23	1.30
	HEIGHT, in	2.80	2.77	2.92
BACK PRESSURE, tsf		5.04	5.04	5.04
INIT. EFF. STR., tsf		0.50	1.01	2.02
MAX. DEV. STRESS, tsf		0.65	1.02	1.31
PORE PRESSURE, tsf		0.37	0.57	1.48
TIME TO FAILURE, min.		85	60	70
RATE, %/min.		0.07	0.08	0.08
ULT. DEV. STRESS, tsf		0.52	0.78	0.96

DESCRIPTION (VISUAL) BLACK ORGANIC SILT HIGH 11 (OH), SANDY.

LL= 432	PL= 194	PI= 238	Gs= 1.60	CONTROLLED STRAIN TEST
TYPE OF SPECIMEN UNDISTURBED				TYPE OF TEST R w/pore pressures

REMARKS SEE ADDITIONAL INFO. ON GRADATION TEST REPORT

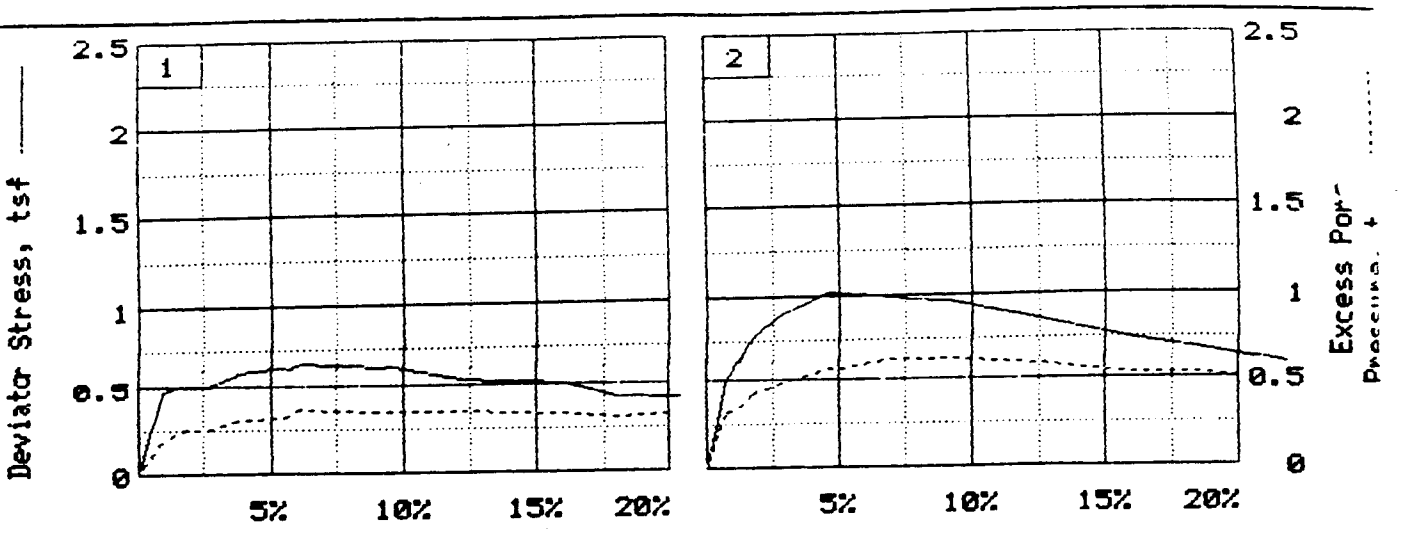
PROJECT PASSAIC RIVER
LEVEE SYSTEM - DIKE #10
AREA

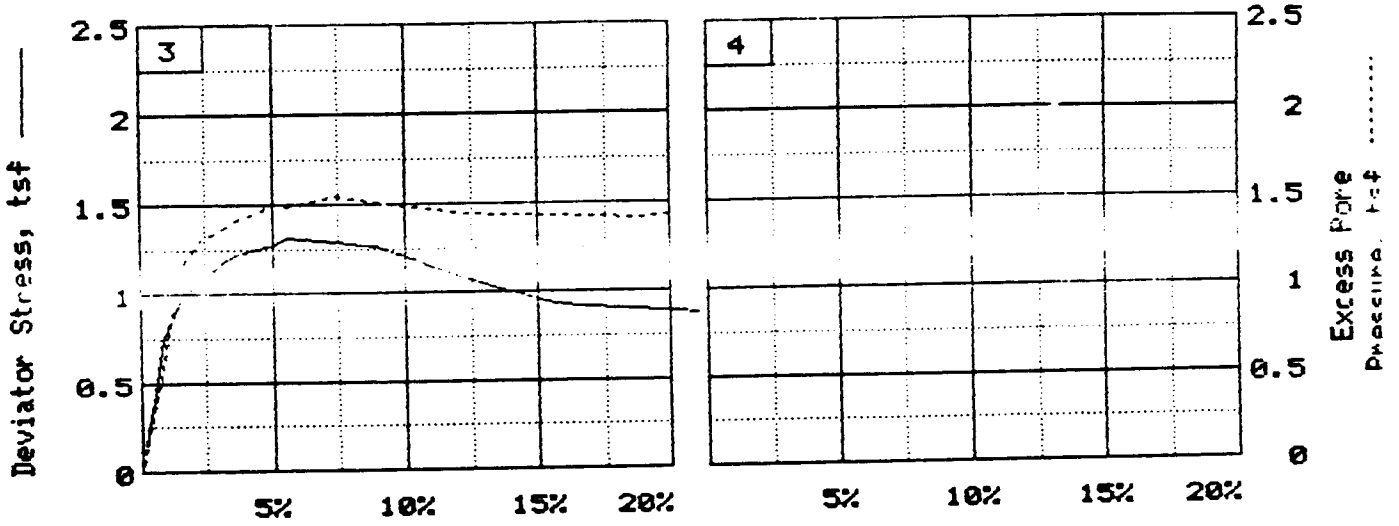
LAB NO. 264/557

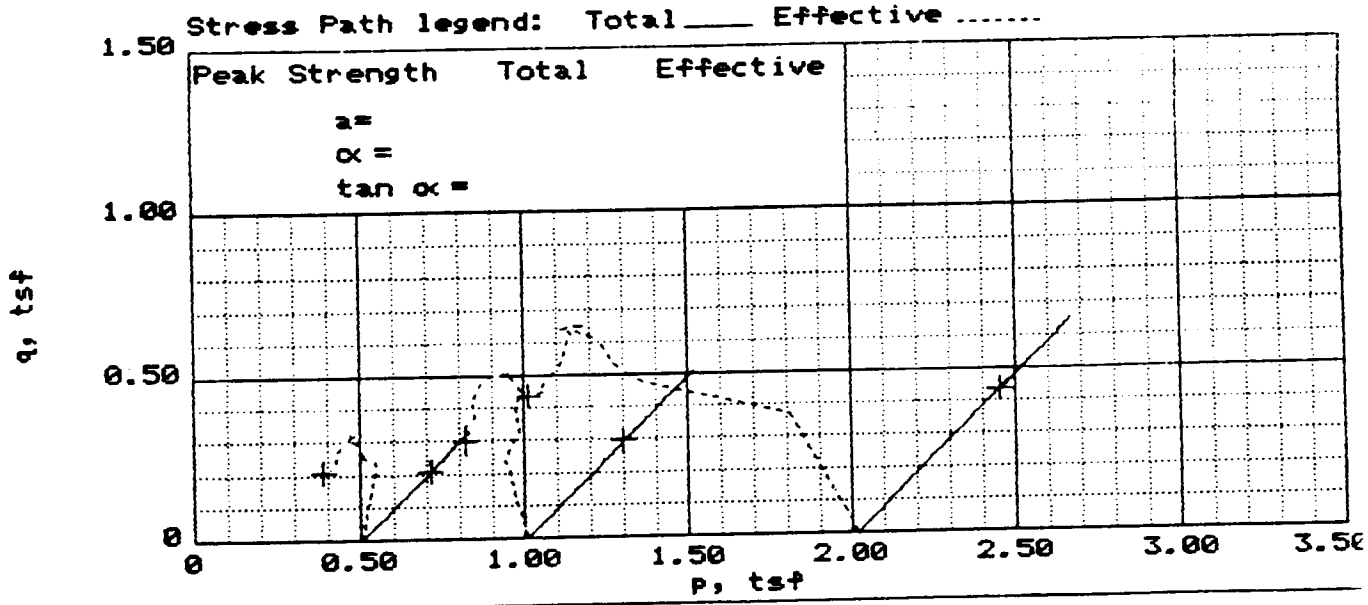
BORING NO. P-10-3BU
SAMPLE NO. 1
DEPTH/ELEV 1.3 - 3.0'
LABORATORY CESAD-EN-FL DATE 31 JAN 94

TRIAXIAL COMPRESSION TEST

SOUTH ATLANTIC DIVISION LABORATORY, CORPS OF ENGINEERS - MARIETTA, GEORGIA
Requisition No. CESAW-EN-6S-94-0003 Work Order No. 7118







PROJECT PASSAIC RIVER LEVEE SYSTEM - DIKE #10
BORING P-10-3BU SAMPLE 1 DEPTH/ELEV 1.3 - 3.0'
TYPE OF TEST R w/pore pressures LAB NO. 264/557
LABORATORY CESAD-EN-FL PAGE 2/2 DATE 31 JAN 94

PASSAIC RIVER FLOOD DAMAGE REDUCTION PROJECT

SECTION 14
PASSAIC 10 LEVEE SYSTEM

ATTACHMENT E.14.6
GEOTECHNICAL ANALYSES

Attachment E.14.6

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Slope Stability, Sta. 41+00, Sudden Drawdown (11')	G-4	3
Slope Stability, Sta. 41+00, Sudden Drawdown (6')	G-5	4
Slope Stability, Sta. 14+00, End of Construction	G-6	5
Slope Stability, Sta. 14+00, Steady Seepage	G-7	6
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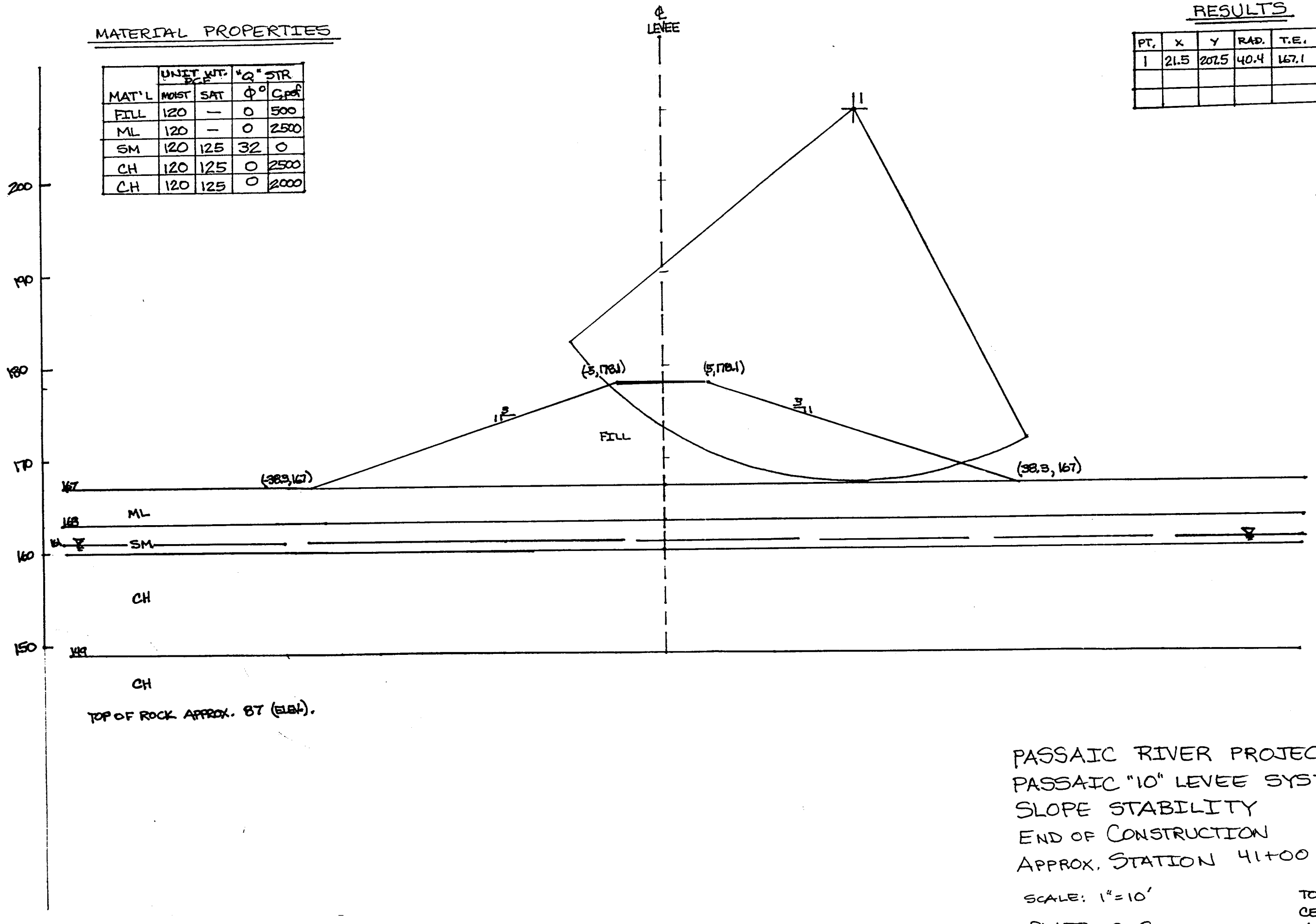
MATERIAL PROPERTIES

MAT'L	UNIT WT. PCF MOIST	SAT	"Q" STR φ°	C, psf
FILL	120	—	0	500
ML	120	—	0	2500
SM	120	125	32	0
CH	120	125	0	2500
CH	120	125	0	2000

RESULTS

PT.	X	Y	RAD.	T.E.	F.S.
1	21.5	202.5	40.4	167.1	4.02



PASSAIC RIVER PROJECT
PASSAIC "10" LEVEE SYSTEM
SLOPE STABILITY
END OF CONSTRUCTION
APPROX. STATION 41+00

SCALE: 1"=10'

PLATE G-2

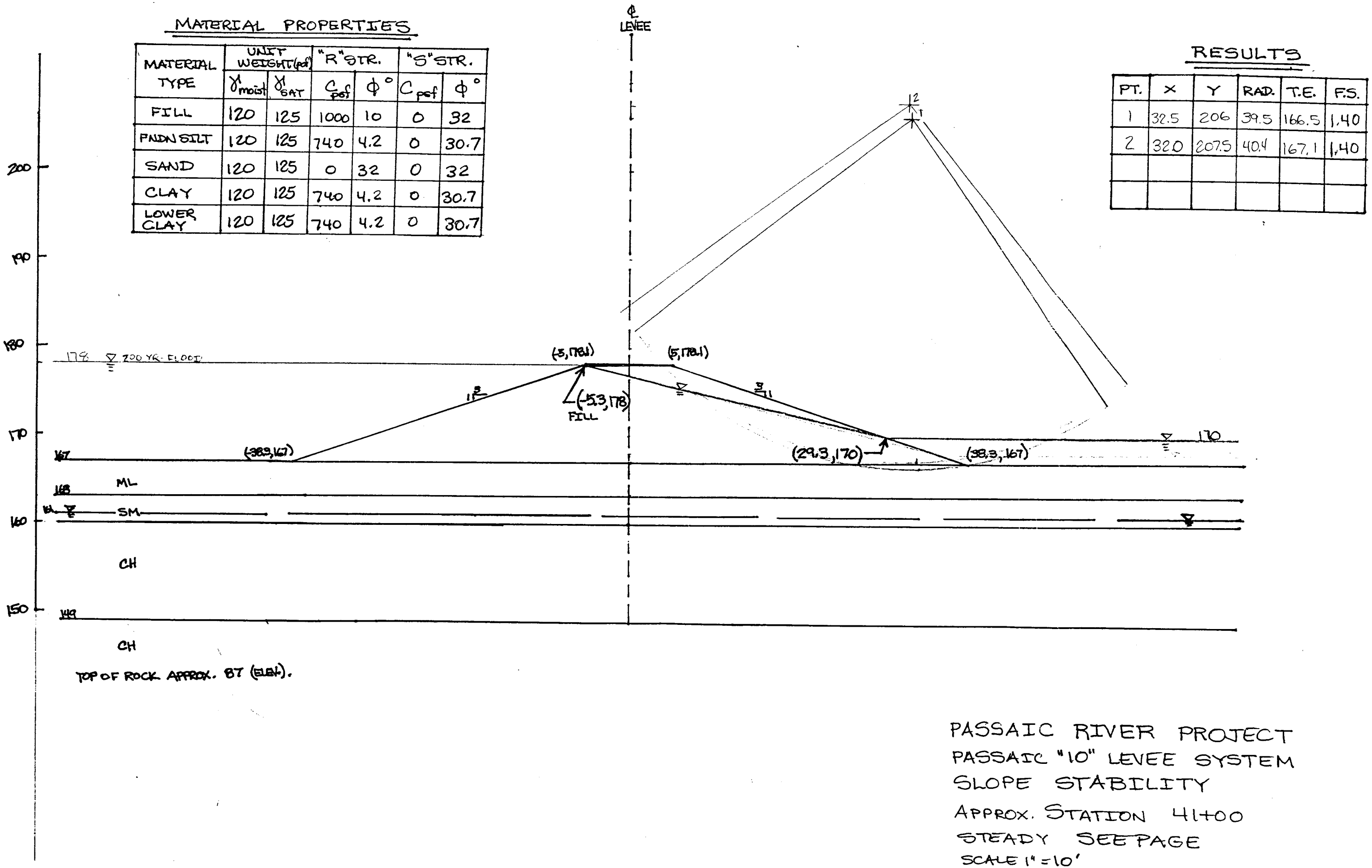
TOM CHILD
CESAW-EN-GS
MAY 1994

MATERIAL PROPERTIES

MATERIAL TYPE	UNIT WEIGHT(pcf) γ_{moist}	γ_{SAT}	"R" STR. C_{psf}	$\phi°$	"S" STR. C_{psf}	$\phi°$
FILL	120	125	1000	10	0	32
FNDN SILT	120	125	740	4.2	0	30.7
SAND	120	125	0	32	0	32
CLAY	120	125	740	4.2	0	30.7
LOWER CLAY	120	125	740	4.2	0	30.7

