LONG SLIP CANAL HABITAT CREATION PROJECT

Part of the
HOBOKEN RAILYARD REHABILITATION PROJECT
Hoboken/Jersey City, New Jersey

FINAL ENVIRONMENTAL ASSESSMENT and SECTION 4(f) EVALUATION

Prepared for:
Federal Transit Administration
June 19, 2000

VOLUME I NARRATIVE

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Long Slip Canal Habitat Creation Project
Hoboken/Jersey City, NJ

Final Environmental Impact Assessment
And Section 4(f) Evaluation

Prepared for

Federal Transit Administration

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July 27, 2000

FINDING OF NO SIGNIFICANT IMPACT/SECTION 4(F) FINDING
Long Slip Canal Habitat Creation Project
in
Hoboken/Jersey City
New Jersey

INTRODUCTION

Based on the *Final Environmental Assessment for the Long Slip Canal Habitat Creation Project* (the Project), dated June 2000, and the *Final Section 4(f) Statement for the NJ Transit Long Slip Habitat Creation Project*, dated March 2000, the Federal Transit Administration (FTA) finds, in accordance with "23 CFR 771.121" that there are no significant impacts on the environment associated with the project. The FTA also approves the Section 4(f) evaluation for the Project in accordance with "23 CFR 771.135".

PROJECT DESCRIPTION

The Long Slip Canal Habitat Creation Project consists of five elements:

- Filling of the Long Slip Canal – this will provide 4.6 acres of new land that will facilitate the Hoboken Yard expansion and reorganization.
- Upgrading the Jersey City combined sewage overflow (CSO) that discharges into the canal – improvements consists of (1) the construction of a new holding tank to reduce sediment and eliminate floatables, and (2) the extension of a new outfall into deeper water.
- Eliminating the Hoboken storm sewers discharging into the canal - the two City of Hoboken CSOs that discharge into the canal will be closed and at the regulators in Observer Highway and the lines will be connected to a reconstructed outfall located offsite north of the Hoboken Terminal as part of a separate project undertaken by the North Hudson Sewer Authority.
- Constructing a 1,000-feet long by 30-feet wide, pile supported pedestrian/bicycle walkway across the canal entrance basin to provide access to the Hudson River Waterfront.
- Creating a 26.1 acres fish habitat by improving the canal water quality.

Construction is expected to occur over 24 months. The estimated total project cost is $35 million.

ALTERNATIVES EXAMINED

A. Long Slip Canal

In addition to the Long Slip Canal fill, the EA contains an assessment of the following alternatives: a no-build alternative, the renovation of the bulkhead, the annexation of adjacent properties, a new satellite storage yard, and the decking the Long Slip Canal.

The filling of the Long Slip Canal was selected as the preferred alternative because it satisfies the following objectives:

- Expand the useable rail yard area by 10 acres by connecting lands isolated by the canal;
- Allows for the rearrangement or addition of tracks;
- Elimination or minimization of stub-end tracks in favor of tracks with connections at both ends;
- Expansion of train storage (there will be room to accommodate 62-67 trains during midday hours).

B. Walkway

Three walkway configurations were developed and evaluated to determine the optimal configuration for rail yard use, public access, and integration with the sewer system improvements and the Hudson/Bergen Light Rail System Station. The alternatives examined were the following:

(a) *Alternative 1* proposes a 950-foot long on-grade walkway that is fully integrated with the HBLRTS station. Only the southernmost 100 feet where the walkway crosses the canal entrance berm would be on fill. The walkway will have direct access to the HBLRTS station and will contain pedestrian plazas.

(b) *Alternative 2* proposes approximately 55,000 cubic yards of fill to create 1.7 acres of land available for rail yard use. The 950-foot long walkway will be constructed on a rip-rapped dike.

(c) *Alternative 3* proposes 7[illegible],000 cubic yards to fill the dike and create 3.1 acres of land.

While Alternative 1 offers the least engineering and environmental benefits, it was selected as the preferred alternative because it provides the least alteration of open waters.

OPPORTUNITY FOR PUBLIC COMMENT

The public has been afforded adequate opportunity to comment on the proposed Long Slip Canal Habitat Creation Project. A *Notice of Document Availability* for the draft Environmental Assessment and Section 4(f) Evaluation for the Long Slip Canal Habitat Creation Project was advertised in local newspapers on March 31 and April 17, 2000, in the *Jersey Journal, The Star Ledger, La Voz* and *The Bergen Record* newspapers. The document was available for review in four Jersey City and Hoboken libraries, NJ Transit headquarters, and FTA's Region 2 Office.

Copies of the document were also provided to the Hoboken and Jersey City planning officials. The 30-day public comment period expired without receipt of any public comment on the Project.

ENVIRONMENTAL IMPACTS AND MITIGATION

NJ Transit will implement all mitigation measures described in the Final Environmental Assessment and the 4(f) Evaluation for the proposed action. The FTA will require that all committed mitigation be implemented according to the final EA and 4(f) Evaluation. The FTA will require that NJ Transit periodically submit written reports on their progress in implementing the mitigation commitments. The FTA will monitor this progress through quarterly review of the final engineering and design and the construction of the proposed action.

A brief summary of the potential impacts and mitigation measures to be implemented for the proposed action follows.

A. Land Acquisition and Displacement

Impacts:

- A 50-foot wide strip in the canal entrance basin north of the pile field will be obtained from the abutting owner in the south, Harbor Development Corporation, in order to construct the walkway.
- A 7,500-foot easement along the north boundary of the Newport Center property will be needed for the Jersey City Sewer extension.

Mitigation Measure:

- NJ Transit has the right of eminent domain and any future development of the Newport Center property will be required by the NJDEP to connect to the Hudson River Waterfront Walkway. The new sewer connection could serve as that public connection.

B. Water Quality

Impacts:

- Existing outfalls for Jersey City and Hoboken CSOs (Combined Sewers Overflow) will be extended into the canal entrance basin.

Mitigation Measures:

- CSOs Improvements - The Jersey City and the Hoboken Park Street CSOs will be improved by a net to recover floatables, an in-line storage tank to capture sediment, and repairs to the tide gate. The outfall will be extended to the canal entrance basin where the waters will have a greater potential for rapid dispersion and flushing.
- Alterations to the shoreline and bottom to improve circulation, flushing, and vertical mixing.

- NJ Transit will establish a monitoring program to ensure effectiveness of the habitat creation program following construction. The program will focus on water quality parameters.

C. Wetlands

Impacts:

- Filling will eliminate up to 4.6 acres (area of canal fill) of subtidal waters.
- Up to 5.6 additional acres of surficial sediments will be excavated from the entrance basin.
- Filling of the canal, excavation of the shoal, and the alignment of the walkway will alter the shoreline alignment and bottom topography.

Mitigation Measure:

- Creation of offsite compensatory tidal wetlands at a mitigation bank in the project vicinity.

D. Stormwater

Impact:

- The confined disposal facility (CDF) will increase the volume of runoff generated from the site.

Mitigation Measure:

- Stormwater from the walkway and runoff from over 20 acres of the rail yard that now discharges directly to the canal will be conveyed through oil and sediment separators.

E. Historic Properties

Impact:

- The filling in of the canal will have an adverse effect upon the Old Main, Delaware, Lackawanna and Western Railroad Historic District, a property eligible for inclusion in the National Register of Historic Places.

Mitigation:

- A Memorandum of Agreement for the project implementation was fully executed among FTA, the Army's Corps of Engineers, the NJ SHPO, the Advisory Council on Historic Preservation and NJ Transit in June 1999 with the following two stipulations mitigating the adverse effect of the canal filling:

    1. NJ Transit shall include specific written and photographic documentation relating to the history and function of the Long Slip Canal in the Historic American Building

Survey/Historic American Engineering Record documentation of Hoboken Yard, to be reviewed by the State Historic Preservation Office (SHPO).

2. In consultation with SHPO, NJ Transit will create an interpretive exhibit describing the history and significance of the Long Slip Canal and the adjacent Delaware, Lackawanna, and Western Railroad passenger and freight yards.

F. Construction

1. Disruption of utilities

Impact:

- Disruption of the Jersey City, Hoboken, and PATH CSOs discharges

Mitigation Measure:

- In order that the Jersey City, Hoboken, and PATH CSOs can continue operating until construction of the extended lines and treatment equipment are completed, canal filling will be phased.

2. Water Quality and Runoff

Impact:

- Water quality may be impacted through erosion and sedimentation resulting from the exposure of site soils during excavation and from transportation, stockpiling and placement of fill materials.

Mitigation Measures:

- The Hudson County Extension of the National Resources Conservation Service (NRCS) will be notified prior construction.
- A soil erosion and sediment control plan will be developed and approved by the NRCS for areas adjacent to the canal that will be disturbed and for staging areas where materials may be stockpiled.
- Most of the material will be transported by rail or barge to minimize trips and exposures.
- During the canal filling operations, a boom-enclosed lock system will be used to contain suspended sediments. Water quality of the lock system will be monitored continuously.

Also, a Section 4(f) Evaluation for the proposed project was required because the project has an adverse effect on the historical character of the Old Main, Delaware Lackawanna and Western Railroad Historic District (OMDLW). The Section 4(f) Evaluation outlines the use of the proposed action of Section 4(f) properties, the avoidance alternatives, and the measures to minimize harm to the impacted historic district. The Section 4(f) Evaluation was provided to the

Department of Interior (DOI) for review, and in an August 14, 1998, letter to FTA the DOI concurred that there is no prudent and feasible alternative to the proposed action.

Based on the discussion in the Section 4(f) Evaluation and the DOI's comments, the FTA has found that there is no prudent and feasible alternative to the use of Section 4(f) resources, and that all possible planning to minimize harm to the Section 4(f) resources has been incorporated into the action.

FINDING

The Federal Transit Administration has reviewed the EA and the Section 4(f) Statement for the Long Slip Canal Habitat Creation Project and has found that there are no significant impacts to the environment as a result of the proposed project. The EA has adequately addressed the environmental issues and impacts of the proposed project, as well as appropriate mitigation measures. In addition, the FTA finds that the Section 4(f) Statement provide sufficient analyses for determining that there are no feasible and prudent alternatives to the Project, and that all possible planning to minimize harm to the environment have been done.

The EA is consistent with 23 CFR Part 771 and FTA Circular 5620.1 Guidelines for Preparing Environmental Assessments. As such, the FTA is issuing a Finding of No Significant Impact (FONSI) for the Project. This FONSI is conditioned upon NJ Transit complying with the mitigation measures described in this FONSI and the EA.

Approved: Letitia A. Thompson — Date: 6/22/00

Letitia A. Thompson
Regional Administrator

FEDERAL TRANSIT ADMINISTRATION'S
SECTION 4(F) FINDING
LONG SLIP CANAL HABITAT CREATION PROJECT
HOBOKEN/JERSEY CITY
NEW JERSEY

Based upon our review of the *Final Environmental Assessment and Section 4(f) Statement for* the Long Slip Canal Habitat Creation Project, and the comments received from the U.S Department of Interior, the Federal Transit Administration finds that there is no prudent and feasible alternative to the proposed project and that NJ Transit has considered all reasonable avoidance alternatives to minimize harm to the historic resources within the study area.

This finding is subject to NJ Transit adhering to the mitigation measures specified in the *Final Environmental Assessment for the Long Slip Canal Habitat Creation Project* (the project), dated June 2000, and the *Final Section 4(f) Statement for the NJ Transit Long Slip Habitat Creation Project*, dated March 2000.

By: Letitia Thompson
Letitia Thompson
Regional Administrator

Date: 06/22/00

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BACKGROUND

NJ Transit owns and operates the historic Hoboken Rail Terminal located on the Hudson River waterfront and served by the 54-acre Hoboken rail yard. The Terminal is a major intermodal transfer station linking 30,000 commuters between Manhattan jobs and urban and suburban communities in 13 New York and New Jersey counties. Approximately 85 commuter trains operate from the yard, making about 400 daily trips. The Hudson-Bergen Light Rail Transit system now under construction will site a terminal at the east end of the canal. Other public transportation services that terminate at the Hoboken facility include the Port-Authority Trans-Hudson (PATH) train, the Trans-Hudson ferries, and various bus lines. The yard supports light equipment inspection and maintenance, train washing and fueling. Since its conversion from largely freight to completely passenger service approximately 40 years ago, the yard has not been expanded or substantially reorganized, in spite of the very different traffic demands of passenger service.

Within the next 5 to 13 years (2002 to 2010), several projects now under planning or construction will nearly double the peak rate of trains entering and leaving the terminal. Even under the existing traffic demands, the Hoboken terminal is experiencing operational and infrastructure problems that require attention. Succinctly, the major problems entail a shortage of train handling and storage space, poor juxtaposition of facilities, and the consequent inability to physically and financially operate trains efficiently.

The Long Slip canal penetrates the yard approximately 80 feet north of its southernmost boundary. The canal is 100 feet wide by 2,000 feet long and 10 to 14 feet deep. It covers approximately 5 acres. The canal isolates the passenger yard from the southern section, that is 80 feet wide and contains about 4 fallow acres. The Long Slip was created c. 1870 so that lighters could be used in the loading/unloading of materials, but the canal has not been used for navigational purposes for over 30 years. The canal empties into the canal entrance basin, an area that is about 300 feet by 1,500 feet (8.6 acres) and is the northern quarter of a 37-acre interpier area.

NJ Transit commissioned several studies that assessed the water quality, sediment characteristics, biological baseline and hydrology of the canal and the entrance basin. These revealed that:

- Canal waters are a highly degraded habitat capable of supporting only limited aquatic species that are adaptable to impoverished conditions. No fish or crabs were found.

- Dissolved oxygen is too low to support diverse life, biological oxygen demand (BOD) levels are extremely high, fecal coliform counts are high, and the area is beset by decomposition gases releasing sediment-trapped oils into the water column.

- Circulation within the canal and the canal entrance area is nearly stagnant; canal waters receive minimal tidal flushing and are virtually unaffected by the hydraulic flow of the river.