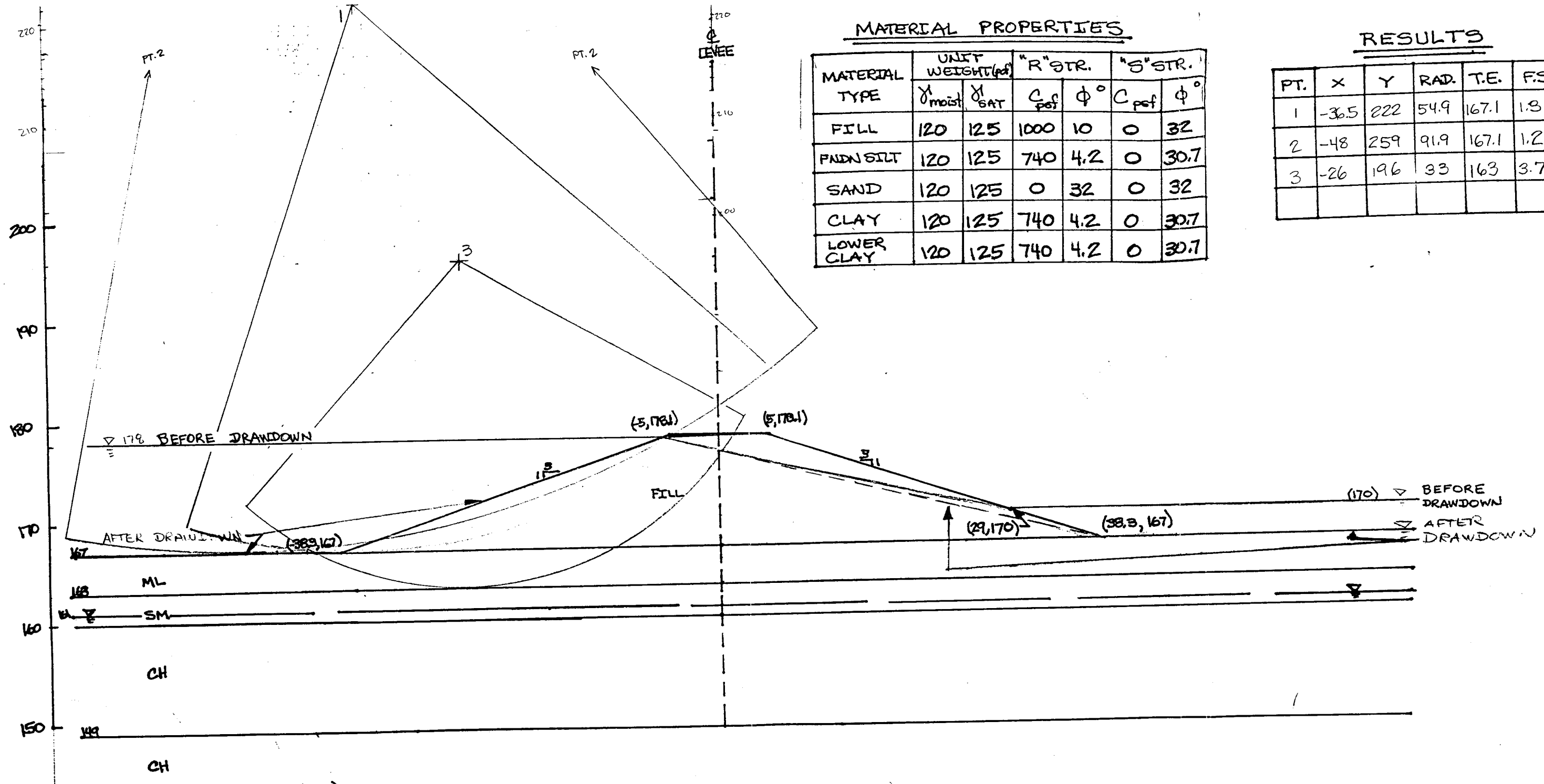
RESULTS

PT.	X	Y	RAD.	T.E.	F.S.
1	32.5	206	39.5	166.5	1.40
2	32.0	207.5	40.4	167.1	1.40



PASSAIC RIVER PROJECT
PASSAIC "10" LEVEE SYSTEM
SLOPE STABILITY
APPROX. STATION 41+00
STEADY SEEPAGE
SCALE 1" = 10'
PLATE: G-3

TOM CHILD
CESAW-EN-GS
MAY 1994



MATERIAL PROPERTIES

MATERIAL TYPE	UNIT WEIGHT(pcf) γ_{moist}	γ_{SAT}	"R" STR. C_{psf}	$\phi°$	"S" STR. C_{psf}	$\phi°$
FILL	120	125	1000	10	0	32
PNDN SILT	120	125	740	4.2	0	30.7
SAND	120	125	0	32	0	32
CLAY	120	125	740	4.2	0	30.7
LOWER CLAY	120	125	740	4.2	0	30.7

RESULTS

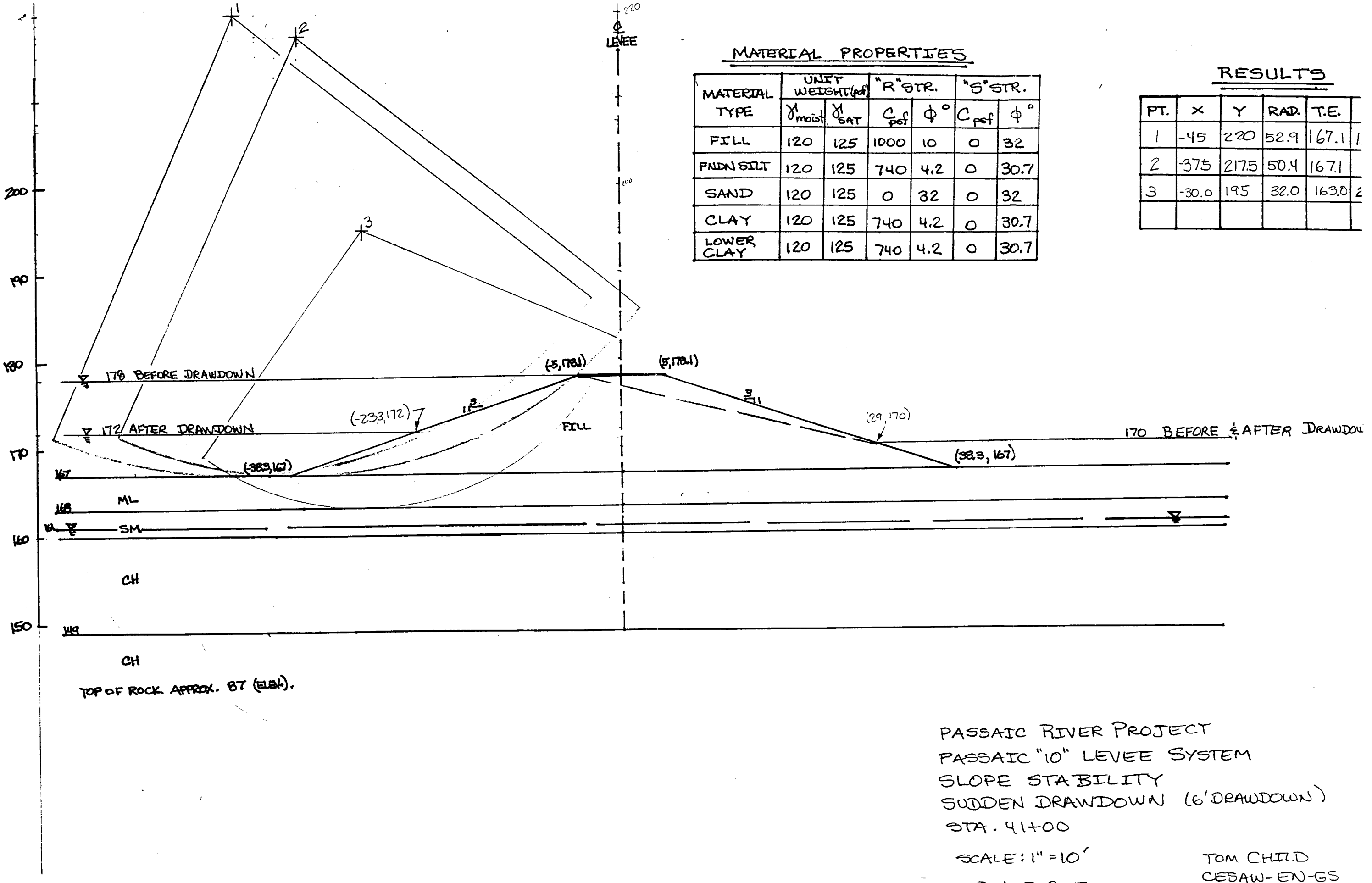
PT.	X	Y	RAD.	T.E.	F.S.
1	-36.5	222	54.9	167.1	1.8
2	-48	259	91.9	167.1	1.2
3	-26	196	33	163	3.7

PASSAIC RIVER PROJECT
PASSAIC "10" LEVEE SYSTEM
SLOPE STABILITY
SUDDEN DRAWDOWN (11' DRAWDOWN)
STA. 41+00

SCALE: 1" = 10'

PLATE G-4

TOM CHILD
CESAW-EN-GS
MAY 1994



MATERIAL PROPERTIES

MATERIAL TYPE	UNIT WEIGHT (pcf)		"R" STR.		"S" STR.	
	γ_{moist}	γ_{SAT}	C_{psf}	$\phi°$	C_{psf}	$\phi°$
FILL	120	125	1000	10	0	32
PNDN SILT	120	125	740	4.2	0	30.7
SAND	120	125	0	32	0	32
CLAY	120	125	740	4.2	0	30.7
LOWER CLAY	120	125	740	4.2	0	30.7

RESULTS

PT.	X	Y	RAD.	T.E.	
1	-45	220	52.9	167.1	1
2	-37.5	217.5	50.4	167.1	
3	-30.0	195	32.0	163.0	2

PASSAIC RIVER PROJECT
PASSAIC "10" LEVEE SYSTEM
SLOPE STABILITY
SUDDEN DRAWDOWN (6' DRAWDOWN)
STA. 41+00

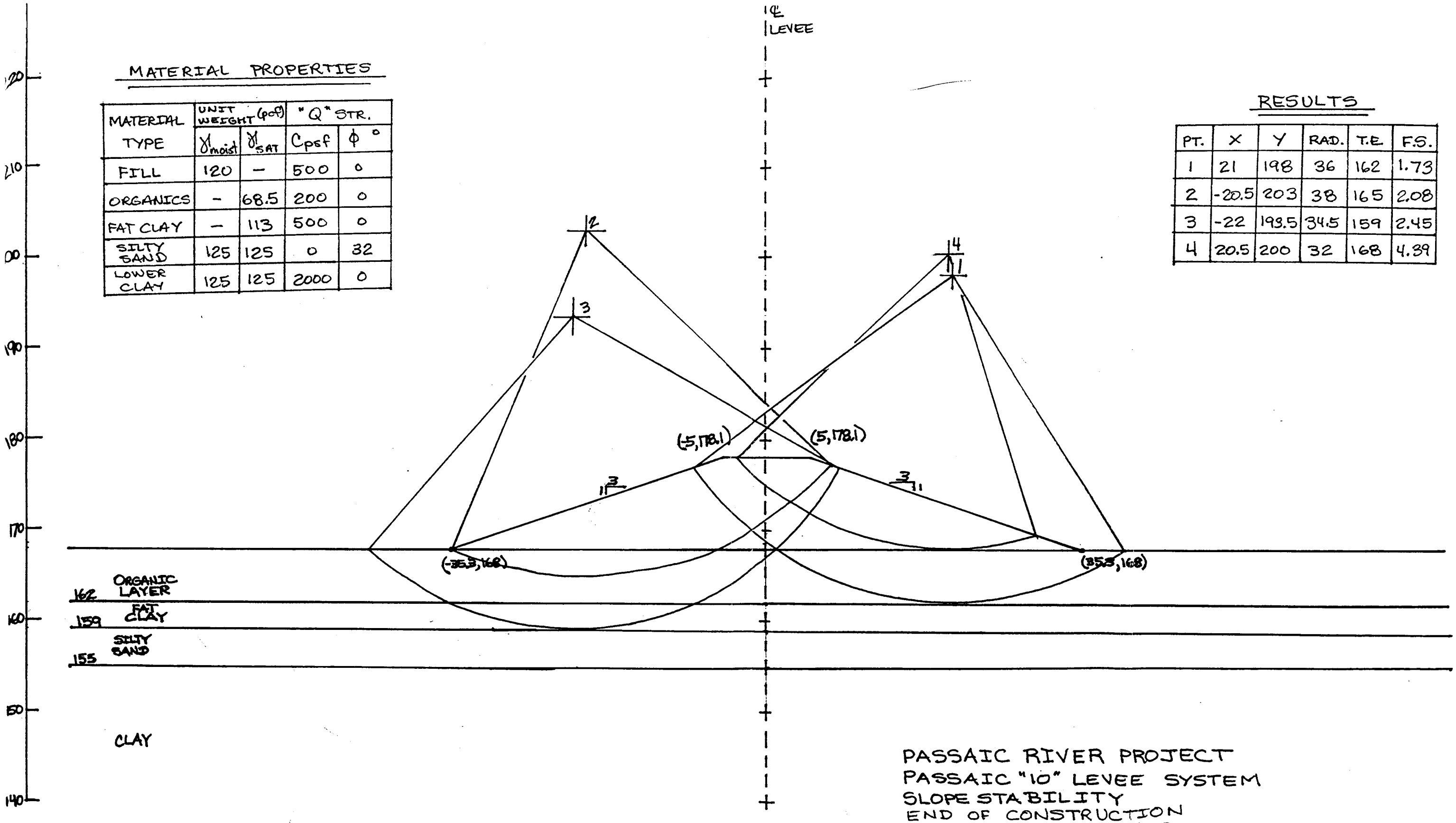
SCALE: 1" = 10'

PLATE G-5

TOM CHILD
CESAW-EN-GS
MAY 1994

MATERIAL PROPERTIES

MATERIAL TYPE	UNIT WEIGHT (pcf) γ_{moist}	γ_{SAT}	"Q" STR. C_{psf}	ϕ °
FILL	120	–	500	0
ORGANICS	–	68.5	200	0
FAT CLAY	–	113	500	0
SILTY SAND	125	125	0	32
LOWER CLAY	125	125	2000	0



RESULTS

PT.	X	Y	RAD.	T.E.	F.S.
1	21	198	36	162	1.73
2	-20.5	203	38	165	2.08
3	-22	193.5	34.5	159	2.45
4	20.5	200	32	168	4.39

PASSAIC RIVER PROJECT
PASSAIC "10" LEVEE SYSTEM
SLOPE STABILITY
END OF CONSTRUCTION
STATION (APPROX.) 14+00

SCALE 1" = 10'

PLATE G-6

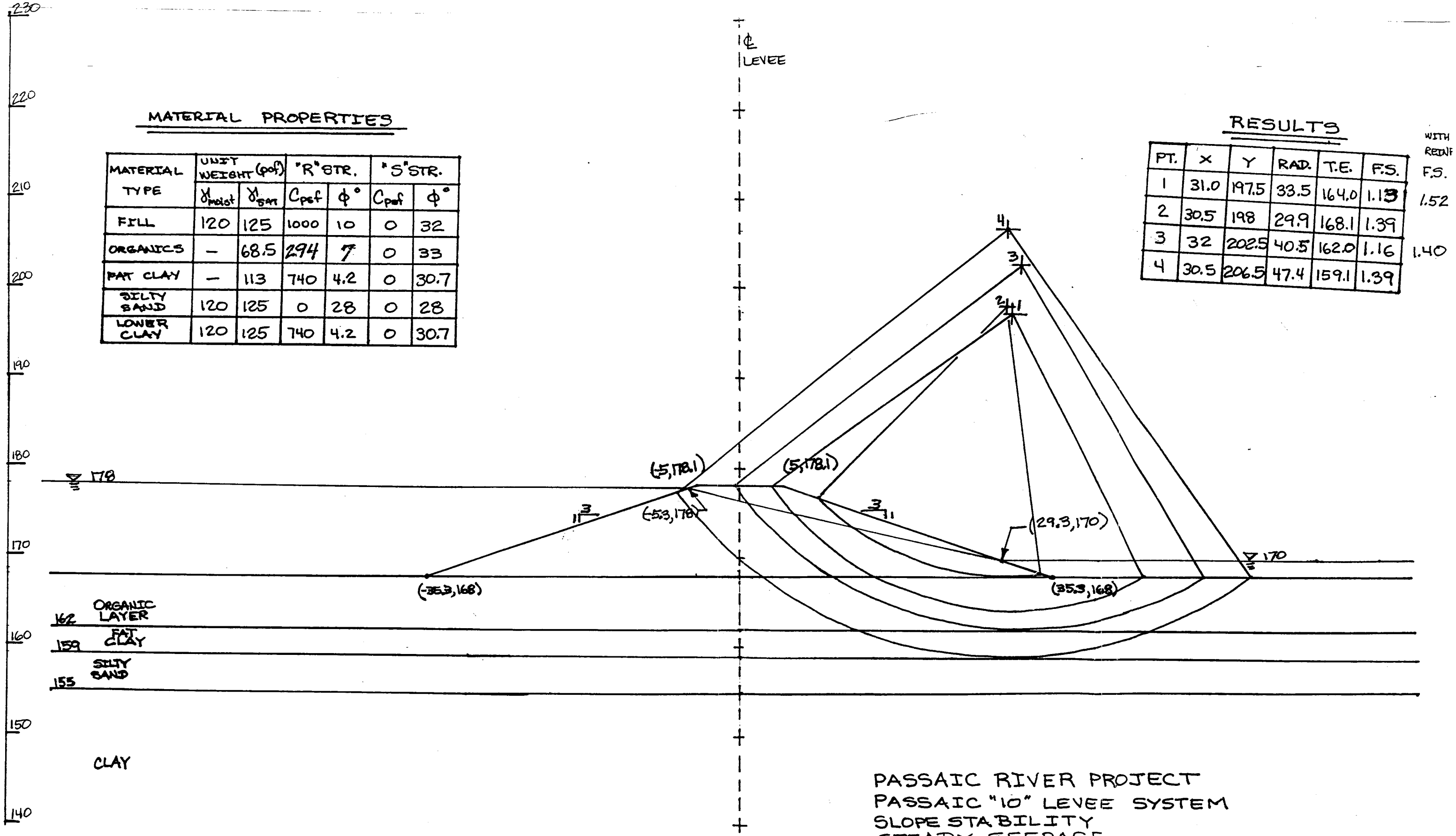
TOM CHILD
CESAW-EN-GS
MAY 1994

MATERIAL PROPERTIES

MATERIAL TYPE	UNIT WEIGHT (pcf)		"R" STR.		"S" STR.	
	γ_{moist}	γ_{sat}	C_{psf}	$\phi°$	C_{psf}	$\phi°$
FILL	120	125	1000	10	0	32
ORGANICS	–	68.5	294	7	0	33
FAT CLAY	–	113	740	4.2	0	30.7
SILTY SAND	120	125	0	28	0	28
LOWER CLAY	120	125	740	4.2	0	30.7

RESULTS

PT.	X	Y	RAD.	T.E.	F.S.	WITH REINF F.S.
1	31.0	197.5	33.5	164.0	1.13	1.52
2	30.5	198	29.9	168.1	1.39	
3	32	202.5	40.5	162.0	1.16	1.40
4	30.5	206.5	47.4	159.1	1.39	



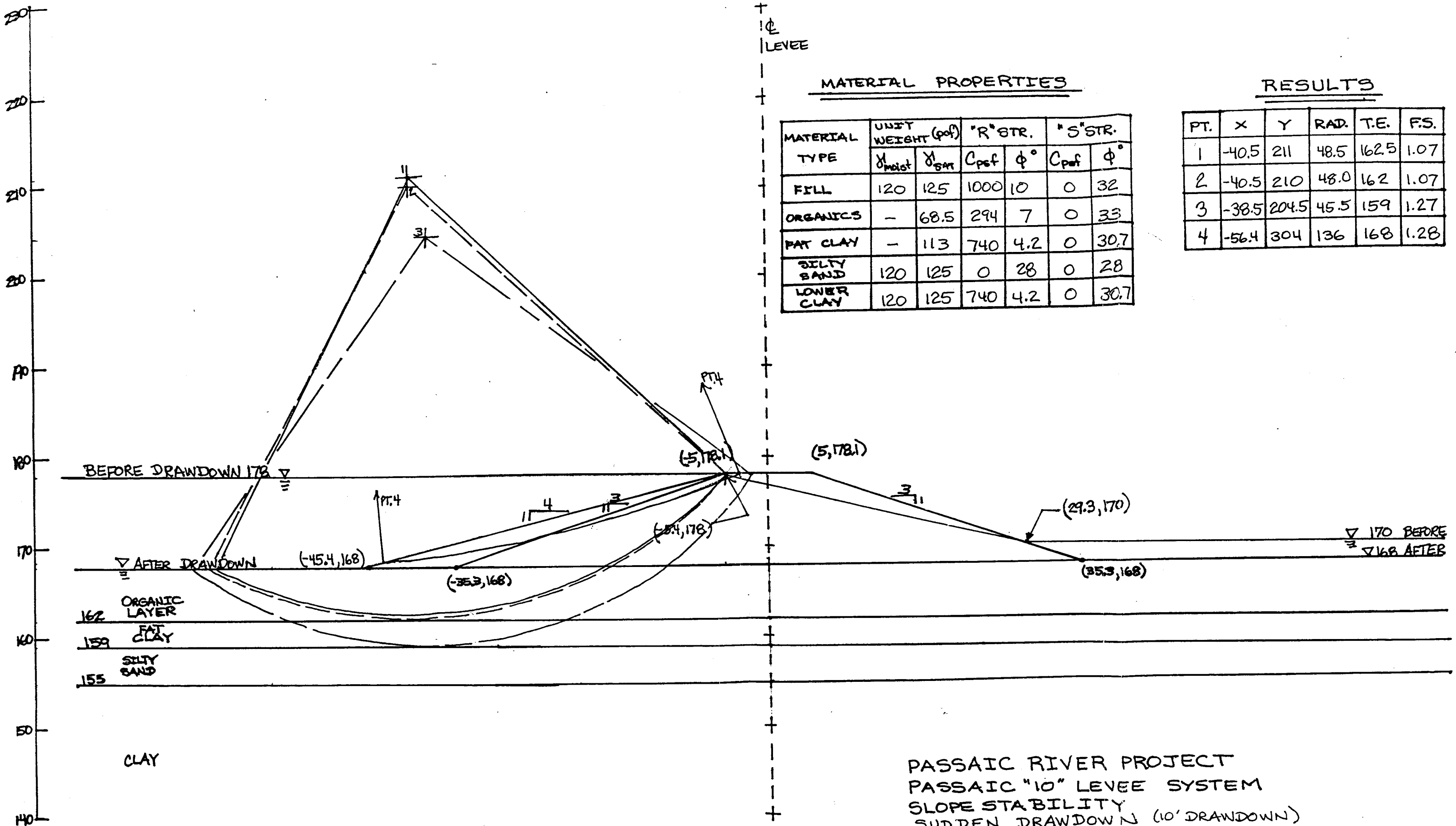
PASSAIC RIVER PROJECT
PASSAIC "10" LEVEE SYSTEM
SLOPE STABILITY
STEADY SEEPAGE
STATION (APPROX.) 14+00

SCALE 1" = 10'

PLATE G-7

TOM CHILD
CESAW-EN-GS
MAY 1994

E 1/ 6-6



MATERIAL PROPERTIES

MATERIAL TYPE	UNIT WEIGHT (pcf)		"R" STR.		"S" STR.	
	γ_{moist}	γ_{sat}	C_{psf}	$\phi°$	C_{psf}	$\phi°$
FILL	120	125	1000	10	0	32
ORGANICS	–	68.5	294	7	0	33
FAT CLAY	–	113	740	4.2	0	30.7
SILTY SAND	120	125	0	28	0	28
LOWER CLAY	120	125	740	4.2	0	30.7

RESULTS

PT.	X	Y	RAD.	T.E.	F.S.
1	-40.5	211	48.5	162.5	1.07
2	-40.5	210	48.0	162	1.07
3	-38.5	204.5	45.5	159	1.27
4	-56.4	304	136	168	1.28

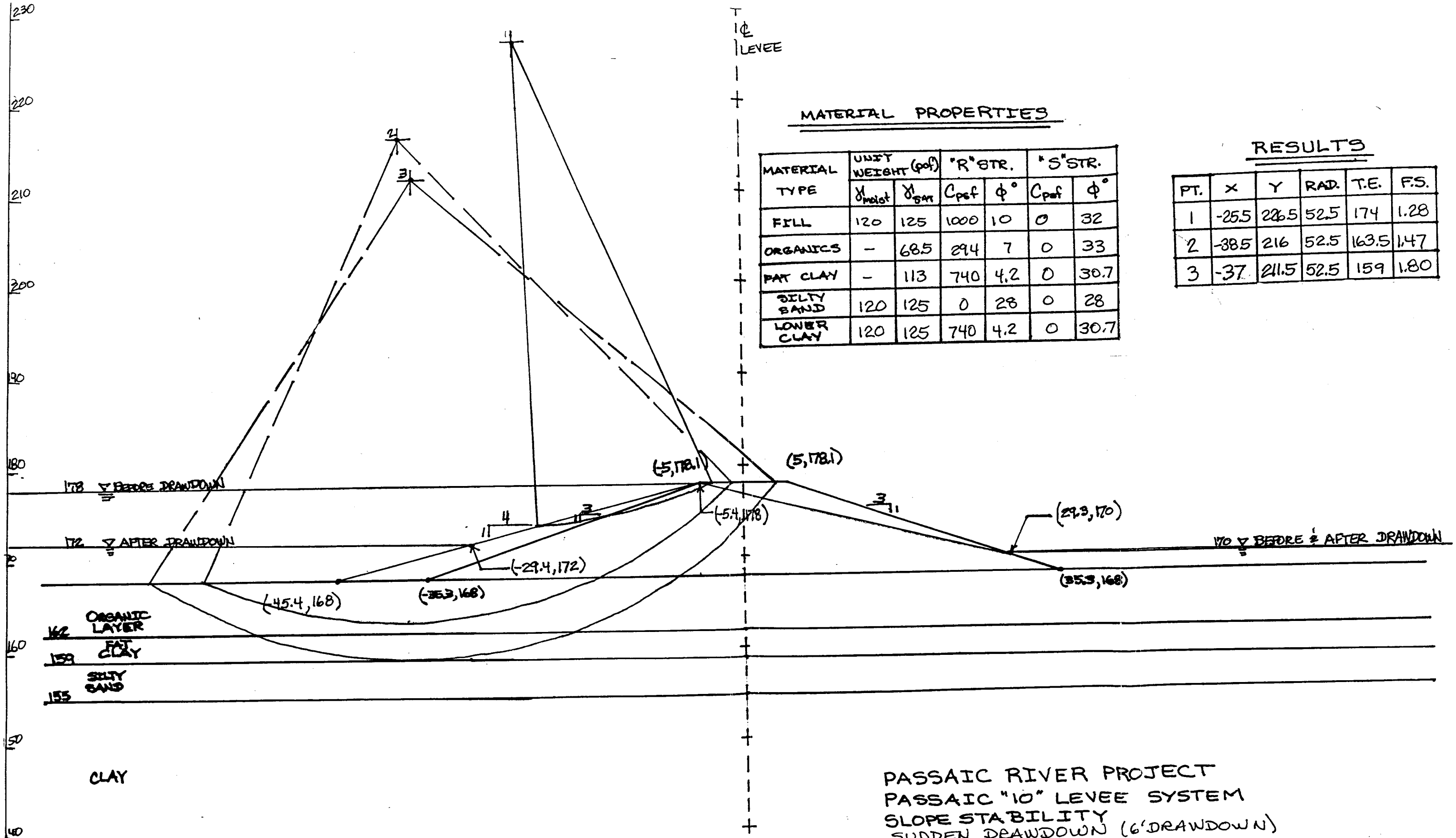
PASSAIC RIVER PROJECT
PASSAIC "10" LEVEE SYSTEM
SLOPE STABILITY
SUDDEN DRAWDOWN (10' DRAWDOWN)
STATION (APPROX.) 14+00

SCALE 1" = 10'

UPSTREAM SLOPE 1V:4H

PLATE G-8

TOM CHILD
CESAW-EN-GS
MAY 1994



MATERIAL PROPERTIES

MATERIAL TYPE	UNIT WEIGHT (pcf)		"R" STR.		"S" STR.	
	γ_{moist}	γ_{sat}	C_{psf}	$\phi°$	C_{psf}	$\phi°$
FILL	120	125	1000	10	0	32
ORGANICS	–	68.5	294	7	0	33
FAT CLAY	–	113	740	4.2	0	30.7
SILTY SAND	120	125	0	28	0	28
LOWER CLAY	120	125	740	4.2	0	30.7

RESULTS

PT.	X	Y	RAD.	T.E.	F.S.
1	-25.5	226.5	52.5	174	1.28
2	-38.5	216	52.5	163.5	1.47
3	-37	211.5	52.5	159	1.80

PASSAIC RIVER PROJECT
PASSAIC "10" LEVEE SYSTEM
SLOPE STABILITY
SUDDEN DRAWDOWN (6' DRAWDOWN)
STATION (APPROX.) 14+00
SCALE 1" = 10'

UPSTREAM SLOPE 1:V 4:H
PLATE G-9

TOM CHILD
CESAW-EN-GS
MAY 1994

COMPUTATION SHEET

U.S. ARMY ENGINEER DISTRICT
WILMINGTON, N C

DESIGN ANALYSIS

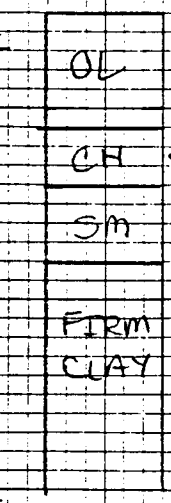
DATE 2/18/94 SHEET No. 1 OF

COMPUTED BY: Tom Child CHECKED BY:

PROJECT: PASSAIC "C"

FEATURE: Consolidation

SOIL MODEL



Present overburden over top of clay
AT BOTTOM OF LAYER

$P_{oc} = 30'(50.6\,pcf) + 6'(68.5 - 62.4\,pcf) =$

$= 151.8 + 36.6 = 188.4\,psf$

$= 0.0942\,tsf$

OL $\gamma'_{SAT} = 68.5\,pcf$

CH $\gamma_{SAT} = 113\,pcf$

overburden for bottom of organics

$P_{oo} = 6'(6.1\,pcf) = 36.6\,psf = 0.0183\,tsf$ (37)

Overburden due to dike $\gamma = 120\,pcf$ height = 10.1'

$P_{od} = 10.1'(120\,pcf) = 1,212\,psf = 0.606\,tsf$

$P_{oo} + P_{od} = 0.6243\,tsf = 1,249\,psf$ (ORGANIC)

$P_{od} + P_{oc} = 0.7002\,tsf = 1,400\,psf$ (CLAY)

BOTH SOILS APPEAR TO BE PRECONSOLIDATED.

FOR CH: $\gamma_{SAT} = 113\,pcf$ FOR OH/OL: $\gamma_{SAT} = 68.5\,pcf$

FROM LAB DATA.

COMPUTATION SHEET

U.S. ARMY ENGINEER DISTRICT
WILMINGTON, N C

DESIGN ANALYSIS

DATE 8/26/94 SHEET No. 2 OF

COMPUTED BY: Tom Child CHECKED BY:

PROJECT: PASSAIC "10"

FEATURE: CONSOLIDATION.

Preconsolidation of clay

MAXIMUM CURVATURE ASSUMED AT PT. A.

$\Delta\alpha = 23°$ $\alpha/2 = 11.5°$

From plot $P_p = 0.67$ tsf $= 1,340$ psf $P_{OC} = 188$ psf

MEANS CLAY IS PRECONSOLIDATED

Preconsolidation of organics

Pt. A = max. curvature

$\alpha = 32°$ $\alpha/2 = 16°$

FROM PLOT: $P_p = 0.22$ tsf $= 440$ psf $P_{OO} = 37$ psf

MEANS ORGANICS ARE PRECONSOLIDATED

THE OVERBURDEN AT THE BOTTOM OF ORGANICS DUE TO LEVEE IS $P_{OL} = 1249$ psf $= 0.6243$ tsf

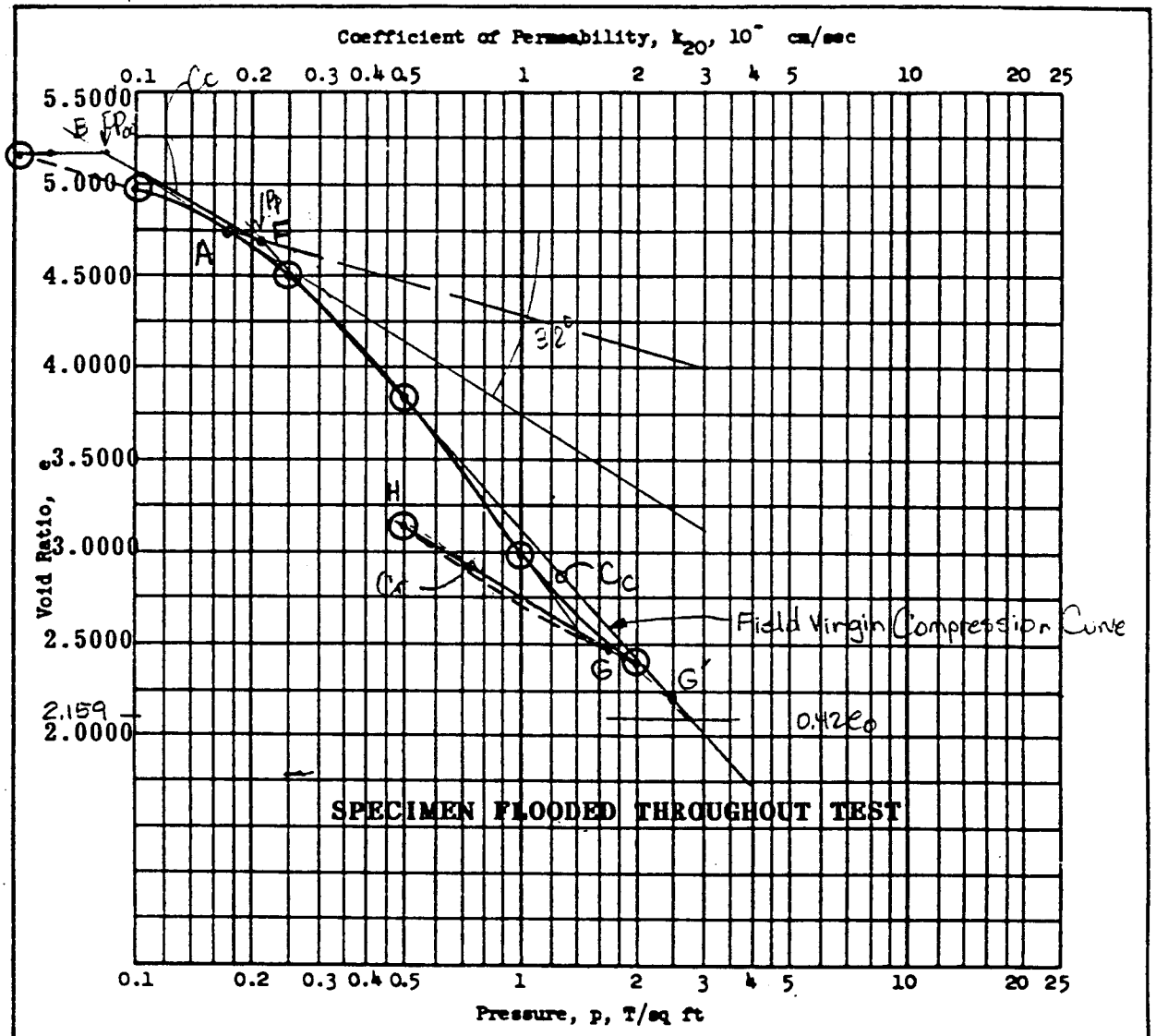
consolidation will occur along both preconsolidation curve and the virgin curve.

THE OVERBURDEN AT THE BOTTOM OF THE CLAY DUE TO THE LEVEE IS: $P_{CL} = 1,400$ psf $= 0.7002$ tsf.