- The CSO discharge waters are neither well-dispersed nor well-oxygenated as they are discharged into waters already oxygen-depleted by anaerobic bottom sediment decomposition.

- Canal waters that do reach the canal entrance basin area degrade those waters.

- Canal sediments are suitable for land-based disposal, under NJ soil clean-up standards.

NEEDS AND OBJECTIVES

The driving objective of this project is cost-effectively developing facilities to enable NJ TRANSIT to efficiently store and maintain increased Hoboken train operations resulting from system expansions now under construction or planned for the near future. Internal analysis of these studies by NJ TRANSIT revealed that the facilities at Hoboken require:

- Expand the useable rail yard area by 10 acres through filling Long Slip Canal, thereby utilizing that space and connecting lands isolated by the canal;

- Rearranged and/or additional tracks (to efficiently handle over 40 train movements per hour);

- The elimination or minimization of stub-end tracks in favor of tracks with connections at both ends.

- Expanded train storage spots (to accommodate in the range of 62-67 trains during midday hours);

- A running repair shop and a new enclosed wheel truing facility (with minimum width of 30 feet and length of 380 feet); Materials storage areas, personnel welfare facilities (lockers, showers, etc.); and,

- Improved roadways for materials delivery, worker circulation, and emergency response vehicle access.

In addition to responding to the rail yard needs, the project seeks to address the environmental needs revealed by the baseline studies. Specifically, the project's environmental objectives are:

- Improve point discharges to meet or exceed minimum standards of the NJDEP New Jersey Pollutant Discharge Elimination System General Permit for Combined Sewer Systems issued January 27, 1995 (NJDEP General Permit);

- Control non-point source pollution;

- Accept dredged material at a confined disposal facility to offset project costs;

- Create new habitat for fish species of local and regional concern; and,

- Increase public access and commuter services consistent with the Hudson River Waterfront Walkway.

PROPOSED PROGRAM

The proposed alternative was selected because of the cost-effective attainment of multiple objectives. Major components of the proposed program include:

1. ***Create a confined disposal facility (CDF).*** Long Slip canal will be filled behind a containment dike across the entrance with 150,000 cubic yards (cv) of dredged sediment or other suitable fill material. This will provide 4.6 acres of new land within the Hoboken yard to facilitate rail yard expansion and reorganization.

2. ***Upgrade the Jersey City CSO that discharges into the canal.*** The existing CSO will be upgraded by the construction of a new holding tank to reduce sediment and eliminate floatables, and by the extension to a new outfall in deeper water greatly improving water quality. These upgrades will eliminate dry weather flows, reduce the load of pollutants in the discharge, control its dispersion, and reduce backflow into the sewer system. The measures will improve the CSO beyond the minimum improvements needed to comply with the US Environmental Protection Agency's 1995 Final CSO Control Policy enforced through the NJDEP New Jersey Pollutant Discharge Elimination System General Permit for Combined Sewer Systems issued January 27, 1995.

3. ***Eliminate Hoboken storm sewers discharging into the canal.*** The two City of Hoboken CSOs (known as H0 and H1) that cross the rail yard and discharge into the canal and canal entrance basin, respectively, will be closed at the regulators in Observer Highway. The lines will be connected to a reconstructed outfall located offsite north of the Hoboken terminal as part of a separate, independent project undertaken by the North Hudson Sewer Authority (NHSA). NJ Transit will support this NHSA stormwater and flood management project by funding the construction of approximately 2,000 linear feet of 6' by 12' sewer along Observer Highway at an estimated cost of $13MM. NHSA will be responsible for the design, construction and permitting of the new regulator, outfall and floatable removal devices.

4. ***Construct and provide access to a segment of the Hudson River Waterfront Walkway***. A nearly 1,000-foot long, 30-foot wide, pile-supported pedestrian/bicycle promenade will be constructed across the canal entrance basin. This walkway will introduce public access to the waterfront and recreational activity along a scenic part of the river where no access currently exists. Other components of the walkway could include interpretive and educational displays.

5. ***Create new aquatic habitat***. New and restored habitat for diverse fish, particularly juveniles, and invertebrate species will result from improvements to the water quality, hydrography, and physical characteristics of the 26.1 acres Habitat Creation Area that includes 7.0 acres of open piles. About 11.1 acres of adjacent interpier waters that include 3.8 acres of open piles are expected to receive "spill-over" benefits. Approximately 80,000 cy of sediments will be removed from the canal basin entrance to restore circulation in the canal entrance basin and the adjacent pile field. This restored circulation, combined with the reduced pollutant loads and the elimination of 12.8 acres of sediment oxygen demand (from canal plus canal entrance

basin) will substantially improve local dissolved oxygen and salinity to levels that are favorable to many fish species that presently are absent. Species populations and diversity also will benefit from the removal of biohazards now accessible to bottom-dwelling and spawning aquatic populations. The rip rap armor used for the containment berm will provide new substrate for attachment of food species and crevices for shelter. These measures fully support the objectives of Essential Fish Habitat protection stated in Fisheries Management Plans developed under the amended Magnusen-Stevens Act.

ALTERNATIVES ANALYSIS

Numerous alternatives to meet the current and projected operational and maintenance needs were developed in several previous study efforts (NJ TRANSIT, 1981; 1992; 1995d; 1997). NJ Transit evaluated several alternative expansion plans that included: renovating the bulkhead, constructing a deck over the canal, acquiring adjacent land, developing a satellite facility, and the proposed project. Of those alternatives, only an alternative involving the filling of Long Slip Canal was concluded to effectively satisfy project objectives while avoiding or minimizing adverse environmental, social, or economic impacts. All except for the proposed project were rejected because they were not fiscally prudent, not available, or had greater environmental impacts. The Proposed Project (Build Alternative) offers the lowest cost, greatest present and future efficiency and the greatest environmental benefit.

SUMMARY OF ENVIRONMENTAL IMPACTS

Post-construction impacts of the Proposed Project will consist of the filling of 4.6 acres of highly degraded subtidal lands and the extension to Jersey City combined sewer outfall into the canal entrance basin. In addition, the State Historical Preservation Office (SHPO) determined that filling the canal will adversely affect the Old Main Delaware, Lackawanna and Western Historic District.

The mitigation program consists of comprehensive measures to improve water quality. These measures address point and non-point discharges, circulation and flushing. Three-dimensional modeling predicts that resultant dissolved oxygen levels in the 37-acre canal entrance basin and interpier area creating habitat for several federally-managed fish species where none now exists. In addition, NJ Transit will purchase 9.1 acres of tidal wetlands at the Marsh Resources Inc. mitigation bank. Cultural resources impacts will be mitigated through a Memorandum of Agreement between SHPO, the proponent and regulating agencies. Overall, the project results in a net environmental benefit.

I. PROJECT SUMMARY

A. INTRODUCTION

The Long Slip Canal Habitat Creation Project is a key element of NJ TRANSIT's Hoboken Terminal Expansion and Rehabilitation Project for the terminal and rail yard located in Hoboken/Jersey City, New Jersey (see Figure I-1 and Figure I-2). The objectives of this project are to:

- expand the useable rail yard area by 8.3 acres through filling the 4.6 acres of Long Slip Canal thereby utilizing that space and connecting lands isolated by the canal;
- increase public access and commuter services; and,
- make to water quality and the estuary improvements commensurate with the resulting impacts.

This document is a Final Environmental Assessment and Section 4(f) Evaluation (EA). It has been prepared by NJ TRANSIT for the Federal Transit Administration (FTA) pursuant to the National Environmental Policy Act of 1969 (NEPA)., as amended, and in accordance with the Council on Environmental Quality regulations implementing NEPA (40 CFR part 1500), FTA's Environmental Impact and Related Procedures (49 CFR part 622); and the Urban Mass Transportation (the predecessor of FTA) Circular 5620.1 Guidelines for preparing Environmental Assessments." The Draft EA was filed on March 29, 2000, after the thirty-day public comment period, during which no comments were received, the FTA issued its' Finding of No Significant Impact on June 22, 2000.

B. PROPOSED PROJECT

The proposed project is designed to benefit NJ TRANSIT through the creation of 4.6 acres of new land providing critical area to improve capacity and operational efficiency entirely within existing site bounds and bringing the southernmost 3.7 acres of the yard (Yard A), now lying fallow, into productive use (a total of 8.3 "new" acres). The proposed project actually has the least costs because capitol expenses required to rehabilitate Long Slip bulkheads are avoided. Additionally, construction and maintenance costs may be offset by fees for the disposal of off-site dredged materials, if selected for fill, and from revenue generated by potential public amenities.

The mitigation plan uses an ecosystem approach to comprehensively address local and regional water quality problems with the objective of creating sustainable fish habitat where none could otherwise exist. Environmental benefits will include the restoration of interpier fisheries habitat and improved water quality. Finally, the Port of New York can also benefit from the safe re-use of dredged materials not suitable for ocean disposal.

As, the project proposed involves five distinct elements described below:

1. ***Create a confined disposal facility (CDF).*** Long Slip canal will be filled behind a containment dike across the entrance with 150,000 cubic yards (cy) of dredged sediment or other filled material. This will provide 4.6 acres of new land within the Hoboken yard to facilitate rail yard expansion and reorganization. It also will collect and treat non-point contaminants from yard runoff.

2. ***Upgrade the Jersey City CSO that discharges into the canal.*** The existing CSO will be upgraded by the construction of a new holding tank to reduce sediment and eliminate floatables, and by the extension as a 10' by 12' line to a new outfall in deeper water greatly improving water quality.

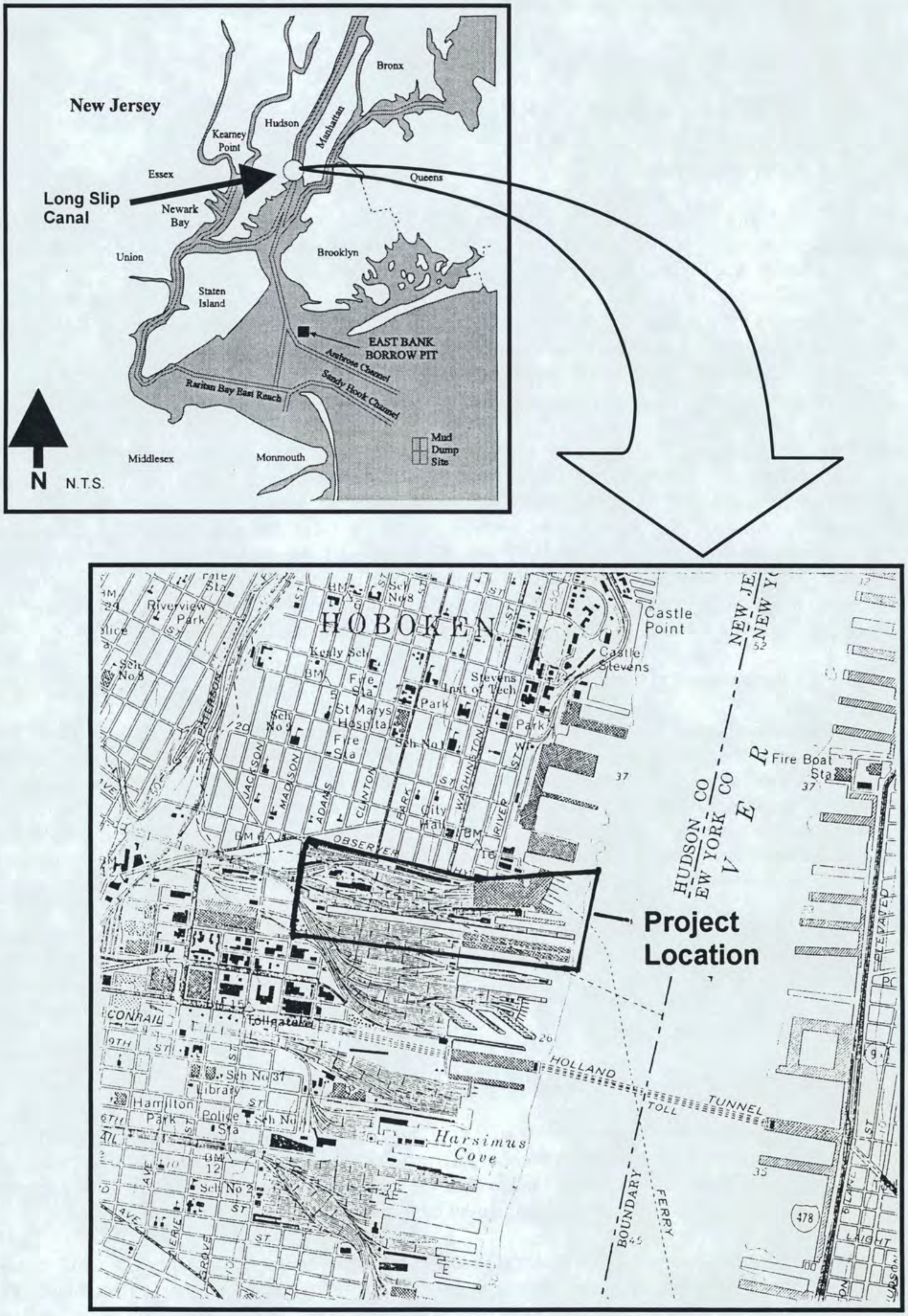

Figure I-1 - Vicinity Map

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View to northeast of Habitat Creation Area

View to east of canal and rail yard

Figure I-2 Aerial photographs of Long Slip Canal

These upgrades will eliminate dry weather flows, reduce the load of pollutants in the discharge, control its dispersion, and reduce backflow into the sewer system. The measures will improve the CSO beyond the minimum improvements needed to comply with the US Environmental Protection Agency's 1995 CSO Control Policy enforced through the NJDEP New Jersey Pollutant Discharge Elimination System General Permit for Combined Sewer Systems issued January 27, 1995.