WHICH MEANS THE MAJORITY OF THE CLAY CONSOLIDATION TAKES PLACE ALONG THE PRECONSOL. CURVE AND JUST BARELY SOME VIRGIN COMPRESSION.

FOR SETTLEMENT THE STRESS INCREASE IS USED.

$\sigma_0' = p_\infty = 0.0183$ tsf
$p_p = \sigma_p' = 0.22$ tsf



Type of Specimen Undisturbed		Before Test		After Test	
Diam 2.47 in.	Ht 1.00 in.	Water Content, w_o	321.3 %	w_f	197.6 %
Overburden Pressure, p_o T/sq ft		Void Ratio, e_o	5.141	e_f	3.161
Preconsol. Pressure, p_c T/sq ft		Saturation, S_o	100.0 %	S_f	100.0 %
Compression Index, C_c		Dry Density, γ_d	16.3 lb/ft^3		
Classification (Visual) Black Organic Silt High LL (OH), Sandy. NOTE: The plus 200 sieve sizes are mostly organic particles rather than sand.		Kiev at e_o =	x 10^{-} cm/sec		
LL 432	G_s 1.60	Project Passic River			
PL 194	D_{10} -	Lab. No. 264/557			
Remarks		Area Levee System - Dike #10			
		Boring No. P-10-3BU		Sample No. 1	
		Depth El 1.3 - 3.0'		Date 8 Feb 94	
		CONSOLIDATION TEST REPORT			

ENG FORM 1 MAY 63 2090 PREVIOUS EDITIONS ARE OBSOLET

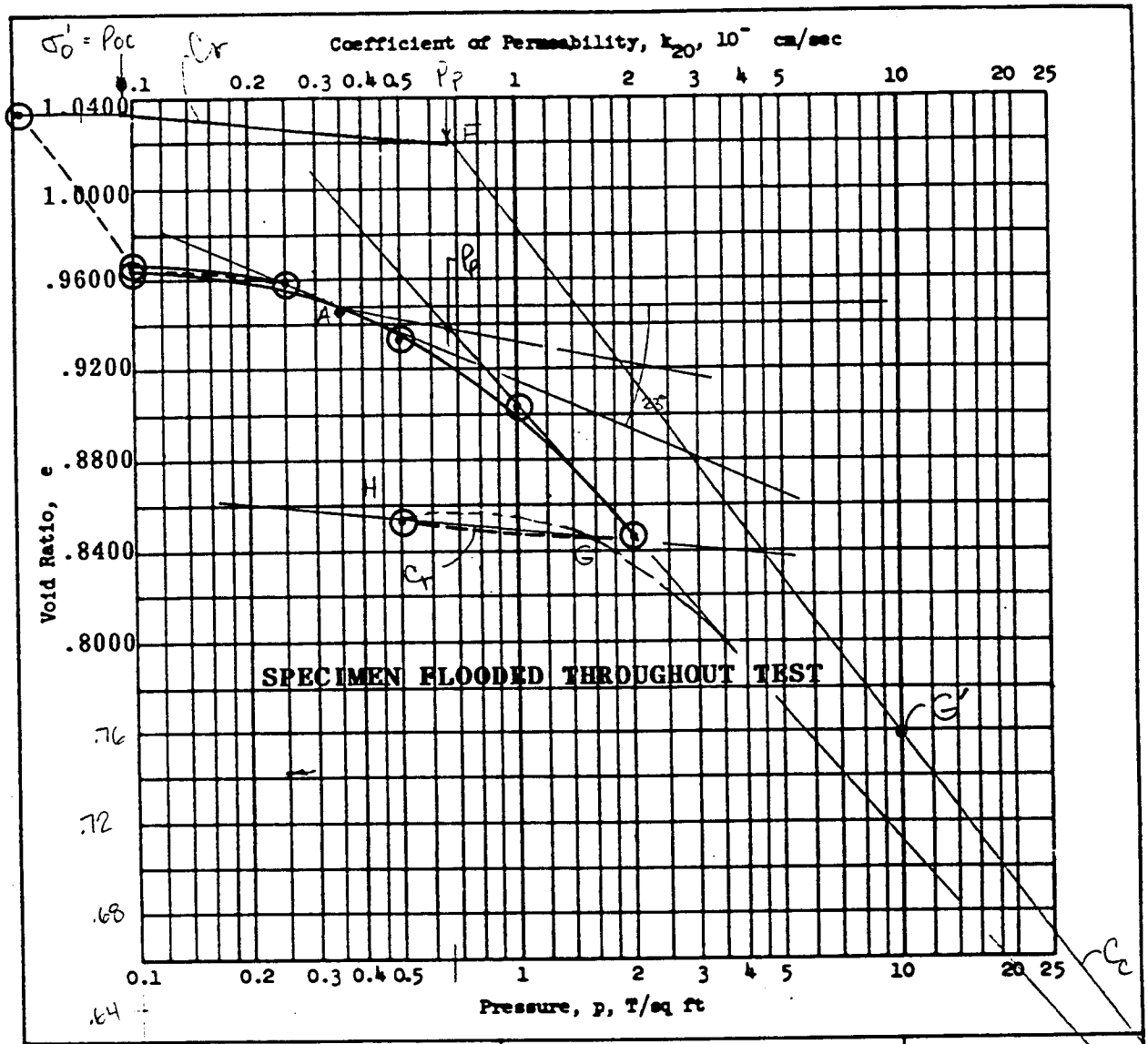
WORK ORDER NO. 7118
REQ. NO. CESAW-EN-GS-94-0003

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE, MARIETTA, GA. 30061

$P_{oc} = 0.0942$ tsf $= \sigma_o'$

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE, MARIETTA, GA. 30061

WORK ORDER NO. 7118
REQ. NO. CESAW-EN-GS-94-0003



Type of Specimen	Undisturbed	Before Test		After Test	
Diam 2.49 in.	Ht 1.00 in.	Water Content, w_o	38.9 %	w_f	32.1 %
Overburden Pressure, P_o T/sq ft		Void Ratio, e_o	1.034	e_f	.853
Preconsol. Pressure, P_c T/sq ft		Saturation, S_o	100.0 %	S_f	100.0 %
Compression Index, C_c		Dry Density, γ_d	81.6 lb/ft^3		
Classification Gray, Fat Clay with a little sand sizes		k_{20} at e_o =	x 10^{-} cm/sec		
LL 60	G_s 2.66	Project Passic River			
PL 24	D_{10} -	Lab No. 264/556			
Remarks		Area Levee System - Dike #10			
		Boring No. P-10-3AU		Sample No. 3	
		Depth El 5.0 - 6.8'		Date 8 February 1994	

CONSOLIDATION TEST REPORT

ENG FORM 2090 1 MAY 63 PREVIOUS EDITIONS ARE OBSOLET

COMPUTATION SHEET

U.S. ARMY ENGINEER DISTRICT

WILMINGTON, N C

DESIGN ANALYSIS

DATE 8/22/94 SHEET No. 3 OF

COMPUTED BY: Tom Child CHECKED BY:

PROJECT: PASSAIC "O"

FEATURE: CONSOLIDATION

RECONSTRUCT VIRGIN CURVE FOR OVERCONSOLIDATED CLAY

EM 1110-1-1904 30 SEP 90 Table 3-6

$e = 0.42 e_o = 0.42(1.034) = 0.434$

$$C_r = \frac{e_H - e_G}{\log_{10} \frac{\sigma_G}{\sigma_H}} = \frac{0.853 - 0.848}{\log_{10} \frac{1.6}{0.5}} = \frac{0.005}{0.505} = 0.0099 = C_r$$

$$C_c = \frac{e_F - e_{G'}}{\log_{10} \frac{\sigma_{G'}}{\sigma_F}} = \frac{1.020 - 0.760}{\log_{10} \frac{10}{0.67}} = \frac{0.260}{1.174} = 0.222 = C_c$$

FOR ORGANICS:

$e = 042 e_o = 0.42(5.141) = 2.159$

$$C_r = \frac{e_H - e_G}{\log_{10} \frac{\sigma_G}{\sigma_H}} = \frac{3.14 - 2.49}{\log_{10} \frac{1.7}{0.5}} = \frac{0.65}{0.532} = 1.223 = C_r$$

$$C_c = \frac{e_F - e_{G'}}{\log_{10} \frac{\sigma_{G'}}{\sigma_F}} = \frac{4.71 - 2.249}{\log_{10} \frac{2.5}{0.21}} = \frac{2.461}{1.076} = 2.288 = C_c$$

The settlement will be the combination of the settlement of the two layers, ie:

$$\rho_c' = \sum_{i=1}^{n} \frac{H_i}{1+e_o} \left[C_r \log \frac{\sigma_p'}{\sigma_o'} + C_c \log \frac{\sigma_o' + \Delta\sigma'}{\sigma_p'} \right] \text{ for } \Delta\sigma_i' \geq (\sigma_p' - \sigma_o')_i$$

and $\rho_c'' = \sum_{i=1}^{m} \frac{H_o}{1+e_o} C_r \log \frac{\sigma_o' + \Delta\sigma'}{\sigma_o'}$ for $\sigma_i' < (\sigma_p' - \sigma_o')_i$

$\rho_c = \rho_c' + \rho_c''$

$\Delta\sigma'$ = EFFECTIVE STRESS INCREASE

COMPUTATION SHEET

U.S. ARMY ENGINEER DISTRICT

WILMINGTON, N C

DESIGN ANALYSIS

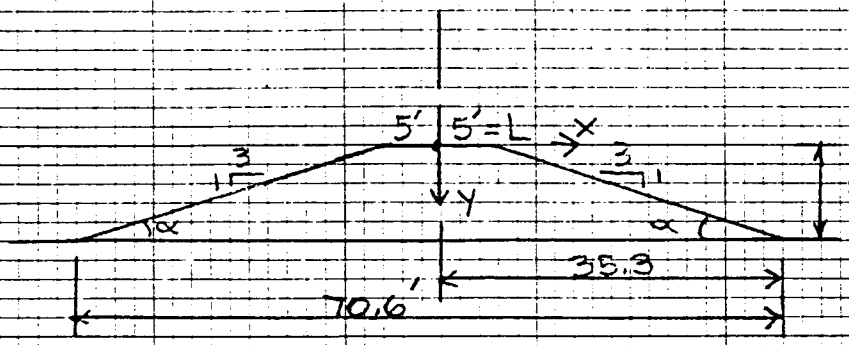
DATE 8/30/94 SHEET No. 4 OF

COMPUTED BY: Tom Child CHECKED BY:

PROJECT: PASSAIC "10"

FEATURE: CONSOLIDATION

TO DETERMINE THE SETTLEMENT OF THE ORGANIC AND CLAY LAYERS, THE EFFECT OF THE LEVEE ON THE UNDERLYING SOIL MUST BE DETERMINED.



$\gamma_L = 120$ pcf

$\alpha = 18.4°$

ASSUME $\mu = 0.3$

USING "SOIL MECHANICS" BY PERLOFF AND BARON, WILEY & SONS COPYRIGHT 1976. REFERENCE CHAPTER 4, SEC 4.5 AND APPENDEX A, FIG. A-12.

ASSUME POISSON'S RATIO = $\mu = 0.3$ USE FIG WITH $\alpha = 15$. CLOSELY APPROXIMATES $\alpha = 18.4°$.

$L = 5'$ $H = 10.1'$ $L/H = 5/10.1 = 0.5$ ASSUME MAX. STRESS AT ℓ, $\frac{x}{H} = 0$

$\gamma H = 120(10.1) = 1212$ psf

AT BASE $y = 10.1$ $Y/H = 10.1/10.1 = 1$ $\sigma_y/\gamma H = 0.86$

$\sigma_y = .86(1212) = 1042$ psf

AT $Y = 13.1$ (MIDPT ORGANICS) $Y/H = 13.1/10.1 = 1.31$

$\sigma_y/\gamma H = 0.84$ $\sigma_y = 1018$ psf

AT $Y = 16.1$ $Y/H = 16.1/10.1 = 1.59$ $\sigma_y/\gamma H = 0.81$

$\sigma_y = 982$ psf

AT $Y = 17.6$ $Y/H = 17.6/10.1 = 1.74$ $\sigma_y/\gamma H = 0.8$

$\sigma_y = 970$ psf

AT $Y = 19.1$ $Y/H = 19.1/10.1 = 1.89$ $\sigma_y/\gamma H = 0.77$

$\sigma_y = 933$ psf

SAW FORM 472 REV 17 APR 1980

COMPUTATION SHEET

U.S. ARMY ENGINEER DISTRICT
WILMINGTON, N C

DESIGN ANALYSIS

DATE 8/30/94 SHEET No. 5 OF

COMPUTED BY: Tom Child CHECKED BY:

PROJECT: PASSAIC "10"

FEATURE: CONSOLIDATION

AT Y = 23.1 Y/H = 23.1/10.1 = 2.23 $\sigma_y/\gamma H = 0.74$
$\sigma_y = 897$ psf

AT Y = 28.1 Y/H = 28.1/10.1 = 2.78 $\sigma_y/\gamma H = 0.68$
$\sigma_y = 824$ psf

AT Y = 38.1 Y/H = 38.1/10.1 = 3.77 $\sigma_y/\gamma H = 0.6$
$\sigma_y = 727$ psf

AT Y = 48.1 Y/H = 48.1/10.1 = 4.76 $\sigma_y/\gamma H = 0.5$
$\sigma_y = 606$ psf

AT THE EDGE OF THE EMBANKMENT: (35.3/H)

AT Y = 10.1 Y/H = 1 $\sigma_y/\gamma H = 0$ $\sigma_y = 0$

AT Y = 13.1 Y/H = 1.31 $\sigma_y/\gamma H = 0.05$ $\sigma_y = 61$ psf

AT Y = 16.1 Y/H = 1.59 $\sigma_y/\gamma H = 0.07$ $\sigma_y = 85$ psf

AT Y = 17.6 Y/H = 1.74 $\sigma_y/\gamma H = 0.09$ $\sigma_y = 109$ psf

AT Y = 19.1 Y/H = 1.89 $\sigma_y/\gamma H = 0.1$ $\sigma_y = 121$ psf

AT Y = 23.1 Y/H = 2.23 $\sigma_y/\gamma H = 0.13$ $\sigma_y = 158$ psf

AT Y = 28.1 Y/H = 2.78 $\sigma_y/\gamma H = 0.15$ $\sigma_y = 182$ psf

AT Y = 38.1 Y/H = 3.77 $\sigma_y/\gamma H = 0.19$ $\sigma_y = 230$ psf

AT Y = 48.1 Y/H = 4.76 $\sigma_y/\gamma H = 0.21$ $\sigma_y = 255$ psf

HALFWAY FROM ℄ TO TOE X = 17.65'

AT Y = 10.1 Y/H = 1 $\sigma_y/\gamma H = 0.65$ $\sigma_y = 788$ psf

AT Y = 16.1 Y/H = 1.59 $\sigma_y/\gamma H = 0.605$ $\sigma_y = 733$ psf

AT Y = 17.6 Y/H = 1.74 $\sigma_y/\gamma H = 0.60$ $\sigma_y = 727$ psf

AT Y = 19.1 Y/H = 1.89 $\sigma_y/\gamma H = 0.59$ $\sigma_y = 715$ psf

AT Y = 23.1 Y/H = 2.23 $\sigma_y/\gamma H = 0.57$ $\sigma_y = 691$ psf

AT Y = 28.1 Y/H = 2.78 $\sigma_y/\gamma H = 0.53$ $\sigma_y = 642$ psf

COMPUTATION SHEET

U.S. ARMY ENGINEER DISTRICT
WILMINGTON, N C

DESIGN ANALYSIS

DATE 8/30/94 SHEET No. 6 OF

COMPUTED BY: Tom Child CHECKED BY:

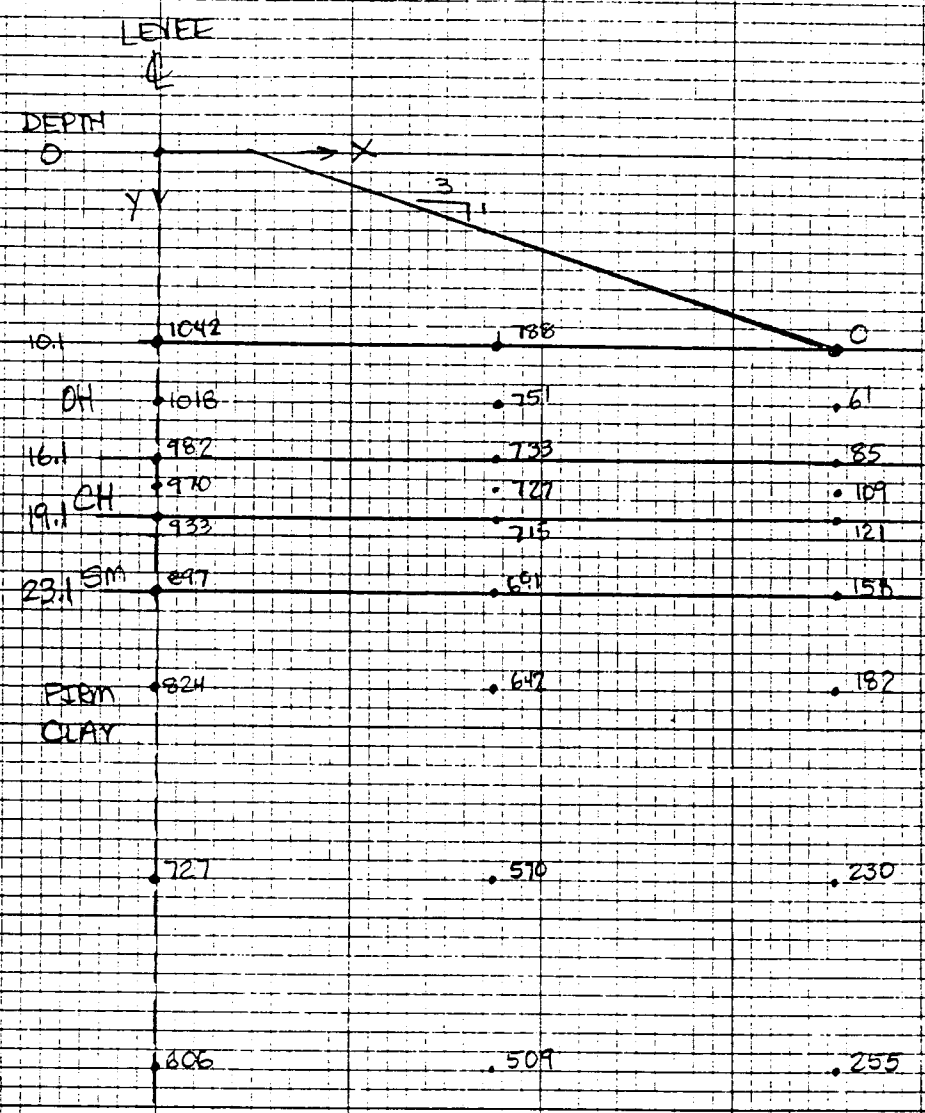
PROJECT: PASSAIC "O"

FEATURE: CONSOLIDATION

AT Y = 38.1 Y/H = 3.77 $\sigma_y/\gamma H = 0.47$ $\sigma_y = 570$ psf

AT Y = 48.1 Y/H = 4.76 $\sigma_y/\gamma H = 0.42$ $\sigma_y = 509$ psf

AT Y = 13.1 Y/H = 1.31 $\sigma_y/\gamma H = 0.62$ $\sigma_y = 751$ psf



COMPUTATION SHEET

U.S. ARMY ENGINEER DISTRICT
WILMINGTON, N C

DESIGN ANALYSIS

DATE 8/30/94 SHEET No. 7 OF

COMPUTED BY: Tom Child CHECKED BY:

PROJECT: PASSAIC "10"

FEATURE: CONSOLIDATION

SETTLEMENT UNDER CENTER OF LEVEE

USE JUST THE TWO LAYERS BECAUSE THEY ARE NOT VERY THICK. THEREFORE DETERMINE SETTLEMENT AT BOTTOM OF OH AND CH LAYERS.