3. ***Eliminate Hoboken storm sewers discharging into the canal.*** The two City of Hoboken CSOs (known as H0 and H1) that cross the rail yard and discharge into the canal and canal entrance basin, respectively, will be closed at the regulators in Observer Highway. The lines will be connected to a reconstructed outfall located offsite north of the Hoboken terminal as part of a separate, independent project undertaken by the North Hudson Sewer Authority (NHSA). NJ Transit will support this NHSA stormwater and flood management project by funding the construction of approximately 2,000 linear feet of 6' by 12' sewer along Observer Highway at an estimated cost of $13MM. NHSA will be responsible for the design, construction and permitting of the new regulator, outfall and floatable removal devices.

4. ***Construct and provide access to a segment of the Hudson River Waterfront Walkway***. A nearly 1,000-foot long, 30-foot wide pedestrian/bicycle promenade will be constructed along the canal entrance basin and across the canal berm. This walkway will introduce public access to the waterfront and recreational activity along a scenic part of the river where no access currently exists. Other components of the walkway could include interpretive and educational displays.

5. ***Create new aquatic habitat***. New and restored habitat for diverse fish, particularly juveniles, and invertebrate species will result from improvements to the water quality, hydrography, and physical characteristics of the 26.1acres Habitat Creation Area that includes 7.0 acres of open piles (see Figure I-3). About 11.1 acres of adjacent interpier waters that include 3.8 acres of open piles are expected to receive "spill-over" benefits. Approximately 80,000 cy of sediments will be removed from the canal basin entrance to restore circulation in the canal entrance basin and the adjacent pile field. This restored circulation, combined with the reduced pollutant loads and the elimination of 12.8 acres of sediment oxygen demand (from canal plus canal entrance basin) will substantially improve local dissolved oxygen and salinity to levels that are favorable to many fish species that presently are absent. Species populations and diversity also will benefit from the removal of biohazards now accessible to bottom-dwelling and spawning aquatic populations. The rip rap armor used for the containment berm will provide new substrate for attachment of food species and crevices for shelter. These measures fully support the objectives of Essential Fish Habitat protection stated in Fisheries Management Plans developed under the amended Magnusen-Stevens Act.

   In conjunction with on-site habitat creation, NJ TRANSIT will purchase 9.1 acres of tidal wetlands,at the Marsh Resources, Inc. mitigation bank in the Hackensack Meadowlands. Wetlands will provide water quality benefits to the estuary through sediment and nutrient attenuation, as well as aquatic habitat. Additionally, the construction and development of this wetlands has educational and outreach potential.

Table I-1 summarizes the alterations and mitigation measures proposed and the area affected by each. The total area of mitigation comprises between **483 and 553** acres, a ratio of at least 35:1 to the altered area.

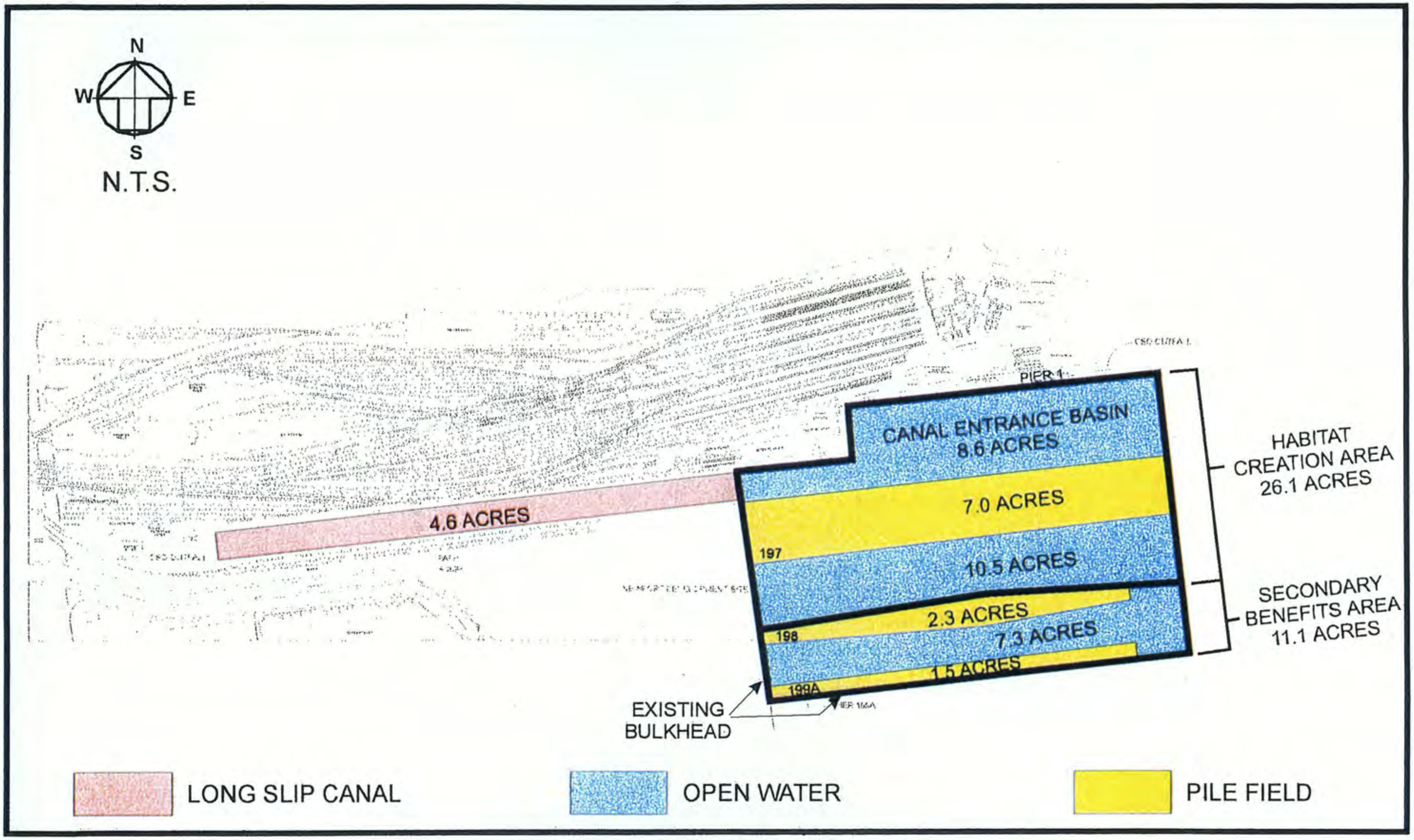


Figure I-3-Canal and Interpier Area

Table I-1 Summary of Alteration and Mitigation Acreage

Activity	Acreage Improved
Alterations	
Canal (filling)	4.6
Excavation	4.1
Total Alteration	**8.7**
Mitigation Measures	
Created fish habitat	26.1
Improved circulation and DO levels	11.1[(a)]
Improved substrate for shelter and food sources	0.1
Isolation of contaminated bottom sediments	36-106[(b)]
Removal of CSO dry weather overflows, floatables, and sediment	>381[(c)]
Controlled non-point source discharge	19
Terrestrial habitat (landscaping)	<1
Compensatory wetlands	9.1
Total Mitigation	**483-553**
Net Improvement	**475-545**

Notes to Table I-1
(a) Adjacent and remaining portions of the 37-acre interpier area.
(b) Equivalence of volume contained by CDF to bottom sediment removal depths of 1 to 4 feet, plus project acreage.
© City of Hoboken sewer maps are incomplete regarding the total area contributory to the storm sewer outfall in Long Slip Canal and the canal entrance basin. The Jersey City CSO drainage is 381 acres.
(d) Wetlands would be established off-site

C. NEED AND OBJECTIVES

NJ TRANSIT owns and operates the historic Hoboken Rail Terminal located on the Hudson River waterfront and served by the 54-acre Hoboken rail yard. The Terminal is a major intermodal transfer station linking 30,000 commuters between Manhattan jobs and urban and suburban communities in 13 New York and New Jersey counties. Approximately 85 commuter trains operate from the yard, making about 300 daily trips. The yard supports light equipment inspection and maintenance, train washing and fueling. Since its conversion from largely freight to completely passenger service approximately 40 years ago, the yard has not been expanded or substantially reorganized, in spite of the much different traffic demands of passenger service. Other public transportation services that terminate at the Hoboken facility include the Port-Authority Trans-Hudson (PATH) train, the Trans-Hudson ferries, and various bus lines.

Within the next 5 to 13 years (2002 to 2010), several projects now under planning or construction will nearly double the peak rate of trains entering and leaving the terminal. Even under the existing traffic demands, the Hoboken terminal is experiencing operational and infrastructure problems that require attention. Succinctly, the major problems entail a shortage of train handling and storage space, poor juxtaposition of facilities, and the consequent inability to physically and financially operate trains efficiently. In addition, Long Slip itself is deteriorating and is in need of restoration. The importance of the Hoboken terminal to regional commuters and the consequent need to maintain adequate capacity and efficient, reliable service has prompted the multi-million dollar yard and terminal renovation program that will be facilitated by the proposed alterations to Long Slip.

Finally, the Hudson Bergen Light Rail Transit (HBLRT) system now under construction proposes a terminal at the Hoboken yard. The terminal will be an elevated pile-supported structure located in the canal entrance basin. Tracks accessing the terminal will cross Long Slip Canal via a pile-supported bridge. That project is proceeding as a separate utility. Applications for a Corps of Engineers Department of the Army Permit and an NJDEP Waterfront Development permit were filed on October 17, 1997. The design, timing, and construction sequence of the Long Slip Habitat Creation Project will consider and will accommodate the HBLRT terminal.

D. PROJECT SETTING

The Long Slip is a man-made canal penetrates the yard approximately 80 feet north of its southernmost boundary. The canal is 100 feet wide by 2,000 feet long by 10 to 14 feet deep, trending east-west, and covers approximately 5 acres. It splits the yard into two unequal sections: all passenger and train activity occurs on a 400-foot wide segment of the property lying to the north; the southern section, which is 80 feet wide and covers about 4 acres, is unused. The Long Slip was created c. 1870 so that water borne lighters could be used in the loading/unloading of materials by crane as part of the freight operations of the former Delaware, Lackawanna & Western (DL&W) railroad. The last recorded docking was in the 1950's. Now the slip handles only the discharge of a storm sewer and a combined sewage overflow (CSO), and is no longer used for any navigational or other purposes. All cargo and freight off-loading equipment have been removed and there is no foreseeable maritime use.

NJ TRANSIT commissioned several studies that assessed the water quality, sediment characteristics, biological baseline and hydrology of the canal and the entrance basin. These revealed that:

- Canal waters are a highly degraded habitat capable of supporting only limited aquatic species that are adaptable to impoverished conditions. No fish or crabs were found.
- Dissolved oxygen is too low to support diverse life, biological oxygen demand (BOD) levels are extremely high, fecal coliform counts are high, and the area is beset by decomposition gases releasing sediment-trapped oils into the water column.
- Circulation within the canal and the entrance area is nearly stagnant; canal waters receive minimal tidal flushing and are virtually unaffected by the hydraulic flow of the river.
- The CSO discharge waters are neither well-dispersed nor well-oxygenated as they are discharged into waters already oxygen-depleted by anaerobic bottom sediment decomposition.
- Canal waters that do reach the canal entrance basin area degrade those waters. Biological common livings especially fish are depauperate compared to similar settings in the vicinity.
- Oxygen demanding canal sediments are suitable for land-based disposal, under NJ soil clean-up standards.

E. ALTERNATIVES SCREENING

Numerous alternatives to meet the current and projected operational and maintenance needs were developed in several previous study efforts (NJ TRANSIT, 1981; 1992; 1995d; 1997). Internal analysis of these studies by NJ TRANSIT revealed that the ideal facilities at Hoboken require:

- Rearranged and/or additional tracks (to efficiently handle over 40 train movements per hour);
- The elimination or minimization of stub-end tracks in favor of tracks with connections at both ends.
- Expanded train storage spots (to accommodate in the range of 62-67 trains during midday hours);
- More generous track spacing (14 feet on center, to facilitate train servicing and repairs);
- A running repair shop.
- A new enclosed wheel truing facility (with minimum width of 30 feet and length of 380 feet); Materials storage areas, personnel welfare facilities (lockers, showers, etc.); and,
- Improved roadways for materials delivery, worker circulation, and emergency response vehicle access.

A total of seven alternative schemes underwent initial screening. Specifically, these included:

- *Alternative 1 - No-Build:* This alternative maintains the "status quo". There will be no significant reorganization of the yard, only maintenance and repair of existing facilities.

- *Alternative 2 - Reorganization within Yard B:* Under this alternative, the rail yard will be reorganized within its existing boundaries. No additional land will be used or acquired. Two schemes, 2a and 2b, were developed under this scenario.

- *Alternative 3 - Annexation of adjacent property*: Under this alternative, adjacent private property would be condemned and annexed to accommodate an expanded rail yard. Given the intensive development in Hoboken, north of the project site, only property in Jersey City immediately south of the yard was considered;

- *Alternative 4 - Use of non-contiguous property at a remote location*: Under this alternative, a 6-acre satellite facility would be developed on railroad lands west of the Hoboken Terminal.

- *Alternative 5 - Use of property occupied by Long Slip Canal*: Under this alternative, the rail yard would be expanded over the land now occupied by the canal. The two scenarios evaluated were:
  5A. Bridging Long Slip Canal; and,
  5B. Filling Long Slip Canal.

The results of the initial screening are summarized in Table I-2 below. Of those alternatives screened, only an alternative involving the filling of Long Slip Canal was concluded to effectively satisfy those objectives while avoiding or minimizing adverse environmental, social, or economic impacts. Alternative 5B offers the lowest cost, greatest present and future efficiency and the greatest environmental benefit, and was developed into the Proposed Project (Build Alternative).