IN ORGANIC LAYER $\Delta\sigma'$ at bottom = 982 psf = 0.491 tsf

$\sigma'_p - \sigma'_o$ = 440 psf − 37 psf = 403 psf $\therefore \Delta\sigma' > \sigma'_p - \sigma'_o$

$$\rho' = \frac{H}{1+e_o}\left[C_r \log \frac{\sigma'_p}{\sigma'_o} + C_c \log \frac{\sigma'_o + \Delta\sigma'}{\sigma_p}\right] \qquad H = 6' \quad e_o = 5.141$$

$C_r = 1.223$ $C_c = 2.288$ $\sigma'_p = 440$ psf $\sigma'_o = 37$ psf $\Delta\sigma' = 982$ psf

$$\rho' = \frac{6}{6.141}\left[1.223 \log \frac{440}{37} + 2.288 \log \frac{37+982}{440}\right]$$

$$= 0.977\left[1.223(1.075) + 2.288(0.365)\right] = 0.977\left[1.315 + 0.835\right]$$

$$= 0.977\left[2.150\right] = 2.1' = 25.2''$$

FOR CH LAYER $\Delta\sigma'$ AT Bottom = 933 psf

$\sigma'_p - \sigma'_o$ = 1340 psf − 188 psf = 1152 psf $\therefore \sigma' < \sigma'_p - \sigma'_o$

$$\rho'' = \frac{H}{1+e_o} C_r \log \frac{\sigma'_o + \Delta\sigma'}{\sigma'_o} \qquad H = 3' \quad e_o = 1.034$$

$\sigma'_o = 188$ psf $\Delta\sigma' = 933$ psf $C_r = .0099$

$$\rho'' = \frac{3}{2.034}(0.0099) \log \frac{188+933}{188}$$

$$\rho'' = 1.475(0.0099)(0.775) = 0.0113' = 0.14''$$

TOTAL SETTLEMENT AT CENTER IS $\rho' + \rho''$

$\Delta S_c = 25.2'' + .1'' = 25.3''$ - Mostly in Organics

COMPUTATION SHEET

U.S. ARMY ENGINEER DISTRICT
WILMINGTON, N C

DESIGN ANALYSIS

DATE 8/30/94 SHEET No. 8 OF

COMPUTED BY: Tom Child CHECKED BY:

PROJECT: PASSAIC "10"

FEATURE: CONSOLIDATION

SETTLEMENT, HALF-WAY TO TOE FROM ℄ AT BOTTOM OF EACH OH & CH LAYER.

ORGANIC LAYER: $\Delta\sigma' = 733$ psf $\sigma_p' - \sigma_o' = 403$ psf $\therefore \Delta\sigma' > \sigma_p' - \sigma_o'$

$$\rho'' = 0.977\left[1.223 \log \frac{440}{37} + 2.288 \log \frac{37+733}{440}\right]$$

$$= 0.977\left[1.315 + 2.288(0.243)\right] = 0.977\left[1.315 + 0.556\right]$$

$$= 0.977[1.87] = 1.83' = 21.9''$$

FOR CLAY: $\Delta\sigma' = 715$ psf $\sigma_p' - \sigma_o' = 1152 > \Delta\sigma'$

$$\rho'' = \frac{3}{2.034}(0.0099)\log \frac{188+715}{188} = 1.475(0.0099)(0.682) = 0.01' = 0.12''$$

$\Delta S_H = 21.9'' + 0.1'' = 22.0''$ Mostly in Organics

$\Delta S_c - \Delta S_H = 25.3'' - 22.0'' = 3.3''$ DIFFERENTIAL

Under toe ΔS_T

FOR Organics: $\Delta\sigma' = 85$ psf $\sigma_p' - \sigma_o' = 403$ psf $\therefore \Delta\sigma' < \sigma_p' - \sigma_o'$

$$\rho' = \frac{6}{6.141}(1.223)\log \frac{37+85}{37} = 0.977(1.223)(0.5182)$$

$$\rho' = 0.619' = 7.43''$$

FOR CLAY: $\Delta\sigma' = 121$ psf $\sigma_p' - \sigma_o' = 1152$ psf $\therefore \Delta\sigma' < \sigma_p' - \sigma_o'$

$$\rho'' = \frac{3}{2.034}(0.0099)\log \frac{188+121}{188} = 1.475(0.0099)(0.2158)$$

$$= 0.0032' = 0.04''$$ Negligible

$\Delta S_T = 7.43'' + 0.04'' = 7.47''$

$\Delta S_c - \Delta S_T = 25.3'' - 7.5'' = \underline{\underline{17.8''}}$ DIFFERENTIAL

COMPUTATION SHEET

U.S. ARMY ENGINEER DISTRICT

WILMINGTON, N C

DESIGN ANALYSIS

DATE 8/30/94 SHEET No. 9 OF

COMPUTED BY: Tom Child CHECKED BY:

PROJECT: PASSAIC "10"

FEATURE: CONSOLIDATION

THIS ANALYSIS ASSUMES THAT THE UNDERLYING SAND AND CLAY SAMPLES CONSOLIDATE NEGLIGIBLY UNDER THE IMPOSED LOAD OF THE LEVEE. THIS SEEMS TO BE VERIFIED BY THE CH LAYER WHICH HAS MINIMAL CONSOLIDATION. THE UNDERLYING LAYERS HAVE LARGER BLOW COUNTS AND A LARGER PRESENT OVERBURDEN, WHICH MAY MEAN A LARGER PRECONSOLIDATION LOAD, AND THAT THEY WILL CONSOLIDATE LESS THAN THE CLAY LAYER ANALYSED.

NOW THAT SETTLEMENT DUE TO CONSOLIDATION HAS BEEN DETERMINED, NOW THE TIME RELATIONSHIP NEEDS TO BE DETERMINED.

FOR ORGANICS: $T_{100} = 300\,\text{min}$ GRAPHICAL

$D_{100} = 4130$ $D_0 = 3500$ GRAPHICAL ($t_1, 4t_1$ method).

NOTE: FOR SAMPLE IN FIELD THERE IS ONE WAY DRAINAGE FOR LAB SAMPLE THERE IS TWO-WAY $\therefore H_e = H/2$

FOR LAB SAMPLE $H = 1.0''$ $H_e = 0.5''$

$$D_{50} = \frac{D_{100} + D_0}{2} = \frac{4130 + 3500}{2} = 3815 \Rightarrow t_{50} = 39\,\text{min}.$$

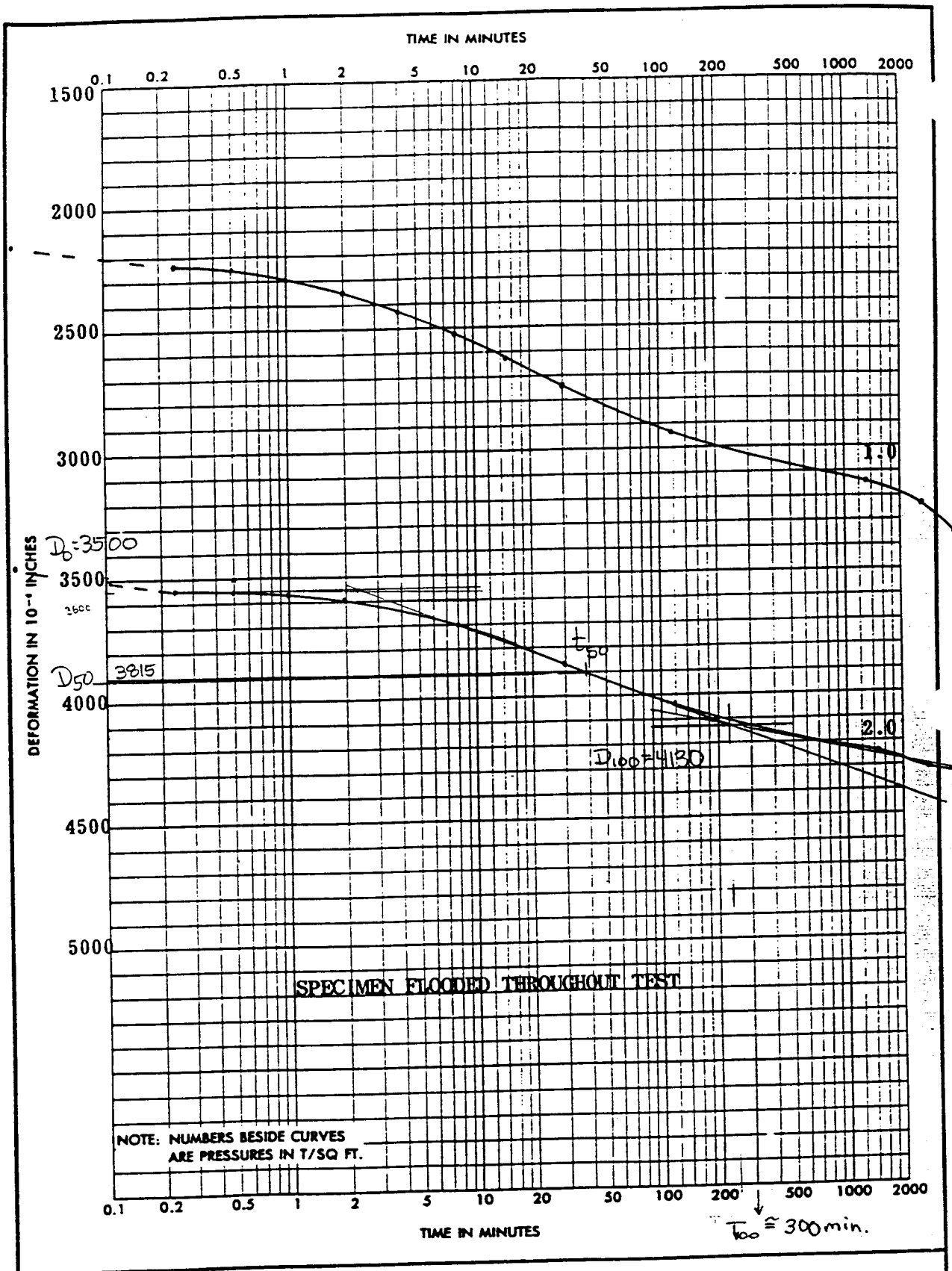
$$C_v = \frac{T_{50} H_e^2}{t_{50}} = \frac{0.197(0.5'')^2}{39\,\text{min}} = \frac{0.0493''}{39\,\text{min}} = 1.263 \times 10^{-3}\ \text{in/min}$$

$$C_v = 1.263 \times 10^{-3}\ \text{in/min} = 1.263 \times 10^{-2}\ \text{ft}^2/\text{day}$$

$$\frac{\text{in}}{\text{min}} \times \left(\frac{1\,\text{ft}}{12\,\text{in}}\right)^2 \times \frac{60\,\text{min}}{1\,\text{hr}} \times \frac{24\,\text{hr}}{\text{day}} = 10\ \frac{\text{ft}^2}{\text{day}}$$

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE, MARIETTA, GA. 30060

WORK ORDER NO. 7118
Req. No. CESAW-EN-GS-0003



PROJECT Passaic River

AREA Levee System Dike #10 Lab No. 264/557 (OH)

BORING NO. P-10-3BU SAMPLE NO. 1 DEPTH 1.3-3.0' DATE 31 Mar 94

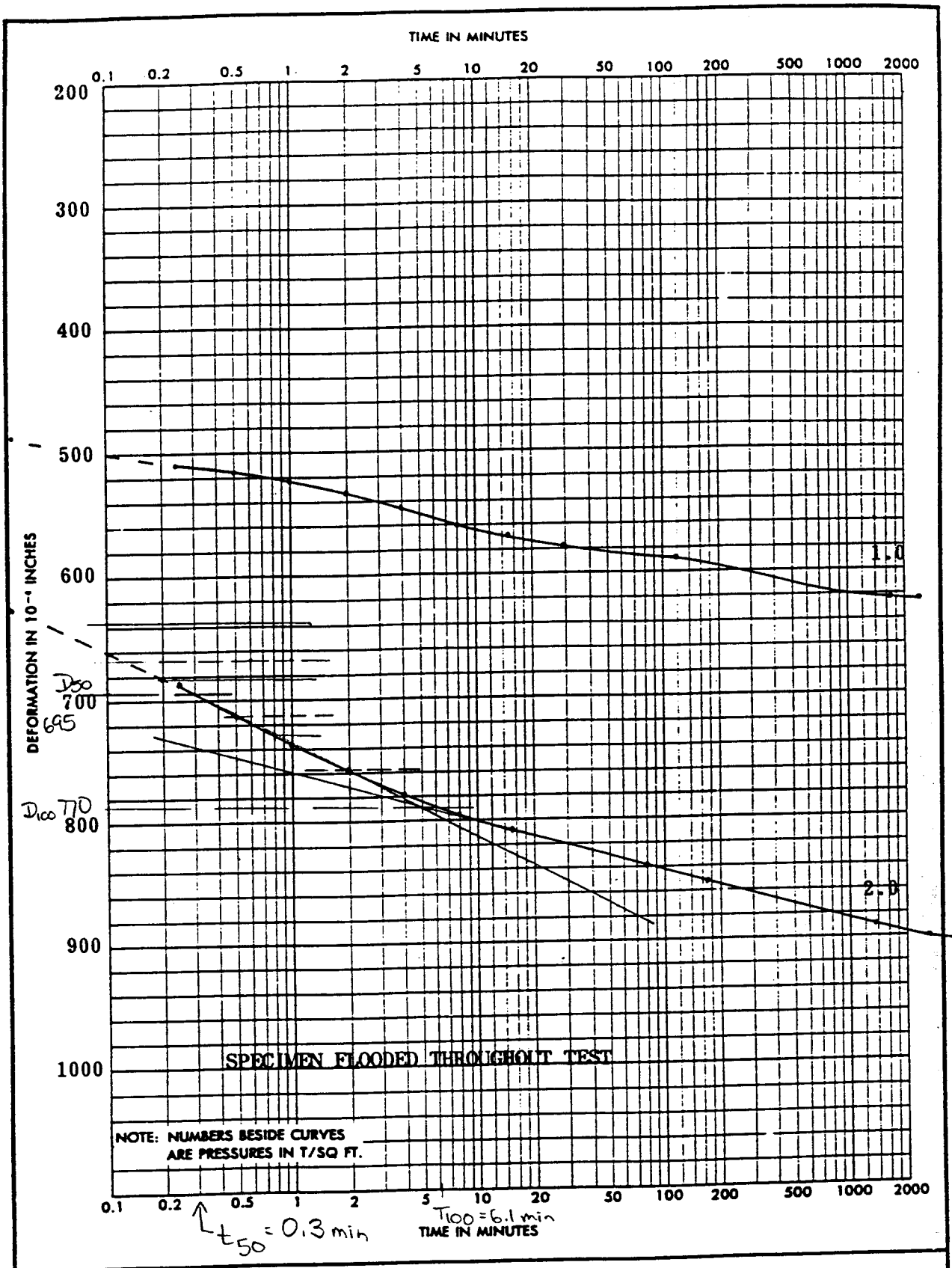
ENG FORM 2088 1 MAY 63 PREVIOUS EDITIONS ARE OBSOLETE.

CONSOLIDATION TEST—TIME CURVES (TRANSLUCENT)

* GPO : 1964 OF—715-963

DEPARTMENT OF THE ARMY, SOUTH ATLANTIC DIVISION LABORATORY
CORPS OF ENGINEERS, 611 SOUTH COBB DRIVE, MARIETTA, GA. 30060

WORK ORDER NO. 7118
Req. No. CESAW-EN-GS-94-0003



PROJECT	Passaic River			
AREA	Levee System - Dike #10		Lab No. 264/556	(CH)
BORING NO.	P-10-3AU	SAMPLE NO. 3	DEPTH 5.0-6.8'	DATE 31 Mar 94

ENG FORM 2088 1 MAY 63 PREVIOUS EDITIONS ARE OBSOLETE.

CONSOLIDATION TEST—TIME CURVES (TRANSLUCENT)

* GPO : 1964 OF—715-965

COMPUTATION SHEET

U.S. ARMY ENGINEER DISTRICT
WILMINGTON, N C

DESIGN ANALYSIS

DATE 8/30/94 SHEET No. 10 OF

COMPUTED BY: Tom Child CHECKED BY:

PROJECT: PASSAIC "10"

FEATURE: CONSOLIDATION

FOR ORGANICS

$t_{95} = \frac{T_{95} H^2}{C_v}$ FOR 95% CONSOLIDATION $T = 1.129$

$C_v = 0.304$ ft/day

Assume H is single drainage $\therefore H = 6'$

$t_{95} = \frac{1.129(6)^2 \text{ ft}^2}{0.01263 \text{ ft/day}} = 3,218 \text{ days} \approx 8.8 \text{ yrs.}$

$\Delta S_o = 25.3''$

$95\% \Delta S_o = 24.0''$

AT ℄ OF LEVEE

FOR CH. $T_{100} = 6.1$ min. $D_{100} = 770$ (GRAPHICAL)

ASSUME $D_o = 620$

$D_{50} = \frac{D_{100} + D_o}{2} = \frac{770+620}{2} = 695 \Rightarrow t_{50} = 0.3$ min

$C_v = \frac{T_{50} H_e^2}{t_{50}} = \frac{0.197(0.5'')^2}{0.3 \text{ min}} = 0.1642 \text{ in}^2/\text{min} = 1.642 \text{ ft}^2/\text{day}$

$t_{95} = \frac{T_{95} H^2}{C_v} = \frac{1.129(3')^2}{1.642 \text{ ft}^2/\text{day}} = 6.19$ day $H = 3'$ for one way drainage

CLAY WILL CONSOLIDATE AUMOST IMMEDIATELY.

FOR ORGANICS AT ℄ LEVEE $\Delta S_o = 25.2''$

$U_{50} = .5 \Delta S_o = .5(25.2) = 12.6''$ $T_{50} = .197$ $H = 6'$

$t_{50} = \frac{T_{95} H^2}{C_v} = \frac{.197(6)^2}{1.263 \cdot 10^{-2} \text{ ft}^2/\text{day}} = 562$ days $= 1.54$ yrs.

$U_{10} = .1 \Delta S_o = .1(25.2) = 2.5''$ $T_{10} = .0078$ $H = 6'$

$t_{10} = \frac{.0078(6)^2}{1.263 \times 10^{-2} \text{ ft/d}} = 22.2$ days

12" of settlement $= \frac{12}{25.2} = 47.6\% = U$ $T_{47.6} = 0.180$

$t_{47.6} = \frac{0.180(6')^2}{1.263 \times 10^{-2} \text{ ft/d}} = 513$ days ≈ 1.4 yrs for 1' of settlement

$U_{80} = .8(25.2) = 20.2''$ $T_{80} = 0.567$

$t_{80} = \frac{.567(6')^2}{1.263 \times 10^{-2} \text{ ft}^2/\text{d}} = 1,616$ day $= 4.4$ yrs;

E.14.6-22

SAW FORM 472 REV 17 APR 1980

COMPUTATION SHEET

U.S. ARMY ENGINEER DISTRICT

WILMINGTON, N C

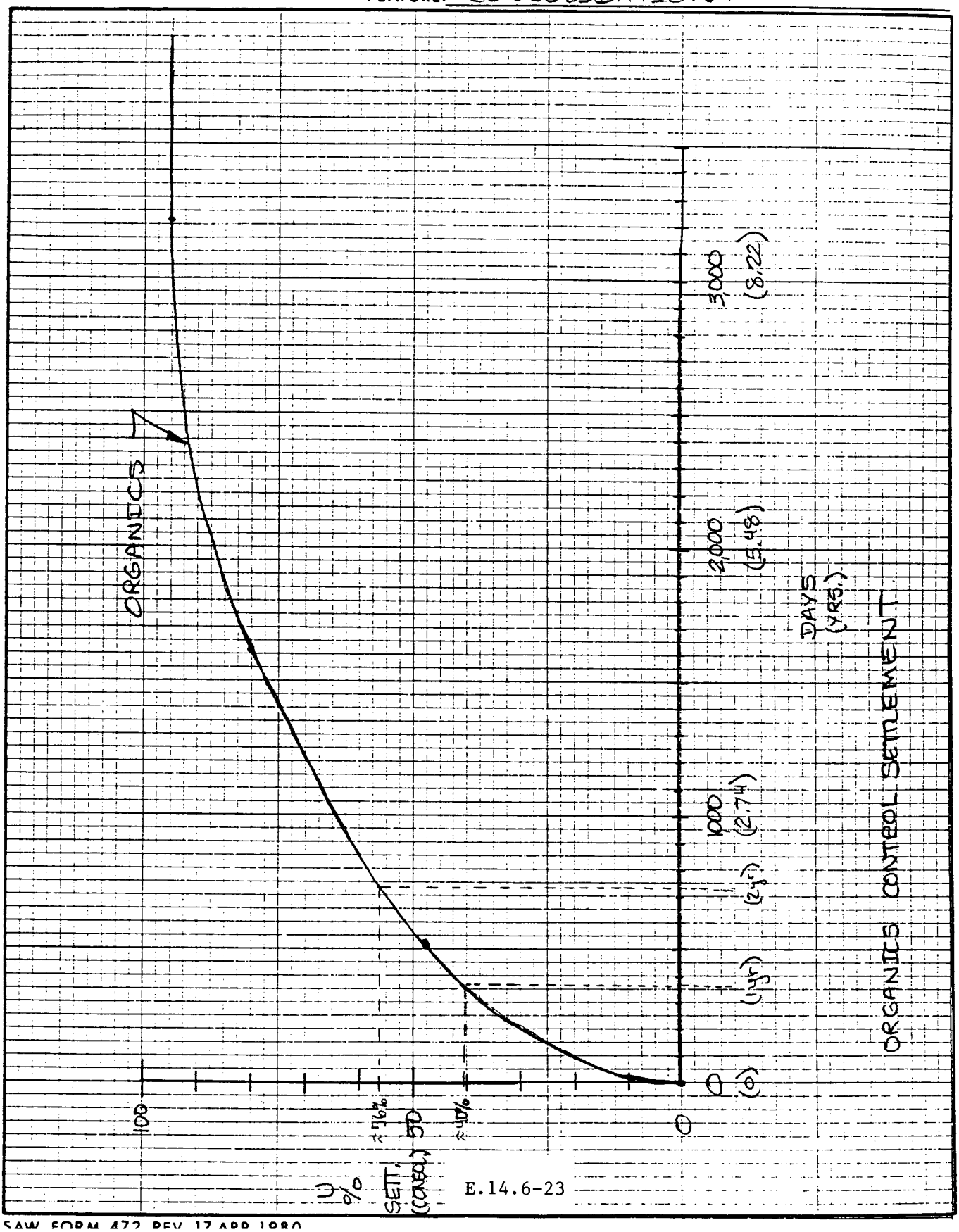
DESIGN ANALYSIS

DATE 8/30/94 SHEET No. 11 OF

COMPUTED BY: Tom Child CHECKED BY:

PROJECT: PASSAIC "10"

FEATURE: CONSOLIDATION



COMPUTATION SHEET

U.S. ARMY ENGINEER DISTRICT

WILMINGTON, N C

DESIGN ANALYSIS

DATE 12/22/94 SHEET No. ___ OF ___

COMPUTED BY: Tom Child CHECKED BY: [illegible]

PROJECT: PASSAIC 10 LEEVEES

FEATURE: UNDERSEEPAGE

FROM "PRINCIPLES OF FOUNDATION ENGINEERING" BY BRAJA DAS; @ 1984 1ST EDITION: PG 37 EQN 1.65

$$C_v = \frac{K}{\frac{\Delta e}{\Delta p(1+e_{av})}\gamma_w}$$

C_v = coefficient of consolidation

K = permeability

Δe = total change in void ratio caused by stress increase = Δp

e_{av} = avg. void ratio during cons.

FOR CH LAYER:

FROM SETTLEMENT CALCULATIONS & LAB TEST (CONSOL)

$C_v = 1.263 \times 10^{-2} \frac{ft^2}{day}$ $\Delta e = 3.80 - 2.40 = 1.4$ $e_{av} = 3.1$

$\Delta p = 2 - 0.5 = 1.5 \, T/ft^2 = 3000 \, \#/ft^2$

$$K = \frac{C_v \Delta e \gamma_w}{\Delta p(1+e_{av})} = \frac{1.263 \times 10^{-2} ft^2/day \, (1H) \, 62.4 \, \#/ft^3}{3000 \frac{\#}{ft^2} \, (4.1)} = \frac{ft}{day}$$

$$= \frac{1.103}{12{,}300} = 0.897 \times 10^{-4} \frac{ft}{d} \text{ say } 0.9 \times 10^{-4} \frac{ft}{d}$$

$$2.54 \frac{cm}{in} \times 12 \frac{in}{ft} \times \frac{1d}{24hr} \times \frac{1hr}{60min} \times \frac{1min}{60sec} = 3.53 \times 10^{-4} \frac{cm}{sec} \cdot \frac{d}{ft}$$

$$k = 0.9 \times 10^{-4} \, ft/d \times 3.53(10^{-4}) \frac{cm}{sec} \cdot \frac{d}{ft} = 3.18 \times 10^{-8} \, cm/sec$$

very poor permeability - clay like.

FOR CH LAYER

$C_v = 1.642 \, ft^2/d$ $\Delta e = (.904 - .845) = 0.059$ $\Delta p = 2000 \, \#/ft^2$ $e_{av} = 0.8745$

$$k = \frac{1.642(0.059)62.4}{2000(1.8745)} = \frac{6.045}{3749} = 1.613 \times 10^{-3} \, ft/d$$

$$k = (1.613 \times 10^{-3}) \times (3.53 \times 10^{-4}) = 5.69 \times 10^{-7} \, cm/sec$$

a typical clay permeability.

COMPUTATION SHEET

U.S. ARMY ENGINEER DISTRICT

WILMINGTON, N C

DESIGN ANALYSIS

DATE 12/23/94 SHEET No. ___ OF ___

COMPUTED BY: Tom Child CHECKED BY: ___

PROJECT: PASSAIC 10 LEVEES

FEATURE: UNDERSEEPAGE

FROM LOOKING AT THE PERMEABILITIES CALCULATED IT IS REASONED THAT THE BOTH THE ORGANIC LAYER AND THE CLAY LAYER CAN BE CONSIDERED AS IMPERVIOUS. THIS LEADS TO THE CONCLUSION THAT NO UNDERSEEPAGE ANALYSIS IS NECESSARY. FOR THROUGH SEEPAGE, OR SEEPAGE THROUGH THE EMBANKMENT, A FLOW NET OR OTHER TYPE OF ANALYSIS IS NOT HELPFUL AT THIS TIME. IF THE EMBANKMENT IS A CLAY TYPE MATERIAL, OR A SAND WITH ENOUGH FINES IT COULD BE CONSIDERED AS IMPERMEABLE. HENCE, NO SEEPAGE WOULD OCCUR AND NO ANALYSIS IS NECESSARY. IF THE LEVEE IS COMPOSED OF A DIFFERENT MAT'L A DECISION ON AN ANALYSIS WOULD BE MADE AT THE TIME THE TYPE OF MATERIAL IS DECIDED UPON.

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MATERIALS RESOURCE STUDY

PASSAIC RIVER FLOOD DAMAGE
REDUCTION PROJECT

GEOTECHNICAL DESIGN
APPENDIX E

SECTION 15
MATERIALS RESOURCE STUDY

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APPENDIX E

SECTION 15

MATERIALS RESOURCE STUDY

15.1 FLOOD PROTECTION PROJECT DESCRIPTION

The Passaic River Basin has been subjected to flooding longer than recorded history. As the area was developed through industrial development, urbanization and development within the flood plain eliminating large natural storage areas, this natural flooding has resulted in disastrous flooding of manmade development and its associated damages.

The flooding in this basin is the most serious in New Jersey as well as one of the major East Coast flood problems. While the flood of record in 1903 was of major proportions, development has continued within the flood plain. Floods in 1968, 1971, 1972, 1973, twice in 1975, 1984 and 1992, all were severe enough to require Federal Disaster Declaration for portions of the basin. The average annual flood damage has been estimated at $105 million. It is further estimated that if a flood of the magnitude of 1903 occurred today, damages of $2.2 billion could be caused.

In recognition of this major flood problem, Congress authorized the Passaic River Flood Protection Project for construction by the Water Resources Development Act of 1990, as modified by the Water Resources Development Act of 1992. The authorized project includes the construction of large diversion tunnels, levees, flood walls, channel modifications and natural flood storage. Details of this overall plan are available in several separate reports.

15.2 STUDY SCOPE

The materials resource study scope provides for investigation of commercial sources for materials required for construction of Passaic River Flood Protection Project features including concrete tunnel lining, inlet and outlet structures, weirs and floodwalls; earth-fill levees and embankments; and hurricane flood walls. The study purpose is to determine probable availability and cost of ready-mix concrete, portland cement, concrete aggregates, fly ash, riprap, graded stone, earth borrow and clay, steel sheet piling, H-piles and reinforcing steel.

Figure E.15.1 shows estimated quantities of material required of each of the major project features totaling about 950,000 cubic yards of concrete, 1.4 million cubic yards of earth fill, 200,000 linear feet of steel H-piles, 900,000 square feet of steel sheet piles and 90,000 cubic yards of riprap and graded stone. Also needed is 50,000 tons of concrete reinforcing steel. Also included in Figure E.15.1 is the construction schedule, showing tunnel excavation and concrete lining between years 2000 and 2006 and most of the levee and inlet and outlet works in years 2004 and 2006. Material quantities required and availability are discussed for each category of material under paragraph 15.4 below. Figure E.15.2 is a project map with locations of listed material sources.

15.3 INVESTIGATION

Lists of material producers within practical distance of the project features were compiled from industrial purchasing guides, NJ Department of Transportation approved sources, telephone directories, personal knowledge and leads provided by contacts during the study.

Waterways Experiment Station Technical Memorandum No. 6-370 test data reports for concrete aggregates, provided by Passaic River Division, were reviewed. Some 6-370 sources operate under new ownership/name; others are defunct; a few could not be identified and are assumed to no longer be in business. Most high capacity active sources within practical range of the project are included in Tables E.15.2 and E.15.3.

Telephone calls to producer companies usually yielded needed information on current production, available quantities, current prices and company expectations for the next 10 years, i.e. will the company still be producing around the year 2005.

Over seventy contacts were made including phone contacts and site visits; not all are recorded on source data forms but provided leads, general information and expert advice.

Follow-ups were made by sending the form completed by the investigator to the person contacted with a request for signature to confirm and to augment or revise the information. A sample copy of the transmittal letter and all forms are attached as Appendix; eleven of the forms were signed and returned. A number of the sources were visited and photographed and the photos are available at the Passaic River Division office.

15.4 FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

15.4.1 Ready Mixed Concrete

The total quantity of concrete required is estimated at about 950,000 cubic yard (cy) of which about 860,000 cy are needed for tunnel lining which is expected to be site-batched. Although another 50,000 or 60,000 cy for large inlet and outlet structures might also be site-batched, for study purposes it is assumed that 90,000 cy will be supplied from commercial ready mixed plants. Most work is scheduled for years 2003 to 2006, requiring 20,000-30,000 cy per year.

The three companies cited in Table E.15.1 have eight plants with a total annual production of more than 1,400,000 cy. They are located within 60 minutes of one or more project features and have ample capacity to provide concrete in the classes, quality and quantity required. All plants are approved by NJDOT.

Average 1994 price is $58/cy delivered, with 3000 psi concrete at $55/cy and 5000 psi at $60/cy.

15.4.2 Stone - Crushed Stone for Aggregates, Bedding, Riprap

About 1 million tons of coarse aggregate are required for the 950,000 cy of concrete and the 90,000 cy of riprap, graded stone and bedding as shown in Figure E.15.1. Annual supply required by the project within the years 2000 to 2006 would be about 150,000 tons for site-batched concrete tunnel lining, 30,000 tons for other concrete and 80,000 tons for other stone, for an annual maximum total of 260,000 tons in the 2005 to 2006 period.

The fourteen quarries listed in Table E.15.2 have an annual capacity of over 30 million tons. All sources are hard, durable rock: diabase, basalt, or gneiss. All producers are New Jersey Department of Transportation approved and produce concrete aggregates in sizes required. Most plants also produce riprap and bedding stone in a range of sizes. All sources are capable of producing aggregate from which concrete can be manufactured meeting quality and durability requirements. None of the sources contain reactive substances which would preclude use of the aggregates in the project. Materials from these sources and geologic formations perform satisfactorily as aggregate and as riprap on NJDOT projects. Materials meeting NJDOT specifications

for coarse concrete aggregate would meet ASTM C33 with a few minor exceptions, e.g. allowable percentages of deleterious particles. Table E.15.2B lists rock type, specific gravities and NJDOT approved sizes. Other sizes can be produced.

Current F.O.B. prices average about $7/ton for coarse aggregate, $9/ton for riprap and $8/ton for graded stone. Transportation costs are discussed in paragraph 15.4.9 below.

15.4.3 Natural Aggregates - Sand and Gravel

About 600,000 tons of fine aggregate are required for the 950,000 cy of concrete. As with the coarse aggregate, maximum supply required would be within the years 2000 to 2006 for tunnel lining and other works totaling about 120,000 tons each year.

The sources listed in Table E.15.3 have current annual production of over 3 million tons; potential capacity is higher.

Material sources are pits in the coastal plain, alluvial or glacial deposits in the NJ Highlands or dredged sand from the Ambrose Channel. All sands have hard, durable particles and are screened and washed, as required, to meet standard specs. Most sources are NJDOT-approved for use in concrete; NJDOT specs for fine aggregates are virtually identical with ASTM C33 with minor exception as noted above. The suppliers have ample capacity to provide required quantity and quality of fine aggregates. All listed sources produce aggregate from which concrete can be manufactured meeting quality and durability standards. None of the sources contain reactive substances which would preclude use of the aggregates in the project.

Current F.O.B. price is about $7/ton. Transportation costs are discussed in 15.4.9 below.

15.4.4 Fill - For Levee Embankment

As shown in Figure E.15.1, about 1.4 million cubic yards of earth fill are required at six levee projects. In Table E.15.4, existing sources of fill are identified as sand and gravel pits, quarries and NJDOT right-of-way. No active commercial borrow pits were identified. Except for virtually unlimited quantities of pit run sand at Jackson Township, probably beyond economical haul distance, material from these sources is available in limited and varying quantities. Availability is subject to uncertainties of pit or quarry expansion and excavation of overburden or the ebb and flow of dirty , non-spec aggregate piles. Experience in New Jersey demonstrates that sufficient

borrow is available for any fill project. Contractors obtain suitable material from existing sources or borrow pits opened for the project.

Soils found at the listed sources within economical hauling distance of the project are generally glacial deposits, residual soils or decomposed bedrock. Typical soils are silty with varying amounts of clay, sand, gravel and/or rock fragments; plasticity is low to moderate. Most soils are good to excellent fill material: able to be readily compacted into stable embankments with relatively low permeability. Compacted densities range between 110 and 130 pcf.