Table I-2 Summary of Alternatives Screening

Criteria	Alternative						
	No Build	Reorg/No expansion		Annex Land	Satellite Yard	Deck Long Slip	Fill Long Slip
	1	2A	2B	3	4	5A	5B
Capital Cost ($M) [(a)]							
Bulkhead repair	10.9	10.9	10.9	10.9	10.9	10.9	0
Waterfront walkway	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Rail bridge	3.2-7.2	3.2-7.2	3.2-7.2				
Other						50.3	8.5
Revenue Offset from CDF							(3.2)
Total	11.5	14.7-18.7	14.7-18.7	14.7-18.7	11.5	61.8	5.9
Annual Operating Cost ($K)							
Hoboken facilities	41	46-59	46-59	46-59	41	108	6
Other					6,384		
Flexibility to Meet Future Needs	Low	Low	Low	Medium	Medium	High	High
Adequacy of Trackage							
2002 Supply							
In yard(s)	38	62	57	64	64	62	62
At platforms [(b)]	7	7	7	7	7	7	7
2002 Demand	50	50	50	50	50	50	50
Excess/(Shortfall)	(5) [(c)]	19	14	21	21	19	19
2010 Supply							
In yard(s)	38	62	57	64	64	62	62
At platforms [(b)]	3	3	3	3	3	3	3
2010 Demand	67	67	67	67	67	67	67
Excess/(Shortfall)	(26) [(c)]	(2)	(7)	0	0	(2)	(2)
Trains on Stub-End Tracks	12	51	21	12	12	29	29
Long Slip Encroachment (KSF)							
Displacement	4.0	4.5 - 9.0	4.5 - 9.0	4.5 - 9.0	4.0	5.0	200.0
Shading	4.2 - 6.2	4.2 - 6.2	4.2 - 6.2	0	NA	196.0	0 - 1
Institution Feasibility	None	None	None	None	Low	Low	High
Environmental Mitigation							
Walkway Alternative	1	1	1	1	NA	1	1, 2, 3
Habitat restoration or new wetlands	No	No	No	No	No	No	Yes
Holding tank & extension of CSO.	No	No	No	No	No	No	Yes
Disposal of dredged materials.	No	No	No	No	No	No	Yes

Notes to Table I-2

(a) Certain additional costs are likely to be incurred but are not included in this summary. These costs are acknowledged below:
- Costs of yard track and other facility reconfiguration/construction at or adjacent to Hoboken or at a remote site. (Applicable to all but Alternative #1).
- Costs of land acquisition at adjacent or remote yard sites. (Applicable to Alternatives #3A and 3B).
- Costs of partial filling or decking of the western end of the Long Slip, (and associated extension of CSO), to accommodate potential shift of repair shop. An estimate for filling 25 percent of the slip is an additional $4.3 million. (Applicable to Alternatives #2a, 2b, and 3a).

(b) The value of these positions is subject to diminution pending a decision on construction of high-level platforms.

(c) The shortfall of train storage facilities could be even higher than indicated here (by 7 to 10 positions) if indeed "no action" is taken to elongate tracks at the north end of Hoboken Yard so that longer trains required for the Secaucus Transfer operating plan can be accommodated, thus making some of the supply less usable.

F. Evaluation of Environmental Impacts

Impacts to the environment were comparatively evaluated for the No-Build Alternative and the Proposed Project (Build Alternative). Criteria used for the evaluation were those specified for this purpose by the Department of Transportation (UTMA, 1979).

The No-Build Alternative evaluated is not a no-action alternative. Engineering investigation has revealed that the Long Slip bulkhead walls have deteriorated to the extent that costly reconstruction and repair is, in fact, essential (whether or not the yard is modified). The expense of this repair, assuming a simple plan of driving sheet piles (about one foot in front of the existing face of the bulkhead) and backfilling the gaps, is estimated at nearly $11 million (1994 dollars). An annual operating cost of $40,000 for maintenance of the repaired bulkheads is also estimated. The bulkhead repair plan would create a waterway impact of approximately 4,000 square feet. Under this alternative, various off-site tracks and sidings would be used for train storage, requiring considerable "deadheading" movements. This then represents the capital cost of continued operation under existing difficult conditions that will only become increasingly inadequate in future, and lead to operation failure.

The results of this evaluation are summarized in I-2 below. This evaluation revealed that the No-Build Alternative would result in decreased service and high capitol expenditures without environmental benefit. The Build Alternative cost-effectively meets operational objectives while offering considerable environmental improvement.

Table I-3 Summary of Environmental Impacts

Environmental Impact	Significance of Impact (Based on Criteria Specified in by FTA Guidelines)	Explanation	Comments
A. Land acquisition and Displacements	Generally Not Significant	• No displacements will result from implementation	• All land area affected by construction is within the existing Terminal boundaries. • NJ TRANSIT will acquire 2,000 ± SF of submerged land. • NJ TRANSIT will acquire about 5 acres of vacant land for the construction of compensatory wetlands.
B. Land-use and zoning	Generally Not Significant	• Proposed project is compatible with surrounding land use. • Proposed project conforms to zoning requirements, as determined through consultation with the appropriate local agency.	• Project maintains an existing use within the existing site boundaries.
C. Air Quality	Generally Not Significant	• Proposed project is consistent with the State Implementation Plan for air quality. • Proposed Project is compatible the Transportation Control Plan	• Build Alternative supports regional expansion of rail network, reducing automobile emissions. • No-Build Alternative requires deadheading morning commuter trains to alternative off-peak storage location and back to Hoboken for evening commute.
D. Noise	Generally Not Significant	• Increases in noise levels with implementation of the project are projected to be 3 dBA (Leq) or less at noise sensitive sites and the proposed project would not result in violations of noise ordinances or standards.	• The Build Alternative introduces no new rail traffic to the Hoboken terminal. • Noise levels will not be increased. • Yard A moves noise source closer to southern boundary, but no residential receptor for over 400 hundred feet from southern boundary.
E. Water Quality	Possibly Significant	• The Corps of Engineers requires a Section 404 permit but comments that only minor impacts are expected.	• No-Build Alternative offers no water quality improvements. • Under Build Alternative two CSOs will exceed compliance with NJDEP General Permit. • Point and non point loads will be reduced. • Sediment oxygen demand will be removed for 4.6 ac. • Circulation and mixing will be restored. • Summer DO will be >4mg/l in over 98% of the 37-acre entrance basin and interpier area.

Environmental Impact	Significance of Impact (Based on Criteria Specified in by FTA Guidelines)	Explanation	Comments
F. Wetlands	Possibly Significant	• No areas meeting the FTA definition of wetlands occur at the site.	• 4.6 acres of Section 404 wetlands will be filled. • Mitigation measures include: - Hoboken and Jersey City CSOs will be improved in excess of NJDEP General Permit. - Essential Fish Habitat will be created in 26.1 acres of interpier area. - About 9 acres of compensatory wetlands purchased at a mitiagtion bank in the project vicinity.
G. Flooding	Generally Not Significant	• Proposed project, with mitigation measures (if needed) would not increase flooding.	• Flooding is tidal, so downstream areas will not be affected by fill.
H. Navigable Waterways and Coastal Zones	Generally Not Significant	• Proposed project does not affect navigation, according to U.S. Coast Guard.	• All work behind pierhead and bulkhead line. • US Coast Guard requested notification when construction starts.
I. Ecologically Sensitive areas	Possibly Significant	• Proposed project would result in minor impacts on an ecologically sensitive area, as determined by the appropriate agency.	• No-Build Alternative would maintain degraded habitat and depauperate communities. • Build Alternative fills 4.6 ac of severely degraded waters. • Build Alternative water quality improvements create Essential Fish Habitat for fish over 26.1 acres of interpier area. • Build Alternative adds hard substrate that diversifies shelter and food available to fish.
J. Endangered Species	Generally Not Significant	• No threatened or endangered species are located in the proposed project area, according to the U.S. Fish and Wildlife Service or the National Marine Fisheries Service.	• NJ Natural Heritage Program reported no known occurrences of threatened or endangered species. • USFWS determined that the project would not adversely affect any federally-listed species.
K. Traffic and Parking	Generally Not Significant	• Proposed project would result in total traffic volumes of less than 600 vehicles per lane on principal arterial, and 500 vehicles per hour on minor arterioles and collectors.	• Project will not generate new vehicular trips.

Environmental Impact	Significance of Impact (Based on Criteria Specified in by FTA Guidelines)	Explanation	Comments
L. Energy requirements and potential for Conservation	Generally Not Significant	• Proposed project is expected to result in the conservation of energy required to operate transportation.	• Improved operational efficiency is anticipated to reduce energy consumption.
M. Historic Properties and Parklands	Generally significant	• In the Section 106 process, the project would have an "adverse effect" on a property listed in the National Register or eligible for inclusion in the Register.	• The project was determined contributory and to have an "adverse effect" on listed properties. • Mitigation specified by an MOA (currently draft) includes: - written and photographic documentation; and - creation of an interpretive exhibit.
N. Construction	Generally Not significant	• Impacts due to construction would be regulated through a local or state ordinance or through environmental mental specifications in the construction contact. • Construction would result in no violation of local, state or federal air, noise, or water quality standards, • Construction plans would include measures to mitigate disruption of traffic and community services such as utilities. • Construction plans would include measures to mitigate disruption of traffic and community services such as utilities. • Construction would not result in adverse impacts on area's businesses.	• Construction would occur within existing site and would not disrupt surrounding businesses or pedestrian ways. • Rail, bus and ferry operation would not be affected by construction. • Construction would conform to hours permitted by ordinance. • Most materials will be transported by barge or air to avoid traffic impacts. • Short duration construction period.
O. Aesthetics	Generally Not Significant	• Proposed project is compatible with visual character of the surrounding area.	• Build Alternative renovates a blighted waterfront. • Walkway creates new viewing site for harbor and Manhattan skyline.

Environmental Impact	Significance of Impact (Based on Criteria Specified in by FTA Guidelines)	Explanation	Comments
P. Community Disruption	Generally Not Significant	• No displacements would be caused by proposed project. • Neighborhood or community would not be split or altered by project. • Service areas of the community would not be interrupted by project. • Access to community facilities would not be reduced by project. • Existing patterns of circulation would not be disrupted by project. • Cohesion of community would not be altered by the physical or psychological separation of residents or activities; no such "barriers" would be created by project.	• All construction activities will occur within the existing terminal area. • Most material transport will be by barge or air.
Q. Safety and Security	Generally Not Significant	• Proposed project includes adequate provision for safe and secure operations. • Proposed project is expected to reduce auto, transit, and/or pedestrian accidents.	• Project will occur within areas currently not accessible to public. • Access restrictions will be enforced by NJ TRANSIT Security.
R. Secondary development	Generally Not Significant	• Proposed project may generate a demand for secondary development, but evaluation by local planning agencies indicates that, if it occurs, it will likely be desirable and in conformance with adopted public land-use plans. • Displacements would not result from secondary development.	• Project is not anticipated to induce secondary development. • Project will enable the Hoboken terminal to accommodate off-site projects currently under construction so that reliable service may be efficiently maintained.

Environmental Impact	Significance of Impact (Based on Criteria Specified in by FTA Guidelines)	Explanation	Comments
S. Consistency with Local Plans	Generally Not Significant	• Local agencies have determined that the project is consistent with the comprehensive plan and other applicable land-use and transportation plans.	• Build Alternative is consistent with Hoboken and Jersey City
T. Environmental Justice	--	--	• Adjacent low income and minority communities will benefit from reliable transportation and increased public access and recreation space.

II. STATEMENT OF NEED

The purpose of the project is to facilitate the expansion and reorganization of the Hoboken Terminal rail yard. In realizing this objective, the proposed project addresses several distinct needs of the general public and the sponsor, while improving the overall quality of the Hudson River estuary in general and fish habitat in particular. These are described below.

A. TRANSPORTATION

Public transportation is a critical quality-of-life factor in New Jersey. NJ TRANSIT is responsible for local and commuter rail and bus operations throughout New Jersey and into adjoining states. It is charged with providing such public transportation services in an efficient, coordinated, safe, and responsive manner. By doing so, NJ TRANSIT conserves the limited energy resources, expands public mobility, and protects the environment. Further more, it fosters commerce and economic well-being, promotes sound land use and urban center revitalization, and serves the needs of the transit dependent population, accomplishments that cannot be attained unless modern, safe, adequate, and efficient facilities and equipment are available. Maintaining and promoting mass transit infrastructure to harvest these benefits is a local and national public need.

1. DEMANDS ON SYSTEM

One of the most critical elements of the NJ TRANSIT transportation system is Hoboken Terminal, a multi-modal facility located at the Hudson River waterfront. As a center of passenger activity, it ranks ahead of all but one other facility in New Jersey. It is equally as important in terms of train movements. Nine commuter rail lines (offering 287 daily trains) terminate here and interface with ferry service, the Port Authority Trans-Hudson (PATH) rapid transit system, the NJ TRANSIT Bus Depot, and various other bus lines. This network of services links lower and midtown Manhattan with many urban and suburban points in 13 counties of northern and central New Jersey and southern New York State. In New Jersey alone, these counties have a resident population in excess of 5.5 million persons (per 1990 Census).

The importance of this transportation facility will intensify in future years. The Hudson-Bergen light rail transit line (HBLRT), when built over the next several years will serve the complex. More frequent service will operate as a result of the Secaucus Transfer station project now under construction. Under the current configuration, the Hoboken facility is experiencing difficulty in meeting the operational and maintenance requirements of the current demands; it will be physically and financially unable to accommodate the future increases. Additional rail services are being planned, including the introduction of trains along the West Shore corridor in eastern Bergen and Rockland Counties (an area of extremely high automobile use) and along the New York, Susquehanna & Western corridor through Passaic and Sussex Counties. Total fleet requirements associated with Hoboken commuter rail services is estimated to grow from 260 cars (current) to 366 cars (in 2002) and eventually to 485 cars (in 2010). Table II-1 derives this growth by rail corridor.

Table II-1 Basis of Future Fleet Demands - Numbers of Cars Daily

Source	1997	2002	2010	1997-2010 Change (%)
Waterfront Connection Services	27	27	65	140
M&E, Montclair Connection, Boonton	123	147	171	39
Main/Bergen, NYS&W	51	102	110	115
Metro North Services	25	27	29	16
Pascack Valley	34	63	68	100
West Shore Line Service	0	0	42	4200
Total	**260**	**366**	**485**	**87**

Trains move into and out of Hoboken Terminal at a peak rate of 30 trains per hour in the peak direction, using four main approach tracks. Additional trains moving in the reverse direction during this time compete for use of the same trackage. This hourly rate is forecasted to grow to 41 trains over the next decade. (While the Midtown Direct project has diverted a small number of train movements away from Hoboken Terminal, a net increase of train service will occur nonetheless. As more trains are operated on existing rail lines to meet expected customer demand, or on new rail corridors to provide a transit alternative to private auto use.)