County Concrete at Kenvil has a pile of silt washed from aggregates estimated by the supplier at 1 million cubic yards. But compaction in fill would be problematic because of its non-cohesive nature and probable sensitivity to water content, and it would be erodible.

Cost of fill material F.O.B. identified sources is quoted as $1 to $5/cy. Hauling cost is discussed under paragraph E.15.4.9 below. Analysis of NJDOT contract prices for common borrow for road embankment indicates that an in-place price of $8 to 12/cy would be reasonable for the levee construction. The higher price would be used for areas with difficult access or other restrictive conditions. The lower price would be used for more massive works, more favorable access and/or shorter haul distance.

Use of fly ash for fill is discussed under paragraph 15.4.5 below.

Unless other fill sources are more economically available at time of construction, use of a portion of the 7 million cy of tunnel spoil is recommended. The mole-excavated shale and sandstone would be excellent levee material, readily compacted, stable and relatively impermeable. The basalt would also be excellent, blended with sedimentary material if required to reduce permeability. This recommendation is consistent with the Phase I Feasibility Report, Dec. 1987, page III-59.

15.4.5 Fly Ash

Use of fly ash to replace portland cement in concrete and as fill material was studied. In concrete, fly ash, a pozzolan, can be substituted for 15 to 20 percent of cement. The project total of 950,000 cy of concrete requires about 300,000 tons of cement or 240,000 tons of cement and 60,000 tons of Class F fly ash.

Class F fly ash is a by-product of burning pulverized anthracite and bituminous coal in power plants. As shown in Table E.15.5, fly ash is available from plants in NJ and east central Pennsylvania in adequate quantity and quality. At prices of $20-30/ton, its use would be economically desirable as replacement for portland cement at $60/ton. Marketers and utility company representatives report the fly ash is continuously tested for hazardous substances and is environmentally benign. Chemical analyses of fly ash from two N.J. plants are included with the Public Service data forms in the full report in the Passaic River Division Office. Except for specific gravity, other detailed material data are not available.

Use of fly ash in levee embankments was investigated. Class F fly ash, consisting primarily of glassy, roughly spherical, silt-size particles, is not considered a practical levee embankment material: it is difficult to handle and compact; compacted density and strength are low; it is highly erodible. Mixed with lime, portland cement, kiln dust or other calcareous materials, Class F fly ash gains considerable strength and is used, for example, to stabilize aggregate bases, for slurry fills, and grout. Although Class F is availabe at low cost at plants in eastern Pennsylvania, having a too high carbon content for use in concrete, the cost of stabilized fly ash is prohibitive for embankment compared with common borrow. Class C fly ash, from burning subbituminous coal or lignite, contains enough calcium to have cementing properties and is used for fill and stabilization, however, it is not produced in the region.

Fly ash should not be considered for use in fills: Class F is not suitable; Class C is not economically available.

Use of fly ash as a substitute for portland cement is recommended.

15.4.6 Portland Cement

About 300,000 tons of portland cement is required for project concrete over the years 2000 to 2006 or 50,000 tons per year.

The cement companies listed in Table E.15.6 have an annual capacity of at least 3 million tons. Ample high quality cement will be available to meet all project requirements. Current delivered price averages under $65/ton.

15.4.7 Steel Piling - Sheet and H-Piles

Project needs for steel sheet piling are estimated as 900,000 square feet (s.f.). About 700,000 s.f. is scheduled for hurricane levees/floodwalls in years 2000 and 2001, or about 350,000 s.f. or 4700 tons per year. About 200,000 lin. ft. of H-piles is estimated to be used in years 2003 to 2006, that is, 50,000 lin.ft. or 1800 tons per year.

Producers listed in Table 15.4.7 currently produce over 6 million s.f./yr of sheet piling in sizes PZ-27, SZ-27 and SPZ-26. H-piling is also produced in ample quantities by the two producers contacted. No difficulty is expected in fulfilling project needs.

Current sheet pile prices average $8.50/s.f. delivered; coal-tar epoxy coating adds about $2.50/s.f.; H-piling (14 HP 73) costs about $15/lin.ft. delivered to North Jersey.

15.4.8 Reinforcing Steel

Project needs for concrete reinforcing steel are estimated as 50,000 tons in years 2000 to 2006 with an assumed annual maximum of 15,000 tons.

The two producers listed in Table E.15.8 have an annual production of about 600,000 tons. They supply most of the re-steel to the two local fabricator/suppliers contacted. Re-steel will be available as needed.

Current fabricated and delivered price is about $0.25 per lb. or $500 per ton; epoxy coating or galvanizing adds about $0.10 to 0.15 per lb.

15.4.9 Transportation Costs

Prices cited for steel, cement, fly ash, and ready mixed concrete are delivered prices. Transportation costs of materials from outside the project vicinity are not sensitive to distance to individual project features but are primarily affected by the relatively longer distance between the source and the region. Costs are not significantly affected by a few miles difference at the receiving end. Ready-mixed concrete delivery costs are relatively uniform because haul distances are restricted by the limited time allowed from batching to placement.

On the other hand, transportation costs for bulky, locally produced materials -- stone, aggregates, fill -- are highly dependent on the haul distances, ranging from 1 mile to 60 miles, between sources and project features. For purposes of the study, no attempt is made to estimate transportation costs from each potential source to each project feature, encompassing innumerable combinations.

As guidance for future, more detailed project cost estimating, the following ton-mile costs are presented:

Assume a dump truck with a legal load capacity of 23 tons, either a three-axle single unit or a five-axle semi-trailer, and a daily cost including driver and operating costs of $600. For example, for a distance of 20 miles (40 mile round trip) and 5 trips per day, cost would be $0.26 per ton-mile. Table below shows estimated costs for various haul distances.

One-way Distance	Avg. Travel Speed-mph	Est. Trips/ /day*	Ton-mile Cost	Cubic yard/ mile cost**
5	20	11	$0.47	$0.70
10	24	7	0.37	.56
20	28	5	0.26	.39
40	35	3	0.22	.33
60	40	2	0.22	.33

* Includees 15 minutes loading and unloading time each trip.
** Cubic yard-mile costs for earth fill are 1.5 times ton-mile costs.

PASSAIC RIVER FLOOD DAMAGE REDUCTION PROJECT

SECTION 15
MATERIALS RESOURCE STUDY

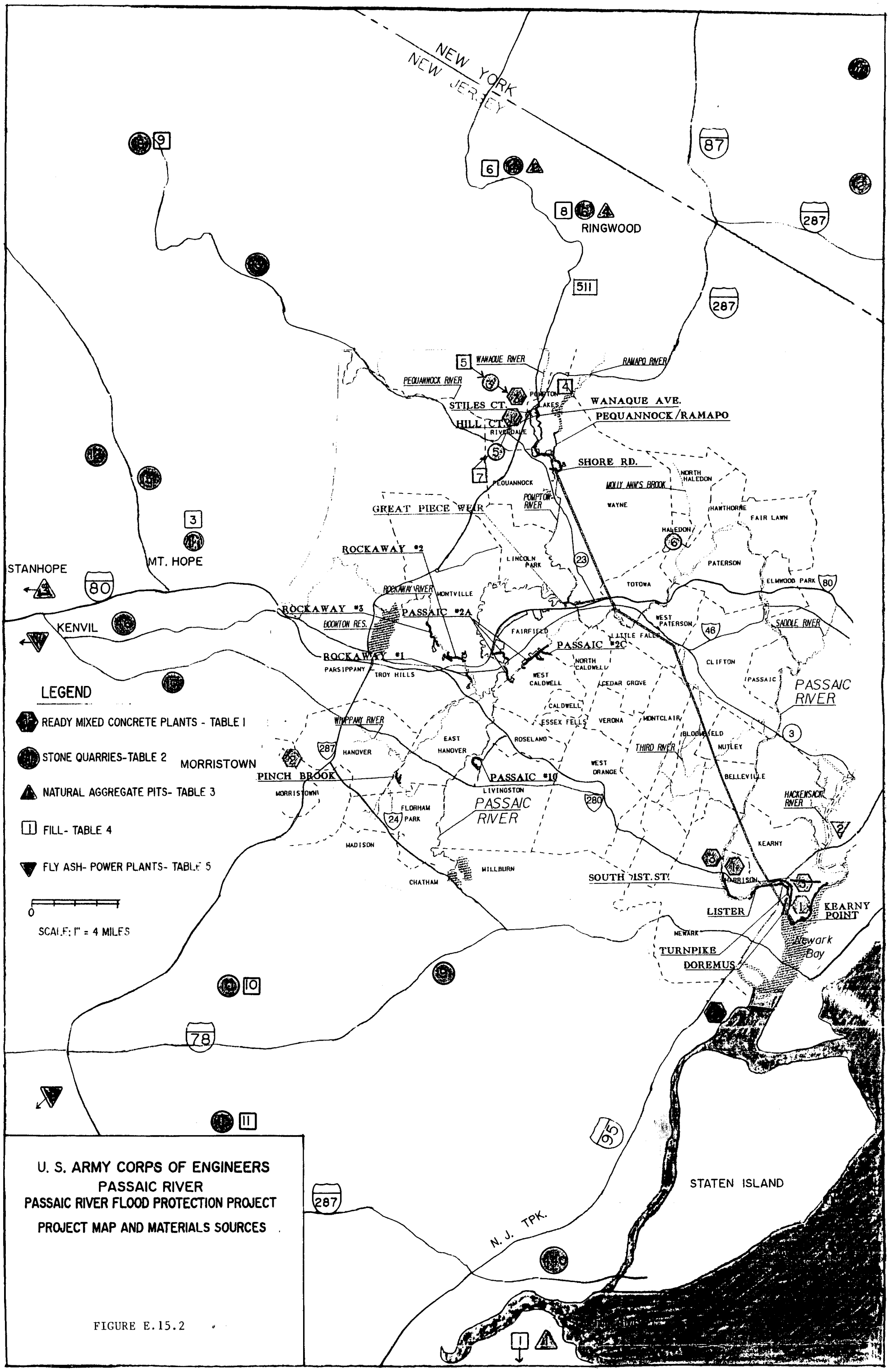
FIGURES

FIGURE E.15.1
ESTIMATED QUANTITIES FOR MATERAILS RESOURCE STUDY

Project Feature	Construction Schedule (YR)*	Concrete (CY)	Offsite Earth Fill (CY)	Piles 14HP73 (LF)	Sheetpiles PZ-27 (SF)	Riprap (24") (CY)	Graded Stone (9") (CY)	Bedding (6")(CY)
	Calendar Year							
Main & Spur Tunnels	2000-06	860,000	(7,000,000 CY Excav)					
Tunnel Outlet & P.S.	2003-05	35,000		25,000	23,000	18,000		5,000
Pompton Inlet Str.	2004-06	13,000		75,000				
Spur Inlet & Bridge	2004-05	10,000		49,000				
Great Piece Weir	2005-06	1,000		18,000			8,000	
Pequannock Weir	2006-08	1,000		35,000		28,000	24,000	7,000
Hurricane Levee/Floodwall	2000-03	20,000	425,000		700,000			
Pompton Levees/Fldwls/Channels	2004-08	4,000	280,000		118,000			
Pinchbrook Levee/Fldwl	1999-00	1,000	32,000		8,000			
Passaic #10 Levee	1999-2000		64,000					
Rockaway #1, #2, & #3 Levee	2005		258,000					
Passaic #2A & #2C Lev/Fldwl	2004-06	2,000	339,000		60,000			
Total		947,000	1,398,000	202,000	909,000	46,000	32,000	12,000

* Construction Schedule #1 - April 1992

Concrete components:
Coarse Agg. 900KT
Fine Agg. 600KT
Cement 300KT
Fly Ash 300 x 0.15 = 50KT



U. S. ARMY CORPS OF ENGINEERS
PASSAIC RIVER
PASSAIC RIVER FLOOD PROTECTION PROJECT
PROJECT MAP AND MATERIALS SOURCES

FIGURE E.15.2

PASSAIC RIVER FLOOD DAMAGE REDUCTION PROJECT

SECTION 15
MATERIALS RESOURCE STUDY

TABLES

TABLE E.15.1
READY MIXED CONCRETE

COMPANY NAME	PLANT LOCATION	PRODUCTION-CY/YR	PRICE DELIVERED	REMARKS
Blue Circle-Raia, Inc.	Riverdale, E. Newark, E. Newark, Jersey City	200,000 200,000	$55-60	Central mix
County Concrete Co.	Morristown, NJ	500,000	$55-60	Central mix 300 cy/hr. capacity
Premco/Colonial Concrete*	Pompton Lakes, Newark, Elizabeth, Jersey City	500,000+	$55-60	Capacity of each plant is 100 cy/hr.

* Premco currently is producing with fly ash, for Port Authority of NY/NJ projects.

TABLE E.15.2A
STONE - RIPRAP, CRUSHED STONE FOR AGGREGATES,
BEDDING, EROSION PROTECTION

COMPANY NAME	PLANT LOCATION	PRODUCTION-TON/YR..	PRICE-F.O.B.	REMARKS
Mt. Hope Rock Products	Mt. Hope, NJ	6,000,000	Riprap $9 Aggregate $6-7	
New York Trap Rock Corp.	W. Nyack, NY	6,000,000	$9 avg.	Barge to Newark vic.
Passaic Crushed Stone, Inc.	Pompton Lakes, NJ	1,500,000	Riprap $10 Aggregate $7	
Ringwood Quarry	Hewitt, NJ Clifton, NJ	1,000,000 1,500,000	Ripraop $6 Aggregate $7-8	
Riverdale Quarry Co.	Riverdale, NJ	1,000,000	Riprap $8 Aggregate $7-10	
Stone Industries, Inc.	Haledon, NJ Ringwood, NJ	1,000,000+ 1,000,000+	$7 $7	
Tilcon	Haverstraw, NY	2,000,000+	$11	Barge tp Newark vic.
Blue Circle-Raia	Hamburg, NJ	2,000,000	Riprap $6 Aggregate $6-9	
Fanwood Quarry	Westfield, NJ	1,000,000	Riprap $8 Aggregate $8-11	
Millington Quarry, Inc.	Millington, NJ	3,000,000	Riprap $8 Aggregate $6-8	
Stavola Construction Materials, Inc.	Bound Brook, NJ	2,000,000	Riprap $6.50 Aggregate $6-7	
Wimpey Minerals, Inc.	Lake Hopatcong, NJ	2,500,000	Aggregate $5-7.50	

TABLE E:15.2B
STONE - RIPRAP, CRUSHED STONE FOR AGGREGATES,
BEDDING, EROSION PROTECTION

COMPANY NAME	PLANT LOCATION	TYPE OF ROCK	BULK SPEC. GRAVITY	L.A. LOSS %	APPROVED SIZES*
Mt. Hope Rock Products	Mt. Hope, NJ	Gneiss	2.70	26	#3, #4, #57, #8, #9, Stone Sand
New York Trap Rock Corp.	W. Nyack, NY	Diabase	2.90	15	#3, #4, #57, #67, #8,Stone Sand
Passaic Crushed Stone, Inc.	Pompton Lakes, NJ	Gneiss	2.73	25	#2, #57, #67, #8, #9, Stone Sand
Ringwood Quarry	Hewitt, NJ Clifton, NJ	Gneiss Basalt	2.72 2.89	18 17	#57, #8, Stone Sand N.A.
Riverdale Quarry Co.	Riverdale, NJ	Gneiss	2.65	28	#2, #4, #57, #8, #9, Stone Sand
Stone Industries, Inc.	Haledon, NJ Ringwood, NJ	Basalt Gneiss	2.92 2.70	14 N.A.	#2. #4, #57, #8, #9, Stone Sand
Tilcon	Haverstraw, NY	Diabase	2.85	12	#3, #4, #57, #67, #8, #9, Stone Sand
Blue Circle-Raia	Hamburg, NJ	Gneiss	2.64	28	#57, #8, #9, Stone Sand
Fanwood Quarry	Westfield, NJ	Basalt	2.84	12	#57, #67, #8, Stone Sand
Millington Quarry, Inc.	Millington, NJ	Diabase/Basalt	2.88	13	#2, #3, #57, #67, #8, Stone Sand
Stavola Construction Materials, Inc.	Bound Brook, NJ	Basalt	2.89	10	#2, #3, #4, #57, #67. #8., Stone Sand
Wimpey Minerals, Inc.	Lake Hopatcong, NJ	Gneiss	2.71	23	#2, #3, #57, #67, #7, #8, #9, Stone Sand

* Source: NJDOT, Bureau, of Materials, Aggregate Producers List, January 1994.

TABLE E.15.3
NATURAL AGGREGATES - SAND AND GRAVEL

COMPANY NAME	PLANT LOCATION	PRODUCTION-TON/YR.	PRICE F.O.B.	BULK SPEC. GRAV.
Clayton Sand Co.	So. Amboy, NJ Jackson, NJ	2-3,000,000	$6-8	2.66* 2.67*
Ringwood Quarry	Stanhope, NJ	Ample	$10	N.A.
Saxton Falls Sand and Gravel	Stanhope, NJ	Ample	Gravel $7 Sand $7	2.68*
Stone Industries, Inc.	Ringwood, NJ	300,000	Sand $7	2.65**

* Source: NJDOT, Bureau of Materials, Aggregate Producers List, January 1994
** Producer

TABLE E.15.4
FILL - FOR LEVEE EMBANKMENT, CORE

COMPANY NAME	PLANT LOCATION	AVAILABLE QTY.	PRICE-C.Y. F.O.B.	REMARKS
Clayton Sand Co.	Jackson, NJ	Adequate	$5	Pit-run sand-beyond economical haul distance
County Concrete Co.	Kenvil, NJ	1,000,000	$2	Silt - low permeability
Mt. Hope Rock Products	Mt. Hope, NJ	Limited	$3-5	Overburden; dirty stone
NJ Dept. of Transportation	Wanaque, NJ	200,000	$3-5	Excess I-287 excavation gneiss; may be available; accessible only thru private property.
Passaic Crushed Stone	Pompton Lkaes, NJ	Limited	$3-5	Overburden-available as site developed
Ringwood Quarry	Hewitt, NJ	Limited	$3	Overburden dirty stone
Ringwood Quarry Co.	Riverdale, NJ	Limited	$3-5	Overburden; dirty stone
Stone Industries	Ringwood, NJ	Limited	$3-5	Overburden; dirty stone
Blue Circle-Raia	Hamburg, NJ	100,000	$5	Dirty stone, Continuous production
Millington Quarry	Millington, NJ	300,000	$3	Overburden
Stavola Construction Material	Bound Brook, NJ	"Several 100,000"	$1	Overburden. Transp. to vic. Morristown, $7/C.Y.