In addition to total fleet requirements and peak hour movements, a key capacity and operational requirement is train storage during non-peak times. Peak train storage requirements occur during the midday period and currently total 42 train positions. This number is expected to grow to 50 by 2002 (at the inception of the Secaucus Transfer project) and thereafter to as many as 62 to 71 trainsets (to accommodate passenger growth and service expansions). Table II-2 below indicates the anticipated storage requirements based on planned and proposed system expansions. Since some of the projects below are proposed but may not be funded, a 2010 storage requirement of 62-67 trains is considered conservative and realistic.

Table II-2 Basis of Future Train Storage Demands

Source	1997	2010	Change (%)
Waterfront Connection Services	4	12	200
M&E, Montclair Connection, Boonton	19	24	26
Main/Bergen, NYS&W	9	15	67
Metro North Services	5	6	20
Pascack Valley	5	9	80
West Shore Line Service	0	5	500
Total	**42**	**71**	**69**

2. OPERATIONAL EFFICIENCY

The yard provides for the inbound and outbound movements of NJ TRANSIT trains, the storage of locomotives and cars, and facilities for running repairs, fueling, train washing, and other equipment servicing functions. Five main tracks through the yard cumulatively feed into 18 platform tracks and various yard storage tracks. The platform tracks can be aggregated into three groups that tend to be linked with certain equipment types, rail lines, and yard storage areas. Thus, not all segments of the yard and platforms are universally available, creating less than full flexibility of operations.

Conflicts occur under the existing yard configuration as trains move between yard entry/exit points and platforms and between platforms and storage sites in the yard. Such conflicts cause train delays and decreased service reliability. Flexibility in maneuvering trains to avoid conflicts is reduced by the fact that not all platform tracks are universally connected with all storage areas or with all of the main tracks (i.e., the yard is in effect a conglomeration of marginally overlapping sub-yards). Trains are further restricted to specific tracks and storage sites based on their power needs (diesel vs. overhead electric) and on their lengths. While operating problems are presently minimized through skillful train dispatching, it is evident that the increased train traffic projected for future years will create an unmanageable situation without some physical yard modifications. There presently is little redundancy to cover track, equipment, weather or other difficulties.

In addition to being moved into, around, or out of the yard, many trains must also be "parked" in the yard for routine inspections and servicing or simply for idle-time storage. There is a severe shortage of train storage tracks, restricting the ability to accomplish these functions effectively while hindering even further the movement of trains around the property. There are presently only 38 yards storage tracks where routine functions can be conveniently performed. These tracks are of varying lengths, and the shorter ones are incapable of accommodating the longest trains that operate today or will increasingly operate in the future. Additional storage space is available at the station platforms, but ideally the use of these positions for storage should occur after the morning peak period and before the evening peak. Peak train storage requirements occur during the midday period and currently total 42 train positions. Already, trains are stored by necessity at inappropriate or inferior locations such as on switching leads and, during peak hours, on platform tracks. Simple train failures at these critical points can cause disproportionately larger-scale service disruptions than would be the case were more suitable storage trackage available.

Added to the shortage of storage tracks are related problems, such as those of track placement. Existing adjacent track spacing of as little as 12 feet (leaving barely 2 feet of maneuvering room between vehicles) reduces the ability of personnel to perform maintenance in the yard and creates safety concerns. As mentioned, some trains are stored alongside the station platforms. The construction of high-level platforms (which is under consideration to meet accessibility mandates), would make continued inspections, servicing, and mandatory testing of the equipment either more difficult or impossible at these locations. Another important limiting factor is the existing variance of up to 11 feet in elevation between various points of the yard, necessitated by the need to cross over Henderson Street to enter or exit the yard. Trains stored at greater than a 0.2 percent grade require special procedures or devices to prevent train runaways. Many stub-end tracks that do not rejoin the main tracks have been built in keeping with these grade restrictions, but at the expense of the operational efficiency and flexibility that connections at both track ends would provide.

Major maintenance work on NJ TRANSIT's system-wide fleet of locomotives and passenger cars is performed at the Meadows Maintenance Complex in Kearny. Through operational experience, NJ TRANSIT identified the need for improved supplemental maintenance facilities at Hoboken to handle minor running repairs (4 hours or less) and component replacements. Some of these functions are performed here at present (sometimes under inappropriate conditions in antiquated structures), and some cannot be done at all. The additional demand on limited yard space that these upgraded facilities entail is justified by operating efficiencies. The nature of the functions performed, the need to return equipment to service within a matter of hours, and the time and costs involved with train movements to remote sites make it necessary to retain the facilities at Hoboken.

The Long Slip itself contributes one more element of yard inefficiency, in that it is a barrier to train movement that restricts access to/from the narrow southern strip of yard property, thus greatly reducing the value of that strip as a solution to any of the foregoing problems. The canal also creates a barrier to emergency vehicle access to the south side of the terminal, constituting a threat to public safety.

3. Level of Service

The rail yard dates to about 1862 and the present station building was opened in 1907, all generally on fill placed in the river. The rail terminal is a state and national historic monument and architecturally significant symbol of American railroading grandeur. These facilities were built in an era of long distance intercity rail travel, very different from the present emphasis on daily peak period commuter operations. Train lengths were generally shorter then, which made for easier dispatching and movement of trains into and out of the complex. While as many or more trains were operated each day on most lines, they were spaced out more evenly throughout the day, with a lower peak period-to-all day service ratio. This avoided the intense peaking characteristics of today's operations, (revenue train peaking during morning and evening commuter rushes and train storage peaking during midday hours). Though the Hoboken terminal became strictly a commuter transit facility nearly 30 years ago, there has been no yard reorganization to accommodate this change in use.

The level of train service was also better accommodated throughout the first half of this century because of the existence of more facilities. An expansive freight yard stretched to the south of the existing yard, all the yard areas were served by more access tracks from the west than exist today, and numerous train storage and maintenance facilities were located in areas nearby. Because of the changes in demand and freight handling techniques, these facilities have long since been demolished and irreversibly converted to non-rail uses. Long Slip Canal and Yard A represent about 9 idle acres, nearly a quarter of the total remaining yard.

The station and yard facilities that remain at Hoboken are inadequate in terms of size and layout. NJ TRANSIT has embarked on a $350 million program to restore, modernize, and reconfigure the station buildings, train shed, and rail yard to meet current and future travel patterns and needs. The proposed project is a key component in this program.

B. Ecosystem Health

Healthy ecosystems provide numerous and diverse benefits to human populations. Development in the estuary has disturbed the processes that benefit society by reducing diversity and connectivity, while stressing the systems with pollutants. Because of the direct and indirect linkages between species, habitats and biogeochemical cycles and energy systems, conservation and restoration measures directed solely at a limited patchwork of land preserves cannot adequately protect or maintain the flow of benefits. A system-wide approach aimed at restoring the natural ecological diversity and connectivity is the goal of current environmental planning (USFWS, 1995).

It is well documented that the economic and ecological values of estuaries are linked (Clark, 1995). Degraded environments translate directly into economic costs in two ways. First, compared to pristine conditions, the productivity or potential harvest of benefits is lower in degraded environments. Second, degraded environments create costs associated with negative effects on resident populations and with remediation. Third is the quality of life condition that affects real estate worth, economic vitality and sustained of ecological improvements. Consequently, the need for economic revitalization set forth in city and regional planning efforts is partially dependent upon the restoration of ecological health in the estuary.

Specific ecological needs that the project will address are fisheries habitat and diversity, water quality, and air quality. Measures to address these needs are described below in Sections III "Alternatives" and IV "Environmental Evaluation".

1. FISHERIES

Over recent years, populations of many Atlantic commercial and game fish have declined substantially or in some cases, collapsed altogether (NOAA, 1995). While overfishing is a cause of decline for some species, population declines for many are the direct result of the degradation or loss of critical estuarine habitat. Development affects fish habitat in many ways including removing shelter for spawning and juveniles, altering circulation patterns, and reducing the diversity of habitats. Toxins, chemicals, sediment, oil, and nutrients from point and non-point source pollution impair biodiversity and population levels. Many of the species that use the New York-New Jersey Harbor estuary for spawning, nursery, juvenile, overwintering, or migration habitat, such as striped bass, Atlantic tomcod, American shad, and tautog, experienced sharp population declines in recent years (Guida, 1997; USFWS, 1995).

In the estuary, about three-quarters of the shoreline is developed (Able, *et al.*, 1995). Management plans that protect and restore stocks have been or are being developed by the Atlantic States Marine Fisheries Commission (Andrews, 1997) under the Magnusen-Stevens Act as amended in 1996 by the Sustainable Fisheries Act. Though the estuary is still productive for fish - stripped bass from the Hudson River may account for as much as 50 percent of the North Atlantic population - its ecological health remains "at substantial risk" due the extreme level of human use and impacts (USFWS, 1995). The juvenile stages of most fish species are particularly vulnerable to effects of environmental degradation. Increasing young-of-the year survival is considered key to expanding local fisheries stocks (Guida, 1997). Therefore, the discussion of habitat restoration should focus particularly, but not exclusively, upon those species of greatest concern, and on their juvenile stages in particular (Guida, 1997). Habitat restoration based upon the needs of juveniles is likely to be the most beneficial to local fish stocks (Able, *et al.* 1995).

Interpier and pile-field habitats, such as those occurring at the project site, can either contribute to the degradation of habitat and water quality or act as beneficial habitat. The US Fish and Wildlife Service (1995) indicated the need for a management focus on the improvement of dissolved oxygen concentrations and improved circulation in these areas to create beneficial habitat. Nearby, comparable waterfront basin areas are major nursery habitats for young-of-the-year striped bass, Atlantic tomcod, and black sea bass, juvenile winter flounder, white perch, American eels, and cunner (Guida, 1997). They also provide good habitat for tautog. The Long Slip canal entrance basin area could provide similar habitat value if bottom D.O. was adequate. Striped bass, in particular, would benefit, since their young-of-the-year migrate into waterfront habitats about the time that D.O. now becomes severely depressed in the Long Slip vicinity.

2. WATER QUALITY

The national and local need for improved water quality is based on economic and public health concerns. There are numerous adverse effects and costs resulting from poor water quality. Both humans and natural systems face direct health risks from ingestion or contact with polluted water and indirect risks from bioaccumulation. Pollutants such as nutrients and organic wastes commonly alter water chemistry by inducing biological or chemical breakdown reactions that can drastically decrease the dissolved oxygen available to other organisms. Suspended sediments increase turbidity, provide a substrate for bacterial, viral, and chemical pathogens to attach, and cause shoaling that alters flow and circulation patterns. Other adverse effects include odors and poor visual quality leading to a general atmosphere of blight and decay. In turn, this has the economic implications of a reduced attractiveness to the public, developers, and investors.

CSOs are the major cause of degraded water quality in the project vicinity. In its present configuration, the canal serves as the receiving water body for two CSOs, one each from the municipalities of Jersey City and Hoboken, that deposit organic debris and cause the sediments to have an extremely high organic content (Guida, *et al.*, 1995). The micro-oxic to anoxic character of Long Slip Canal's waters in summer is well-documented, as is the high oxygen content of its waters during winter and early spring (Andrews, 1984; NJ TRANSIT, 1995b). Most of the canal's bottom and that of the western end of the canal entrance basin into which the canal opens are more than 13 feet deep at mean high water (MHW). These areas are separated from the deep river channel (30+ feet deep) by a shoal (11 feet deep or less at MHW) (see Section IV – E – "Water Quality"). The biota of the canal itself is almost non-existent in summer, grading to depauperate in fall, undoubtedly due to the continuous low D.O. during warm weather (Guida, *et al.*, 1995).

High salinity water (exceeding 20 ppt) can become trapped in the deep bottom of the canal for periods exceeding a full tidal cycle, exposing it to anaerobic sediments with high microbial activity for more than six hours at a time, thus rendering it severely oxygen-depleted. This oxygen poor, high salinity, water is prevented from mixing with overlying water by strong density gradients that form as a result of tidal salinity fluctuations in the river. And probably exacerbated by the discharge of fresh water from the two CSOs in the canal and an additional Hoboken CSO discharging directly into the canal entrance basin. The flow patterns of the two canal outfalls is not known, but the canal entrance basin discharge appears to be continuous, if small, even during dry weather. Bottom contours allow the low-D.O., saline water from the canal bottom to spread out over the western part of the canal entrance basin and southward through the piling field, but prevent drainage eastward toward the river basin. The result is an extremely depauperate benthic community in the canal and canal entrance basin (Guida, *et al.* 1995), and a degraded habitat for fish (Andrews, 1984; Guida, *et al.*, 1995) that probably includes at least part of an otherwise valuable pile field

High flows from the canal's two CSOs during wet weather create episodes of undesirable waste solids deposition and floatables discharge. They also seem to temporarily break down the salinity stratification and bottom stagnation that characterizes dry weather conditions by simply flushing out the high salinity water (LMS, 1996). During cool weather, the slowing of microbial oxygen consumption allows D.O. levels to approach saturation in the waterfront basin (Able, *et al.*, 1995) and even in the canal itself (Andrews, 1984; NJ TRANSIT, 1995b), where New Jersey SE-2 estuarine water quality standards are easily met during winter and spring. This slowing of oxygen consumption, however, allows organic matter inputs from the CSOs during cold weather to accumulate rapidly in canal sediments, producing a backlog of labile material to be oxidized when warm temperatures resume (NJ TRANSIT, 1995b). Long, narrow canals have inherently poor circulation. Added to this, the fact that Long Slip's bottom is deeper than anything else around it and that stratification due to short-term salinity changes is characteristic of this reach of the Hudson Estuary, this situation is primed for anoxia as the temperature rises.

3. SEDIMENT QUALITY

Sediment testing in the western third of Long Slip Canal has turned up moderate levels of contamination with lead, copper, zinc, arsenic and various aromatic hydrocarbons, but no detectable PCBs and only traces of chlorinated hydrocarbons. TCLP (leachate) tests with these sediments met New Jersey ID-27 criteria for non-hazardous industrial waste (NJ TRANSIT, 1995b). Since this part of the canal is scheduled for closure by this project, the data has no direct bearing on the waterfront restoration project, except that it probably represents a worst case situation locally, as all sites sampled lie directly between the two CSOs that discharge into the canal.

Perhaps of greater relevance to possible sediment contamination issues is a more widespread and intensive survey of sediment toxicity in the entire Hudson-Raritan Estuary (Long, *et al.*, 1995). In this study sediments from locations throughout the estuary were tested both for their toxicity toward amphipods, bivalves and bioluminescent bacteria, and analyzed for a full range of organic and metallic contaminants. Polynuclear aromatic hydrocarbons (PAHs) appeared to be contaminants most clearly correlated to toxicity toward amphipods and bacteria. Sediments from the lower Hudson River, while clearly contaminated were among the *least* toxic in the estuary. Most tests, in fact, showed sediments from the first 18 miles of the river (the Battery to Dobbs Ferry) to be non-toxic. These results suggest that well-planned and executed habitat restoration is likely to succeed on the Hudson River waterfront without interference from residual environmental toxicity. This would not be the case in the East River or Newark Bay, both of which contain highly toxic sediments.

4. Dredging and Dredged Material Disposal

The Port of New York and New Jersey, the third largest port in the US (in terms of total cargo volume) is inarguably essential to the regional economic health. Currently, the port is experiencing difficulties in maintaining adequate depths that threaten up to 40 percent of the total port volume (USACOE, 1996). According to the Corps of Engineers (1996), the difficulties result from the need to dredge and dispose of millions of cubic yards of sediment. The projected need for dredged material disposal over the next three years exceeds 12-14 million cubic yards, of which about 66 percent are not suitable for ocean disposal. Polluted sediments increase the costs and limit the opportunities for dredging and the safe disposal of dredge sediment. The difficulties in disposing of sediment not suitable for ocean disposal results in deferred maintenance of naturally shoaling navigation channels. This, in turn, affects commerce by gradually restricting the draft of shipping. The need to site disposal facilities and to develop beneficial uses for materials not suitable for ocean disposal is therefore a priority for several federal and state agencies.

5. Air Quality

The recent strengthening of legislation to protect air quality such as the Clean Air Act emphasize the importance of efforts to reduce emissions of air pollutants. Improved air quality is a well-known benefit of public transportation, particularly electric trains. That the project will facilitate the implementation of regional transportation projects that will reduce automobile traffic is of critical importance given the regional non-attainment of U.S. Environmental Protection Agency air quality goals. By 2010, the Secaucus Transfer project alone, will divert about 15,000 daily vehicle trips and 420,000 vehicle miles traveled (Marchwinski, 1995). These traffic primarily will occur during the AM and PM peak hours. Conservatively, that project will reduce regional hydrocarbon emissions by 356 pounds per day, carbon monoxide emissions by 922 pounds per day, and nitrous oxide emissions by 806 pounds per day (Marchwinski, 1995).

Since public rail transportation replaces commuter traffic, it addresses depletions in air quality at the times of greatest generation. However, to attract, maintain, or increase ridership levels, it is necessary to provide reliable, efficient service. With poor service, ridership will revert to automobiles and the associated air quality benefits will be lost.

C. PUBLIC ACCESS

The concept of coastal waterways being a common resource is a fundamental right protected by laws and policies since the Justinian codes of ancient Rome. Current federal and New Jersey coastal law policies continue to protect that right by ensuring the public's access to the waterfront.

In areas such as the intensely developed and industrial Hoboken and Jersey City waterfronts, public open space is in especially short supply. There is currently little to no safe riverfront access for the neighborhoods of Jersey City and Hoboken that surround the project area. Open space provided by parks is limited to small local parks such as E.F. Jones and Montgomery parks in Jersey City and Washington and Columbus parks in Hoboken.

The Hudson River Waterfront Walkway (NJDEP, 1984), a partially constructed walkway extending from the George Washington Bridge, approximately nine miles to the north of the site, through Liberty State Park to the Bayonne Bridge, about nine miles to the south, helps meet that shortage. Critical gaps exist, in part due to the heavy industrialization of the waterfront. However, based on current waterfront development permits, completion of the walkway through the Hoboken Terminal and the Weehawken Cove will open six *continuous* miles of walkway stretching from Jersey City through Hoboken, Weehawken and West New York (Trust for Public Land, 1996).

III. ALTERNATIVES

The primary objectives of this project are to increase the train storage capabilities, improve the efficiency of train operations at the Hoboken Terminal rail complex, and upgrade obsolete, antiquated equipment and facilities that are expensive to maintain. Two alternative analyses were performed. First alternative analysis determined where the needed rail storage facilities should be located (Section III-A, below). Once it was determined that the expansion should occur at the Hoboken terminal and that filling Long Slip canal was the best alternative, economically and environmentally, a second alternative analysis was performed to determine what configuration of the walkway and canal entrance basin optimizes water quality and habitat benefits (see Section III-C, below).

A. SCREENING AND SELECTION PROCESS

Numerous alternatives were identified under several previous study efforts (NJ TRANSIT, 1981; 1992; 1995d; 1997) and evaluated on their ability to satisfy those objectives while avoiding or minimizing adverse environmental, social, or economic impacts. The primary objectives were not fully satisfied by most of the alternatives considered, and only an alternative involving the filling of Long Slip Canal was concluded to effectively meet those objectives.

A total of seven alternative schemes were developed. In addition to the No-Build alternative, off-site alternatives, and two schemes to reorganize within the existing area of active rail facilities, alternatives were developed to expand the physical size of the active rail yard. Specifically, the alternatives evaluated during the initial screening process were:

- *Alternative 1 - No-Build:* This alternative maintains the "status quo". There will be no significant reorganization of the yard, only maintenance and repair of existing facilities.

- *Alternative 2 - Reorganization within Yard B:* Under this alternative, the rail yard will be reorganized within its existing boundaries. No additional land will be used or acquired. Two schemes, 2a and 2b, were developed under this scenario.

- *Alternative 3 - Annexation of adjacent property*: Under this alternative, adjacent private property would be condemned and annexed to accommodate an expanded rail yard. Given the intensive development in Hoboken, north of the project site, only property in Jersey City immediately south of the yard was considered;

- Alternative 4 - *Use of non-contiguous property at a remote location*: Under this alternative, a 6-acre satellite facility would be developed on lands west of the Hoboken Terminal.

- *Alternative 5 - Use of property occupied by Long Slip Canal*: Under this alternative, the rail yard would be expanded over the land now occupied by the canal. For reasons of cost, present and future efficiency and overall benefits, Alternative 5B is the preferred alternative. The two scenarios evaluated were:

  5A. Bridging Long Slip Canal; and,
  5B. Filling Long Slip Canal.

1. Screening Methodology

Criteria for the evaluation of alternatives to meet the future demands were derived from a number of previous studies (NJ TRANSIT, 1981, 1992, 1995d, and 1997) that identified deficiencies in the present rail yard operations. Internal analysis of these studies by NJ TRANSIT revealed that the ideal facilities at Hoboken require:

- Rearranged and/or additional tracks (to efficiently handle over 40 train movements per hour);
- Expanded train storage spots (to accommodate 62-67 trains during midday hours);
- More generous track spacing (14 feet on center, to facilitate train servicing and repairs); and,
- A running repair shop.

Also critical are a new enclosed wheel truing facility (with minimum width of 30 feet and length of 380 feet), materials storage areas, personnel welfare facilities (lockers, showers, etc.), and improved roadways for materials delivery, worker circulation, and emergency response vehicle access.

Another important aspect of a more efficient yard is the elimination or minimization of stub-end tracks in favor of tracks with connections at both ends. Tracks with double-end access have several advantages. They allow individual cars to be detached from train sets for servicing or repairs from either end of the track, simplifying activities and minimizing conflict with other yard operations at the time the move is required. Secondly, train movements between points are made more straightforward, with less "jockeying". And finally, alternate routing is made available in the event of a track blockage at one end, avoiding "trapped" trains.

The initial set of alternatives was evaluated for their intrinsic ability to meet the design requirements, cost, and operational efficiency. The environmental impacts of each alternative and the potential for beneficial mitigation were additional, critical components of the screening process.

Table III-1 summarizes the characteristics, costs, and benefits of the seven railyard alternatives screened. Both Rail Yard Alternatives 5A and 5B allow for an improved and adequate yard arrangement that would increase the reliability of rail operations. Both also have the potential to create a pleasing public access area conveniently linked to the passenger station and adjacent properties, and only these alternatives offer flexibility for further yard modifications, should such future need arise. They differ in costs and environmental impacts, with the fill option being the only means of accomplishing an integrated solution to the combined sewer discharge problem while also providing for storm water pre-treatment and habitat augmentation. Given the prohibitively higher costs of Alternative 5A, and with the much healthier environmental program associated with Alternative 5B, Alternative 5A is rejected as a clearly inferior means of accomplishing the necessary yard expansion, and Alternative 5B is preferred.

2. Results of the Screening Process

a) Alternative 1 - No-Build

The evaluation of an alternative that would maintain the status quo of the Hoboken Terminal facilities serves to illustrate the existing and anticipated problems that require attention and have prompted the multi-million dollar yard and terminal renovation program. Succinctly, the major problems entail a shortage of train handling and storage space, poor juxtaposition of facilities, and the consequent inability to physically and financially operate trains efficiently. In turn, the actual and perceived reliability of the public service offered will deteriorate. In fact, the existing yard will be incapable of accommodating the levels of train service that are planned to accompany the opening of the Secaucus Transfer facility in 2002.

Table 0-1 Summary of Alternatives Screening

Criteria	Alternative						
	No Build	Reorg/No expansion		Annex Land	Satellite Yard	Deck Long Slip	Fill Long Slip
	1	2A	2B	3	4	5A	5B
Capital Cost ($M) [(a)]							
Bulkhead repair	10.9	10.9	10.9	10.9	10.9	10.9	0
Waterfront walkway	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Rail bridge	3.2-7.2	3.2-7.2	3.2-7.2				
Other						50.3	8.5
Revenue Offset from CDF							(3.2)
Total	11.5	14.7-18.7	14.7-18.7	14.7-18.7	11.5	61.8	5.9
Annual Operating Cost ($K)							
Hoboken facilities	41	46-59	46-59	46-59	41	108	6
Other					6,384		
Flexibility to Meet Future Needs	Low	Low	Low	Medium	Medium	High	High
Adequacy of Trackage							
2002 Supply							
In yard(s)	38	62	57	64	64	62	62
At platforms [(b)]	7	7	7	7	7	7	7
2002 Demand	50	50	50	50	50	50	50
Excess/(Shortfall)	(5) [(c)]	19	14	21	21	19	19
2010 Supply							
In yard(s)	38	62	57	64	64	62	62
At platforms [(b)]	3	3	3	3	3	3	3
2010 Demand	67	67	67	67	67	67	67
Excess/(Shortfall)	(26) [(c)]	(2)	(7)	0	0	(2)	(2)
Trains on Stub-End Tracks	12	51	21	12	12	29	29
Long Slip Encroachment (KSF)							
Displacement	4.0	4.5 - 9.0	4.5 - 9.0	4.5 - 9.0	4.0	5.0	200.0
Shading	4.2 - 6.2	4.2 - 6.2	4.2 - 6.2	0	NA	196.0	0 - 1
Institution Feasibility	None	None	None	None	Low	Low	High
Environmental Mitigation							
Walkway Alternative	1	1	1	1	NA	1	2, 3
Habitat restoration or new wetlands	No	No	No	No	No	No	Yes
Holding tank & extension of CSO.	No	No	No	No	No	No	Yes
Disposal of dredged materials.	No	No	No	No	No	No	Yes

Notes to Table III-1

(a) Certain additional costs are likely to be incurred but are not included in this summary. These costs are acknowledged below:
- Costs of yard track and other facility reconfiguration/construction at or adjacent to Hoboken or at a remote site. (Applicable to all but Alternative #1).
- Costs of land acquisition at adjacent or remote yard sites. (Applicable to Alternatives #3A and 3B).
- Costs of partial filling or decking of the western end of the Long Slip, (and associated extension of CSO), to accommodate potential shift of repair shop. An estimate for filling 25 percent of the slip is an additional $4.3 million. (Applicable to Alternatives #2a, 2b, and 3a).

(b) The value of these positions is subject to diminution pending a decision on construction of high-level platforms.

(Notes continued on next page.)

Notes to Table III-1 continued

(c) The shortfall of train storage facilities could be even higher than indicated here (by 7 to 10 positions) if indeed "no action" is taken to elongate tracks at the north end of Hoboken Yard so that longer trains required for the Secaucus Transfer operating plan can be accommodated, thus making some of the supply less usable.

The "No-Build" title of this alternative is something of a misnomer in that engineering investigation has revealed that the Long Slip bulkhead walls have deteriorated to the extent that costly reconstruction and repair is, in fact, essential (whether or not the yard is modified). The expense of this repair, assuming a simple plan of driving sheet piles (about one foot in front of the existing face of the bulkhead) and backfilling the gaps, is estimated at nearly $11 million (1994 dollars). This then represents the capital cost of continued operation under existing difficult conditions that will only become increasing inadequate in the future, leading to operation failure. An annual operating cost of $40,000 for maintenance of the repaired bulkheads was also estimated. The bulkhead repair plan would create a waterway impact of approximately 4,000 square feet.

b) Alternative 2 - Reorganization Without Yard Expansion

Conceptual investigation was made recently of rail yard reorganization schemes that would address existing and anticipated inadequacies while staying within the existing physical dimensions of the yard (NJ TRANSIT, 1995d). It was determined that no scheme could be developed that would comprehensively alleviate the yard's shortcomings, when limited to the present yard geography. Relaxing that condition slightly, the study concluded with identification of two basic yard schemes that, while not ideal, could produce some operational improvement. Both of these schemes, however, encroached on the Long Slip. They are designated herein as Alternatives 2a and 2b. (They were designated respectively as Schemes 6 and 8 in the prior conceptual study (NJ TRANSIT, 1995d). While they both offer some improvement over the No-action Alternative, neither is preferred since they are too expensive to justify the incomplete relief of existing and future conditions that they offer.