TABLE E.15.5
FLY ASH

COMPANY NAME	PLANT LOCATION	PRODUCTION-TON/YR.	PRICE F.O.B.	REMARKS
J.T.M. Industries, Allentown, PA (Marketer)	Montour, PA	200,000	$9	PA Power and Light plants. Class "F"; meets ASTM C618. Spec. grav. = 2.47
	Brunner Island, PA	200,000	$3	Not suitable for concrete; too much carbon to meet C618.
McNeil Bros. Milford, CT (Marketer)	Jersey City, NJ Trenton, NJ	150,000	$15 ($20-30 delivered)	Public Service Gas & Electric plants. Class "F" meets C618. Spec. grav. = 2.26

TABLE E.15.6
PORTLAND CEMENT

COMPANY NAME	PLANT LOCATION	PRODUCTION-TON/YR.	PRICE DELIVERED	REMARK
Blue Circle Cement, Inc.	Ravena, NY	Adeqaute	$60±	Barged to Newark area
Hercules Cement Co.	Stockertown,, PA	1,000,000	$65	
Lehigh Portland Cemet Co.	Cementon, NY	700,000	$65	If plant shuts down, company import.
Lone Star Cement Co.	Nazareth, PA	650,000	$60	

TABLE E.15.7
STEEL PILING - SHEET AND H-PILES

COMPANY NAME	PLANT LOCATION	PRODUCTION-SF/YR..	PRICE DELIVERED	REMARKS
Bethlehem Structural Steel Products, Corp.	Bethlehem, PA	1,800,000 Ample	$8.60/sf $15/1f	PZ-27 12HP74
Shoreline Steel Supply Co.	New Haven, MI	500,000	$8.40/sf	SZ-27
Syro Steel Corp.	Girard, OH	4,000,000 Ample	$8.10/sf	SPZ-26 14HP73

TABLE E.15.8
REINFORCING STEEL

COMPANY NAME	PLANT LOCATION	PRODUCTION-TON/YR..	PRICE DELIVERED	REMARKS
N.J. Steel	Sayreville, NJ	500,000	-	
Auburn Steel. Co. (Producer)	Auburn, NJ	90,000	-	
Barker (Fabricator/supplier)	Keasbey, NJ	-	$0.26*	Price fabricated and delivered.
Thompson Materials (Fabricator/Supplier)	Whippany, NJ	-	0.25*	Price fabricated and delivered.

* $0.35 - 0.40/s.f. with epoxy coating

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SECTION 16

EXCAVATED MATERIALS DISPOSAL STUDY

16.1 SCOPE OF THE STUDY

The scope of this study is the investigation of the character, transportation and disposal of material excavated during construction of the main tunnel, spur tunnel, shafts, and inlet and outlet structures. The investigations include a description of the quantity and character of the material, alternative methods of transportation outside the tunnel, potential disposal sites, the effect of possible hazardous, toxic and radiological waste (HTRW) contamination of the excavated material, and the economics of disposal. The goal of the study is to determine the means and the cost of disposing of excess excavated materials.

16.2 ORGANIZATION OF THE REPORT

This material disposal study is organized into two major sections. The first section is covered in Section 1, 2 and 3 and reports on the material characteristics, uses, disposal locations, transportation modes and economics of material assumed to be free of HTRW contamination. The remainder of the study is an HTRW impact assessment, that addresses the regulatory framework, potential for HTRW contamination, and disposal impact and cost for a given quantity of HTRW contaminated material. The full excavated materials disposal report is available for review at the Passaic River Division office. The following is a summary of the report.

16.3 MATERIAL CHARACTERISTICS AND POTENTIAL USES

The estimated quantity of rock excavation from tunnel construction is 6.1 million in-place cubic yards made-up of 1 million cubic yards of basalt and 5.1 cubic yards of shale/sandstone. Tunnel boring machines are assumed to produce a spoil consisting of rock fragments having a maximum size of 6 inches. Both the basalt and shale/sandstone materials are expected to have graduations from the 6-inch maximum size down to silt size. A relatively small volume of rock will be excavated from shafts. Shafts excavation will be by drilling and blasting with an expected maximum size of one-half cubic yard.

Soil materials will be excavated during construction of shafts, channel modifications and the inlet and outlet structures. The estimated in-place quantity of soil is about 2.0 million cubic yards. The material excavated at the two inlet structures is expected to be granular. At the outlet structure soils will consist of soft mud on the river bottom with underlying soft to hard varved clays. Both granular and clay soils are expected at the shafts.

Bulking and shrinkage factors have been developed for preliminary evaluation of the quantity of material to be transported and to determine the volume of disposal needed. The bulking factor for rock is estimated as 1.7 and for soil. Shrinkage factors are estimated as 0.75 for rock, 0.75 for granular soils and 0.85 for clays.

Potential uses of excavated materials vary. The granular soils provide an excellent source of material for both compacted and uncompacted embankments and levees. Some of the granular material may be of adequate quality to process into fine aggregate for concrete. The stiffer clays may be used for uncompacted embankments and levees or for cover on landfills. The very soft clays have no practical use.

Basalt rock could be processed into coarse aggregate for concrete or asphalt, possible use as stone base for roadways or for compacted embankments. The excavated shale/sandstone material could be used for compacted embankments and levees, uncompacted embankments and levees, uncompacted embankments and under water fills.

The average daily muck material production rate is estimated to be 8,000 to 10,000 cubic yards per tunnel boring machine. This rate is often controlled by the muck handling equipment between the boring machine and the top of shaft. Consequently, the above ground muck handling equipment, transportation and receiving site must be designed to handle this rate so as not to become the controlling factor in the construction schedule. For the purpose of this report it is assumed that adequate temporary (shaft site) storage and transportation is available to keep up with the tunneling operation.

16.4 POTENTIAL DISPOSAL LOCATIONS

Both temporary and permanent locations for the transportation and disposal of surplus material have been investigated. Temporary storage is required at production shafts to account for variations in transportation rates that may be caused by a ban on night truck traffic, road congestion,

operational deficiencies etc. For a 10,000 cy/day production rate, a temporary storage area of 70,000 cy is estimated to be adequate to protect against problems with the transportation system effecting tunnel progress. Using a pile height of 20 to 25 feet approximately 2 acres are required at a muck shaft site to accommodate temporary storage.

The approach used in investigating potential permanent disposal locations assumed that adequate disposal locations need to be available to accept twice the bulked volume excavated without consideration of beneficial use for project levees and other structures. This conservative approach is considered appropriate given potential changes in schedule.

Three base groups were contacted to determine the availability of disposal locations. Trade associations provided the names of potential users of the material in the construction industry. Public and quasi public agencies including the New Jersey Department of Transportation, New Jersey Turnpike Authority, New Jersey Sports Exhibition Authority, Hackensack Meadowlands Development Corporation and other were contacted about future projects or other needs for material. The third group contacted included known NJ private developers that have indicated future major developments. In all approximately 120 contacts were made. Each contact was provided with a verbal description of the project, the types of material to be disposed of and the project schedule. In all, over 25 responses were received.

Potential disposal sites with adequate capacity to meet the goal of twice the anticipated bulked excavated materials have been identified. Sufficient capacity has been found to be available within 10 miles of production shafts. Interest in surplus materials has been indicated from both the public and private sector.

The most interest was shown in the basalt and clean granular materials. Quarries looking to reclaim land for development, private developers and state agencies (NJSEA) were interested in the sandstone/shale materials for fill. None of the responses indicated that they would be willing to pay for the material, nor that there would be a charge for dumping.

16.6 TRANSPORTATION MODES

Three transportation modes are available for transporting excavated material; highway, rail and water. Shafts have been located to take advantage of as many modes as practical. Highway, rail and water are available at Shafts 2B, 2C and the

outlet; highway and rail at the Spur and Shafts 3, 4, 2A and 2.

Highway transport is available at all production locations. Twenty ton capacity trucks are assumed to be used for hauling. In most cases haul roads will be required to reach shaft sites, and local road and bridge load rating capacities will need to be check for adequacy.

The Passaic Basin is interlaced with railroads including Conrail, Amtrak, New Jersey Transit, and NYS&W. Rail may be used in conjunction with trucking or spur track construction may be required. The routes that the material would transverse are generally well used and train movement will probably occur at night.

Water transportation, mainly by barges, would be limited by the few navigable channels in the proximity of production locations. Docking facilities will be required both at the shaft and at disposal locations. Additionally, conveyor or truck transportation is required to deliver material from the shaft to barge loading and unloading facilities.

Unit costs for the transport of excavated materials have two major cost components; the operating cost of the transporting vehicle, and the cost of facilities to load, unload and transport(rail) the vehicle. The most common form of transportation is by truck, and, as such, other modes of transportation will be compared to this mode. A hauling distance of 20 miles round trip is sufficient to reach a large number of disposal facilities identified. The estimated cost for this mode of transportation is $6 to $10/cy depending on length of haul and traffic congestion.

The large volume of material to be moved and the availability of rail, raises the possibility that rail could be an economical mode of transportation. While the cost per cubic yard of hauling by rail would be less than that estimated for truck, the cost of hauling to a loading point, spur track construction and loading and unloading facilities would increase the unit cost.

Hauling costs by barge will result in the lowest bulk unit cost. However the capital cost for loading and unloading facilities will be the highest. While waterways are available at some production location, the study has not revealed disposal sites with sufficient capacity to use this transport mode.

16.6 HTRW ASSESSMENT

The HTRW assessment conducted in this investigation is a review of existing data, evaluation of likely contamination issues which could be expected at production sites and an assessment of the effects of possible HTRW contamination of the excavated materials on disposal options. Based on these assessments each work site was screened to develop likely contaminant and response scenarios and the range of related costs associated with the various technologies was estimated. In conjunction with this effort, and considering the large volume of excavated material, the potential to exceed local hazardous waste treatment, storage, disposal and recycling (TSDR) capacity exists. State and federal regulatory officials were contacted to obtain information regarding current and projected commercial hazardous waste disposal facility capacity.

16.7 REGULATORY FRAMEWORK

While the degree of HTRW impact cannot be determined at this time, it can be estimated based on existing data. Handling of soil and groundwater suspected or known to be contaminated is regulated by State and federal agencies. The general guidelines established by the New Jersey Department of Environmental Protection (NJDEP) and United States Environmental Protection Agency (USEPA) are used as the basis for determining how HTRW soils must be handled.

16.8 HTRW CONSIDERATION AT WORK SHAFTS

Based on evaluation of the environmental records search reports, it appears that there is a strong likelihood of encountering significant HTRW contamination at the sites of Work Shafts No. 3, 2B, 2C, as well as encountering HTRW contamination of Newark Bay sediment disturbed during construction of the outlet structures. At these work shaft sites, it appears likely that contaminated soil and groundwater requiring special handling and management will be encountered during shaft construction. At other work shaft locations, although the potential for contamination exists, the likelihood of significant contamination is not considered as likely based on the information reviewed.

Specific treatment and or disposal requirements will be dependent upon the nature and extent of HTRW contamination actually encountered. In reviewing the environmental records search report, the potential contaminants which may be encountered which may be encountered may include volatile organic compounds (VOCE), semi-volatile organic compounds (SVOCs), petroleum compounds (TPH), metals, polychlorinated biphenyls

(PCBs) and others. On and offsite treatment options and disposal options exist for these classes of contaminants. Cost impacts, relative disposal and reuse of non-impacted excavation spoil due to HTRW will depend on the quantity and degree of impact of the affected materials. Based on the treatment and disposal options assessed, which may be applicable, unit cost impacts may range from nearly no impact to more than $1,400 per ton for incineration of hazardous soil exclusive of transportation costs.

NJDEP has guidelines which allow for beneficial reuse of non-hazardous contaminated soils. Such uses typically are for road bed material, daily cover at landfills and at recycling facilities. Reuse of contaminated material would need to be shown to have no negative impact to groundwater, surface water, human or ecological receptors. Accordingly, levee and floodwall design which incorporates reuse of contaminated material excavated at other project features may have to factor in these considerations so that these features serve to contain residual contamination, if any, in the material proposed for reuse.

A review of currently permitted landfills indicates that a total of 13 permitted hazardous wast landfills with annual capacity in excess of 2.25 million tons are operating east of the Mississippi River. Eleven commercial hazardous wast incinerators with annual capacity in excess of 120,000 tons were also identified in the search. Individuals contacted report that most of these facilities are anticipated to be operating during the period of tunnel construction and may therefore be available for use if required or desired. Seven solid waste landfills which accept ID 27 (industrial) waste material were identified in New Jersey.

Various onsite and offsite technologies which may potentially be required to treat and dispose of HTRW-contaminated excavated materials have been identified. A range of unit cost estimates have been prepared for the various soil and groundwater technologies discussed. The estimates are presented for comparison purposes. The cost estimates have been prepared based on specific assumptions, and are subject to modification based on actual site conditions encountered during construction.

16.9 NEW JERSEY SOIL REUSE PROGRAM

The NJDEP has established a policy allowing for the beneficial reuse of non-hazardous contaminated soils with the approval of the NJDEP. Potential reuse options that have been identified include use of spoil to reclaim quarries, use as construction fill and use in construction of other project features. Non-hazardous excavated material which has been

impacted by HTRW contamination potentially can be reused if levels do not exceed regulatory limits, may be treated to reduce levels of contaminants and/or engineering controls (such as containment barriers) can be incorporated into the reuse options such that the material may be suitable for reuse. A specific soil reuse plan incorporating excavated material sampling data and proposed reuse will need to be prepared for review and approved by NJDEP.

16.10 DISPOSAL OF DREDGED MATERIAL

The outfall construction will require the dredging of approximately 85,000 CY of sediments from Newark Bay. Of this amount, it is estimated that 22,500 CY is contaminated. Various disposal options, both current practice and alternatives under consideration, are discussed. For clean sediments, the most feasible options are beneficial reuse of ocean disposal. Disposal at a capped ocean subaqueous borrow pit is the appropriate option for contaminated material at an estimated cost of $6 - $12 per cubic yard. Disposal at a containment island is feasible if the schedule for development of an inland containment facility is such that the facility will be ready to accept sediment when outlet construction is on-going.

16.11 CONCLUSIONS AND RECOMMENDATIONS

- At present adequate capacity exists for the disposal of the anticipated quantities of surplus excavated material.

- Disposal sites are available generally within 10 miles of production shafts.

- Highway, rail and water transportation modes are available within the project area. Because of the proximity of the disposal sites to the production shafts, highway would appear to be the most cost effective mode for most excavation sites.

- Contacted potential receptors of excavated material have not indicated that they would be willing to compensate the COE for material. However, they have indicated there would be no charge for dumping.

- The economics of transportation modes are dependent on the loading and unloading facilities required at the shaft sites. Truck transport appears to be the most cost effective, however to keep pace with production 50 trucks are required over a two shift work day. Rail transportation may be more environmentally acceptable when considering temporary impacts on air, noise and traffic.

- A relatively strong likelihood of encountering HTRW contamination of excavated materials is anticipated at Work Shafts No. 2B, 2C, and 3, and contaminated sediment may be encountered during construction of the outfall structure in Newark Bay. The potential for encountering HTRW contamination at other work shaft locations exists but is not considered as likely as at the noted locations.

- Options for addressing HTRW-impacted excavated materials are dependent upon the nature and extent of contamination. Options include on or off-site treatment, offsite disposal and on or off-site reuse.

- Remedial technologies required to address HTRW-contaminated materials are also contaminant-specific. Estimated unit cost impacts range from only those costs associated with sampling and analysis to support a reuse petition to NJDEP to more than $1,400 per ton (exclusive of transportation and analytical costs).

- Off-site reuse options which may be compatible with tunnel muck disposal options under consideration are possible but will require preparation of a soil reuse plan and approval by NJDEP.

- In the event that excavated materials are considered hazardous waste and require offsite disposal/treatment at a permitted TSDF, a total of 13 permitted RCRA landfills east of the Mississippi River have been identified at least 8 which anticipate being operational through the year 2010 and at which more than 2.25 millions tons per year current annual capacity are reported. In addition, 11 commercial hazardous waste incinerators were identified east of the Mississippi which handle solids, all of which anticipate being operational through the year 2010 and which have a combined annual capacity of more than 120,000 tons; and 2 commercial cement kilns have been identified which accept solids with a combined annual capacity of approximately 140,000 tons. A total of 177 operating solid waste landfill facilities were identified in New Jersey including one landfill in Hudson County in which several of the work shafts are located. Of these facilities, 7 are reported to be authorized to accept NJDEP ID 27 wastes (which includes contaminated, non hazardous soil).

- The tunnel outlet structure will require dredging of sediment which contain detectable levels of several metals endrin and dioxin which likely result in a portion of the sediments to be classified as Category III - unsuitable for unconfined open

ocean disposal. Dioxin concentrations were not detected at a range of 5 - 20 parts per trillion in surface sediment. Assuming that a new ocean disposal site is identified and available for non contaminated sediment during the time of outlet construction, disposal costs may be on the order of $6 per cubic yard. Disposal options for contaminated sediment which appear feasible include disposal in a capped subaqueous borrow pit may be on the order of $10 per cubic yard. Other potential disposal options for contaminated sediments which are not considered appropriate include capped subaqueous mound or upland disposal wherein disposal costs may exceed $40 per cubic yard exclusive of pretreatment and land transportation costs.

The following recommendations are provided:

- The identified disposal sites should be monitored to determine their continued desire to accept material.

- The development of construction documents should include a review of potential disposal sites, and that information should be made available to the perspective bidders.

- A schematic layout of work areas should be performed to determine if sufficient area is available for each alternative transportation mode.

- Detailed site-specific environmental data at each of the work shaft locations should be obtained to confirm the presence and the nature and extent of HTRW contamination, if any.

- Construction planning should consider the results of the recommended sampling in determining final treatment and disposal requirements for impacted excavated materials. Sufficient space and time for onsite staging and treatment of excavated materials should be allocated if on-site treatment is required at work shaft sites.

- Soil reuse options should be determined in advance and soil reuse plans submitted to NJDEP in advance of construction so that necessary NJDEP approval can be obtained.

- Assessment of the impact of HTRW to tunnel excavated material disposal should be periodically updated to address changes in regulations, HTRW conditions at work shafts, disposal and treatment site capacity and disposal/reuse options considered for the entire project.