The two schemes have identical environmental impacts. Beyond the construction period, the major impacts are the introduction of bridge piers in the Long Slip and the associated restriction of navigation in the westernmost portion of the waterway. The extent of impacts will vary according to options for the angle and type of bridge construction selected. The bridge width would vary from 20 to 24 feet and the bridge deck area from 4200 to 6200 square feet. Open deck construction could allow for increased light penetration. Piers would number from 4 to 7, individually requiring a footprint area of between 120 and 715 square feet, each resting on between 9 and 16 piles imbedded in the slip bottom. Neither scheme would involve any CSO abatement measures, but both would accommodate a portion of the Hudson River waterfront walkway.

To recap, these two alternatives offer partial, but not full solutions to existing and anticipated problems, and some of that improvement is severely undermined by developments related to the HBLRT. While encroachment on the Long Slip *might* be limited to construction of a new bridge, this simultaneously limits the long-term flexibility of the yard facilities and the ability to respond to future needs. Considering these aspects, along with the associated costs of each alternative, neither is preferred.

c) Alternative 3 - Annexation of Adjacent Properties

Alternative 3 involves acquisition of portions of the Newport development property in Jersey City to the south of the yard, including portions of 18th Street (a major local thoroughfare serving the Newport development) and several retail establishments. NJ TRANSIT possesses the power of eminent domain, and could acquire these properties where the public benefit justifies the usurpation of private enterprise and property. In this case, the negative local impacts and the potential level of ill will created between the affected localities and the agency could be substantial impediments to the acquisition. The loss or modification of part of 18th Street will have significant adverse impacts on local traffic conditions, and the loss of part or all of the retail enterprises (recently established) could affect employment opportunities and run counter to long-standing city and state urban redevelopment aspirations for the community.

As with the previous alternatives, this one requires the investment of about $11 million for restoration of the Long Slip bulkhead walls. The need for a bridge over the Long Slip (as under Alternatives 2a and 2b) will also likely occur. Additional substantial costs would be incurred for land acquisition (not estimated). Again, a portion of the Hudson River waterfront walkway would not be precluded. However, NJ TRANSIT may become responsible for a larger segment than under the alternatives previously discussed, and therefore assume somewhat higher capital and maintenance costs. This alternative does not address any CSO abatement measures.

This alternative is similar in its outcome to that of Alternative 2a, in that it allows adequate room for trains, but likewise in a less than efficient manner. Because this alternative offers no net improvement in operations over Alternative 2a, and can be expected to produce substantial negative impacts in Jersey City, all at higher costs, this alternative is rejected.

d) Alternative 4 - New Satellite Storage Yard

Alternative 4 would create a satellite yard facility of approximately 6 acres providing for remote storage of trains (up to the maximum estimated unmet future need). Although the former Erie Railroad Monmouth Street yard site is conveniently nearby, it measures just under 4 acres in size and is therefore inadequate. Because of the topography and dense development of the remaining urban area at and approaching Hoboken Terminal, any candidate sites for this new facility would have to be located west of the Palisades geological formation and the Bergen (rail) Tunnels, i.e., somewhere in the near areas of the Hackensack Meadowlands Development District (HMDD). Without specifying any particular site, it can reasonably be expected that if an available and suitably-sized parcel could be found in the HMDD, it would invariably involve some level of environmental drawbacks (wetlands disturbance, site contamination, community opposition, loss of ratable, etc.).

The satellite facility concept has other more restricting drawbacks. Increased operating costs would be attributable to the inherent and substantial increase in non-revenue (deadhead) train moves required between the site and Hoboken, and to the inefficient provision/operation of duplicative employee quarters, supervisory staffing, and other necessary elements which would otherwise be consolidated at Hoboken. Assuming establishment of a site within 4 miles of West End Interlocking, annual operating costs in 2002 would increase by between $4.4 million and $4.6 million (depending on the mix of diesel vs. electric equipment involved). This increment would grow to about $ 6.4 million by 2010. Additional evaluation was conducted of alternate sites: alongside the Meadowlands Maintenance Center (where some staffing costs could be overlapped) and at the Monmouth Street site (which would involve fewer total train-miles of movements). The recurring fiscal impacts at these sites in 2002 would be $3.1 million and $3.7 million, respectively.

More critically, operations reliability under the satellite yard concept would be severely jeopardized. The trunklines leading into and out of Hoboken and connecting to any potential new site are already active throughout most of the day. Those track segments that pass through the Bergen Tunnels constitute an extremely sensitive bottleneck of the rail system, and have no reasonable expansion potential. Introduction of the added deadhead train activity would intolerably increase the potential for train conflicts along these congested tracks. An analysis of morning peak period train movements through the tracks of the West End interlocking in 2002 was conducted to determine if adequate capacity exists to accommodate the added train movements associated with the remote storage site. It was determined that with all trains operating on schedule, only half of the necessary deadhead train movements could be accomplished. The evening peak period, with slightly higher anticipated service levels, can be expected to have equal, or even more acute problems. In years beyond 2002, there would be demand through the interlocking for additional revenue and deadhead train movements, exacerbating this situation further.

This alternative also requires the capital and operating cost investments associated with the Long Slip bulkhead wall repairs and the Hudson River waterfront walkway. No CSO abatement measures are involved. Additional capital costs (not estimated) would be required for land acquisition and construction of tracks and other yard facilities at the remote site. As previously mentioned, operating costs of normal train service activities would also increase. This alternative is rejected because it produces net improvements that are similar (or more likely inferior) to those of Alternative 2a, while involving higher capital investment and substantially increased operating costs. Moreover, this alternative is not believed to be operationally feasible.

e) Alternative 5 - Use of the Long Slip Property

Alternative 5 considers expansion of the physical yard acreage by including some portion of the Long Slip Canal. The Long Slip is the only substantially unused acreage within the existing yard boundaries. Two methods were considered to accomplish the merger of the Long Slip property with its contiguous land areas (at the elevation of those adjacent properties): decking the waterway (Alternative 5A) and filling the waterway (Alternative 5B). Both offer the following advantages to railway operations:

1. The storage track goal can be met while still providing a west end connection on many of the yard storage tracks (About 62 positions would be created, with 29 on stub-end tracks).

2. Many of the new storage tracks would be of sufficient length to accommodate the greater number of full-length trains expected as ridership grows. The tracks would have a minimum spacing of 14 feet, giving ample room for inspections and servicing.

3. More substantial land buffers between the yard and adjacent public and private properties can be provided, as compared to the other alternatives investigated.

4. The yard access road would meet acceptable standards and be realigned to connect south with 18th Street rather than west with Henderson Street, adding to the buffer zone and avoiding any at-grade crossings.

5. Tracks approaching and passing through the new shop can be constructed at mandatory level grades, and the incidence of conflicting train movements between the shop and other yard areas would be minimized.

6. All train operations would fall within sight and immediate access of planned crew deployment facilities, thus avoiding further investments.

7. Adequate room for employee facilities, materials storage, vehicle access, and HBLRT land needs would be available without further private property takings.

f) Alternative 5A: Decking Long Slip

Decking the Long Slip with a continuous impervious metal. plate or concrete cover would block or filter the penetration of sunlight to the water surface (over 4 acres) and would entail disruption within the slip during construction of substantial supporting structures (2 piers running the length of the slip). The result would be an enclosed waterway accessible to fish and other aquatic life but severely degraded by the continued discharge of a combined sewer outfall and relatively turgid flows leaving a dark and generally unsupportive (as well as non-navigable) estuarine environment.

This alternative involves the same capital and annual operating expenses ($11 million and $40,000, respectively) discussed previously for renovation of the Long Slip bulkhead walls. Costs as previously discussed for construction of a portion of the Hudson River waterfront walkway would also apply here. In addition, construction of a deck over the waterway will require over $50 million, in 1994 dollars. The annual maintenance cost associated with this option is $67,000.

g) *Alternative 5B: Filling the Long Slip -- the Preferred Alternative*

Filling the Long Slip to existing grade involves filling of 4.6 acres of water. The actual filling of the slip would be accomplished using clean fill material or dredged materials excavated from the greater New York harbor dredging program, that would otherwise have to be disposed of elsewhere, with greater environmental consequences and at greater cost, or both.

Alternative 5B is estimated to cost $8,540,000 (to fill in the entire slip). Interestingly, the cost decreases when the Long Slip is filled, because necessary bulkhead wall repairs are avoided. Included in these 1994-dollar estimates are costs associated with extension of combined sewer lines. In addition, costs as previously presented for Hudson River waterfront walkway construction and maintenance would be incurred. If the use of dredged material is acceptable to NJTransit's construction schedule and to NJDEP, there are potential offsetting revenues that lower the mitigation costs. Offsetting revenue strategy is (1) up to $3 million anticipated from the acceptance of dredged material from New York Harbor (based on 200,000 cubic yards of material at $16 per cubic yard), making this not only the most effective, but the least costly of all the options evaluated. Alternative strategy (2) is $0.8 million anticipated for 230,000 cubic yards of amended dredged material and $2 million structural fill placement offset.

3. SUMMARY

Of the seven initial railyard alternatives developed, only Rail Yard Alternatives 5A and 5B allow for an improved and adequate yard arrangement that would increase the reliability of rail operations. Both also have the potential to create a pleasing public access area conveniently linked to the passenger station and adjacent properties, and only these alternatives offer flexibility for further yard modifications, should such future need arise. They differ in costs and environmental impacts, with the fill option being the only means of accomplishing an integrated solution to the combined sewer discharge problem while also providing for storm water pre-treatment and habitat augmentation. Given the prohibitively higher costs of Alternative 5A, and with the much healthier environmental program associated with option 5B, Alternative 5A is rejected as a clearly inferior means of accomplishing the necessary yard expansion. Alternative 5B, Filling Long Slip, is the most reasonable alternative for accomplishing the yard expansion goals and is the Preferred Alternative.

B. FINAL ALTERNATIVES

The No Build and the Preferred or Build Alternative were chosen by NJ TRANSIT to be the final alternatives for environmental analysis. Detailed descriptions of each are provided below.

1. NO BUILD

This alternative leaves Long Slip unfilled and, together with Yard A to the south, unincorporated in the plans for the rehabilitation of the Hoboken Terminal. There would be no waterfront walkway across the slip and no improvement to the CSOs. NJ TRANSIT would be required to make a capitol expenditure of over $11 million for bulkhead repair without any operational benefits.

2. THE PREFERRED ALTERNATIVE (BUILD ALTERNATIVE)

The Build Alternative consists of the filling of Long Slip Canal to create approximately 4.6 acres of land for the expansion of commuter rail capacity in order to meet current and projected operating requirements. Mitigation consists of CSO upgrade, the creation of 28.1 acres of healthful nursery and juvenile habitat for several fisheries of regional concern, disposal for 150,000 cubic yards of dredged material unsuitable for ocean disposal from off-site, the development of the public and recreational fishing access and compensatory wetlands. The overall development plan is shown in Figure III-1. Detailed descriptions of these program elements are presented below.

The Long Slip Canal will contain fill in the order of 180,000 cubic yards. Figure III-2 indicates the locations of fill to be emplaced. For the purpose of conservatively estimating the volume that can be accommodated, a total of 150,000 cubic yards is assumed. Table III-2 summarizes the quantities of fill in each location. This fill may be comprised of dredged materials not suitable for ocean disposal from New Jersey waters elsewhere in the harbor or amended dredged material. Dredged material suppliers will be responsible for obtaining any needed approvals or certifications for the transport and use of these materials. Alternatively, clean fill may be used. The decision of which fill to use will be made by NJ TRANSIT and the construction management consultant based on design and construction considerations, scheduling considerations, availability and cost of the materials at the time needed. The environmental impacts of the fill material options are discussed below in Section IV-N "Construction".

C. MITIGATION PLAN

Because the project site is fully developed as a transportation facility, no feasible opportunity to construct in-kind replacement open water areas exists. To condemn and demolish portions of the rail yard for that purpose would be contrary to the driving need for the project - the development of increased capacity to support growing public transportation demand. It would eliminate benefits to the general public arising from an extensive and cost-efficient system of public transportation.

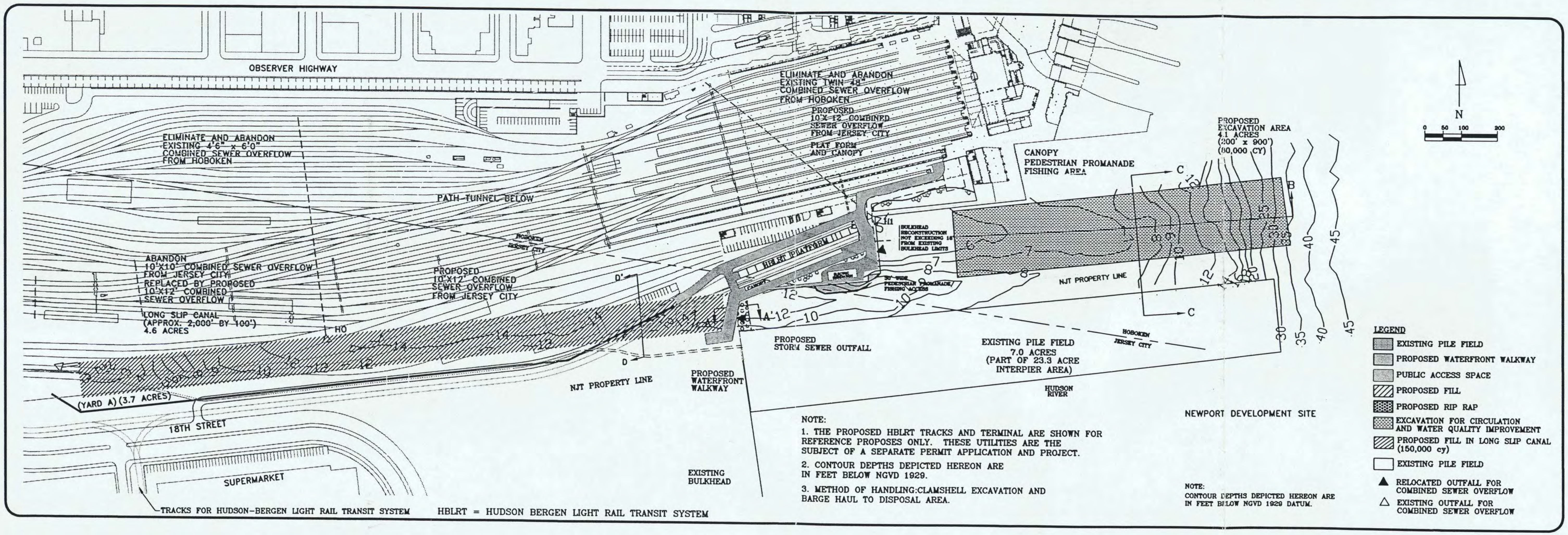


Figure III-1 Development Plan

Dames & Moore

Figure III-2 Locations of Fill and Excavation

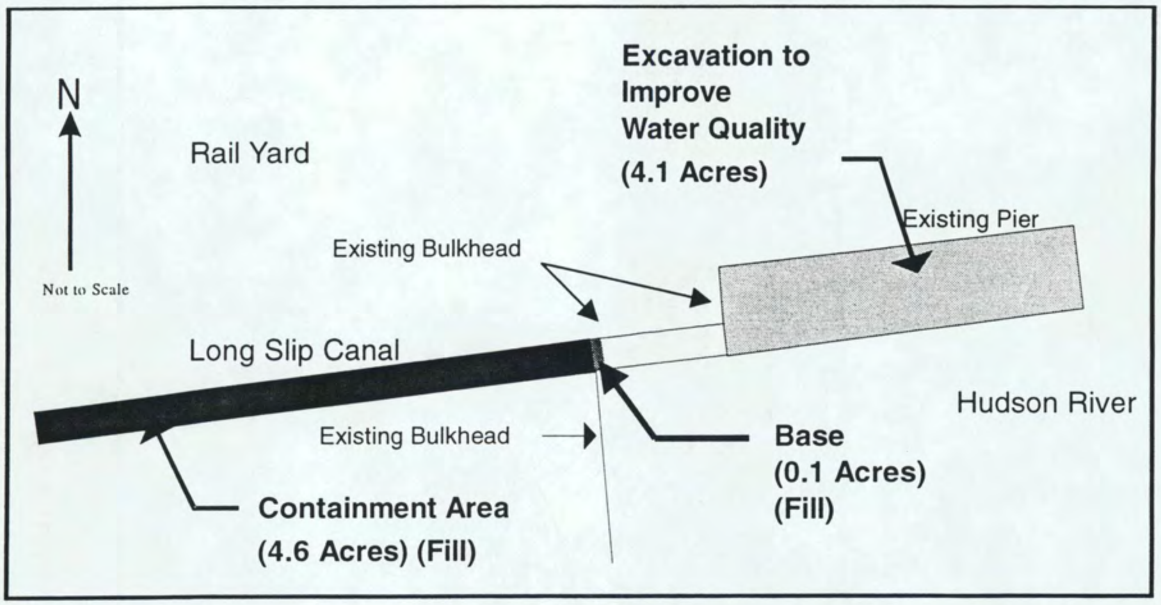


Table III-2 Composition of Fill by Area of Emplacement

Component	Containment Area Fill (CY)	Berm Base Fill (CY)	Excavation (CY)
Fill Material	150,000	--	--
Cap	10,000	--	--
Surcharge/core	30,000		--
Rubble	--	1,500	
Excavated Materials	--	--	(80,000)
Totals	**190,000**	**1,500**	**(80,000)**
Total Fill Emplaced (190,000++1,500):		**191,500 cubic yards**	
Total Containment Volume (190,000+1,500):		**191,000 cubic yards**	
Net Capacity for Off-site Dredged Material:		**70,000 cubic yards**	

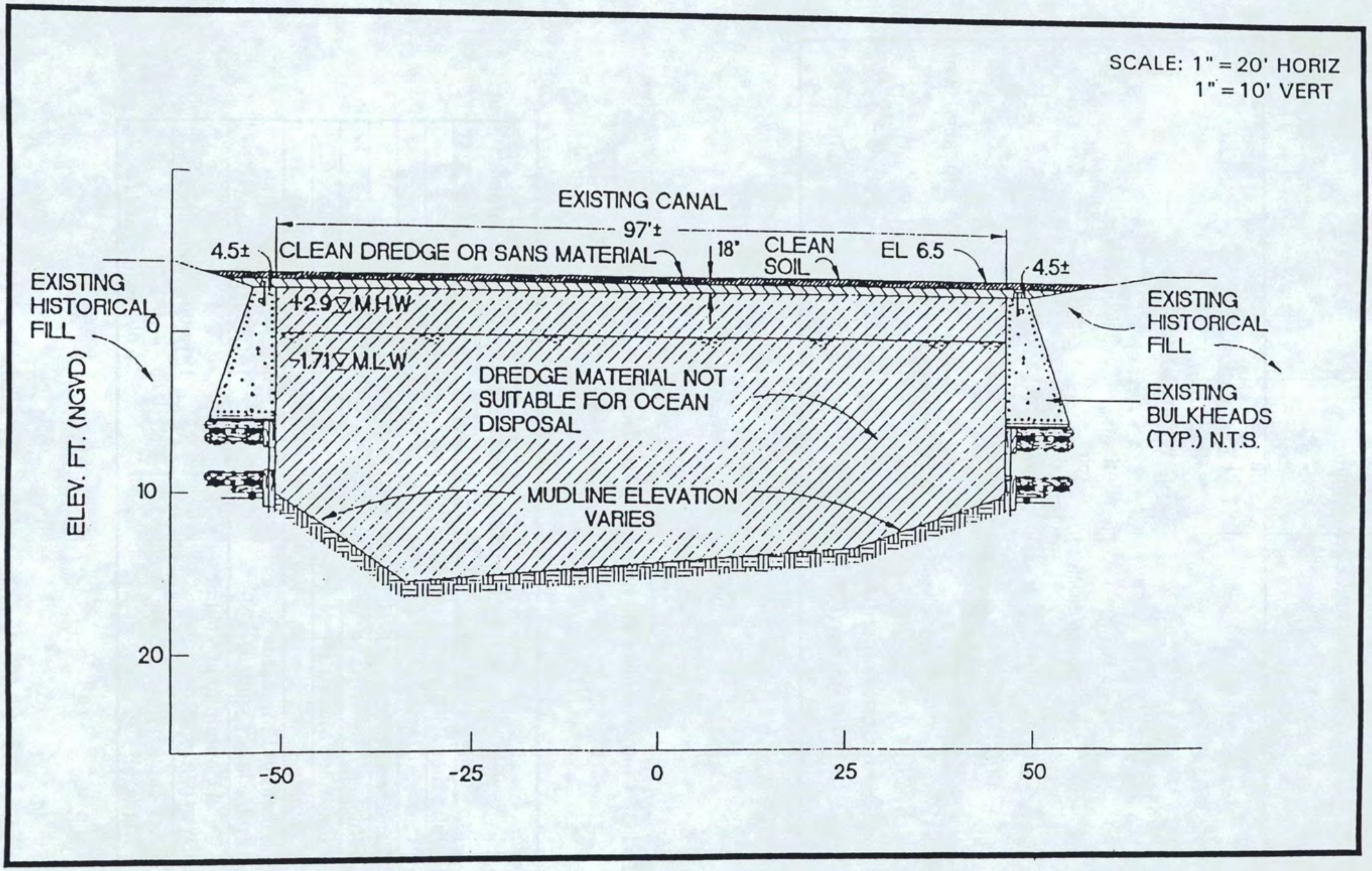


Figure III-3 - Typical Fill Section

Instead, the proponent proposes as mitigation for the loss of 4.6 acres of navigable waters and subtidal habitat, substantial measures that improve water quality allowing fish to repopulate the pilings and open water adjacent to the site, that improve the overall water quality of the estuary, and that improve access and recreational opportunities to the general public (see Figures III-4 and III-5). These are collectively termed the Habitat Creation Plan and are summarized below to provide the reviewer an overview of the mitigation program and its conceptual basis. Each component is described in detail under appropriate sections of Section III – "Environmental Evaluation" below. The total area of this mitigation plan is 475-545 acres, a ratio of at least 35:1 to the altered area.

1. BASIS OF DESIGN

At first glance, it is counter-intuitive that the activities proposed for habitat creation are beneficial. Several factors make this a compelling approach to reverse the incremental insults sustained by development along the lower Hudson. First, the site shoreline was created last century for economic, rather than environmental purposes, leaving a legacy of non-"eco-friendly" design. Second, upland for conversion to subtidal land is unavailable in the project vicinity. Finally, the water quality restoration resulting from the CSO improvements proposed by the project is many years ahead of alternative funding for that work. The mitigation plan is designed to yield the optimum improvement possible.

In order to develop this project program and mitigation, it was necessary to understand the linkages between the canal, the adjacent 37-acre interpier area, and the Hudson River and how the canal and the interpier area function within the context of that system. The Habitat Creation Plan is a summation of that concept and the holistic, ecosystem approach to the project design.

Baseline work identified the following causes of degraded water quality and the depauperate fish populations in the interpier area:

- CSOs - Three CSOs discharge sediment, organics, floatables and contaminants.

- Non-point source discharges - Storm water drainage from much of the rail yard discharges directly to the canal via surface or subsurface flows.

Sediment influx and turbidity- The Jersey City CSO is the major source of sediment to the canal and entrance basin, but there are additional sources. Many portions of the canal bulkhead in the canal and along the west-end of the entrance basin are deteriorated to such an extent that the fill material is being scoured by tides and waves. Another source of turbidity in the canal entrance basin is the resuspension of sediments washed by stormwater into the pile field adjacent to the canal entrance from stockpiled soil on the Newport Center property that is unprotected by soil erosion and sediment control measures. Wave energy in the canal basin is somewhat focused and intensified by the entrance basin geometry so that the material is continually resuspended.

- Lack of circulation and flushing - Circulation within the canal and the entrance basin area is constricted by shoaled sediment near CSO discharge points. The shoals and the geometry of the canal preclude daily tidal flushing. The Jersey City CSO discharges are a major source of "new" water to the canal to occasionally flush the canal, albeit with polluted fresh water. Because of the lack of flushing, pollutants are concentrated and stored in the canal. When they do reach the canal entrance basin and the interpier area, the pollutants are in a much more concentrated form.

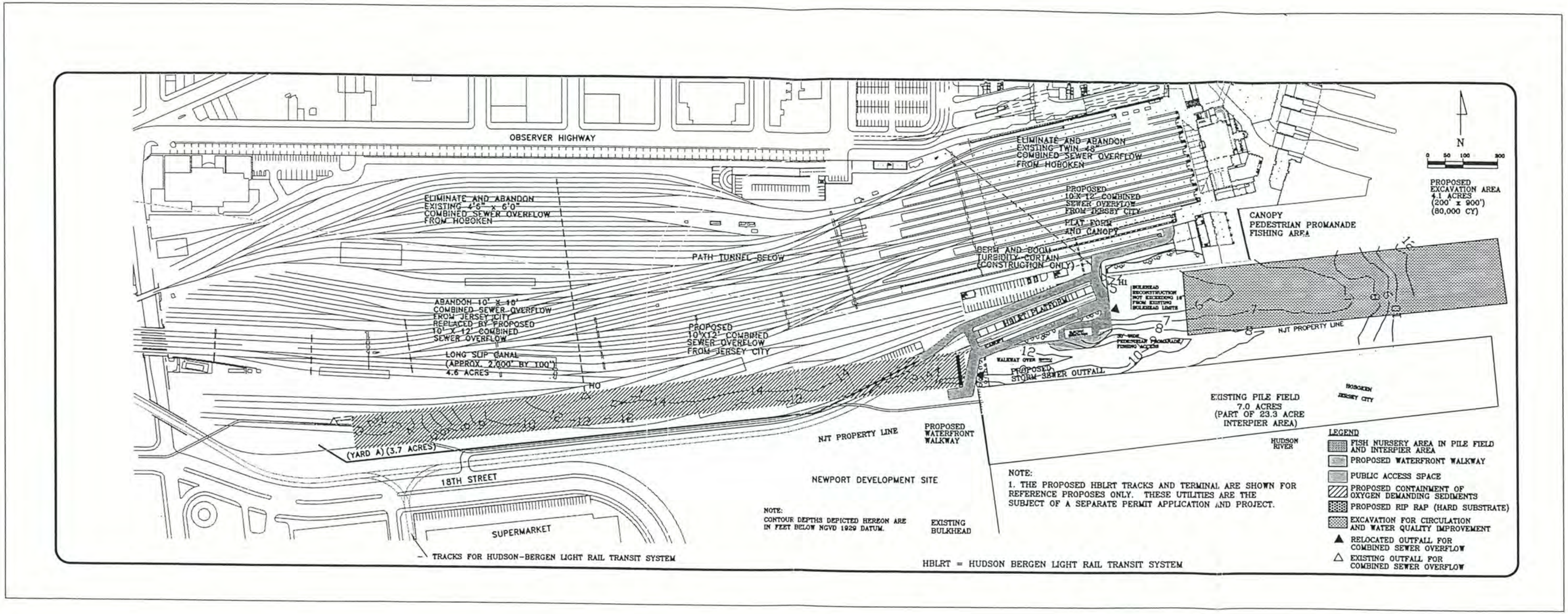


Figure III-4 Mitigation Plan

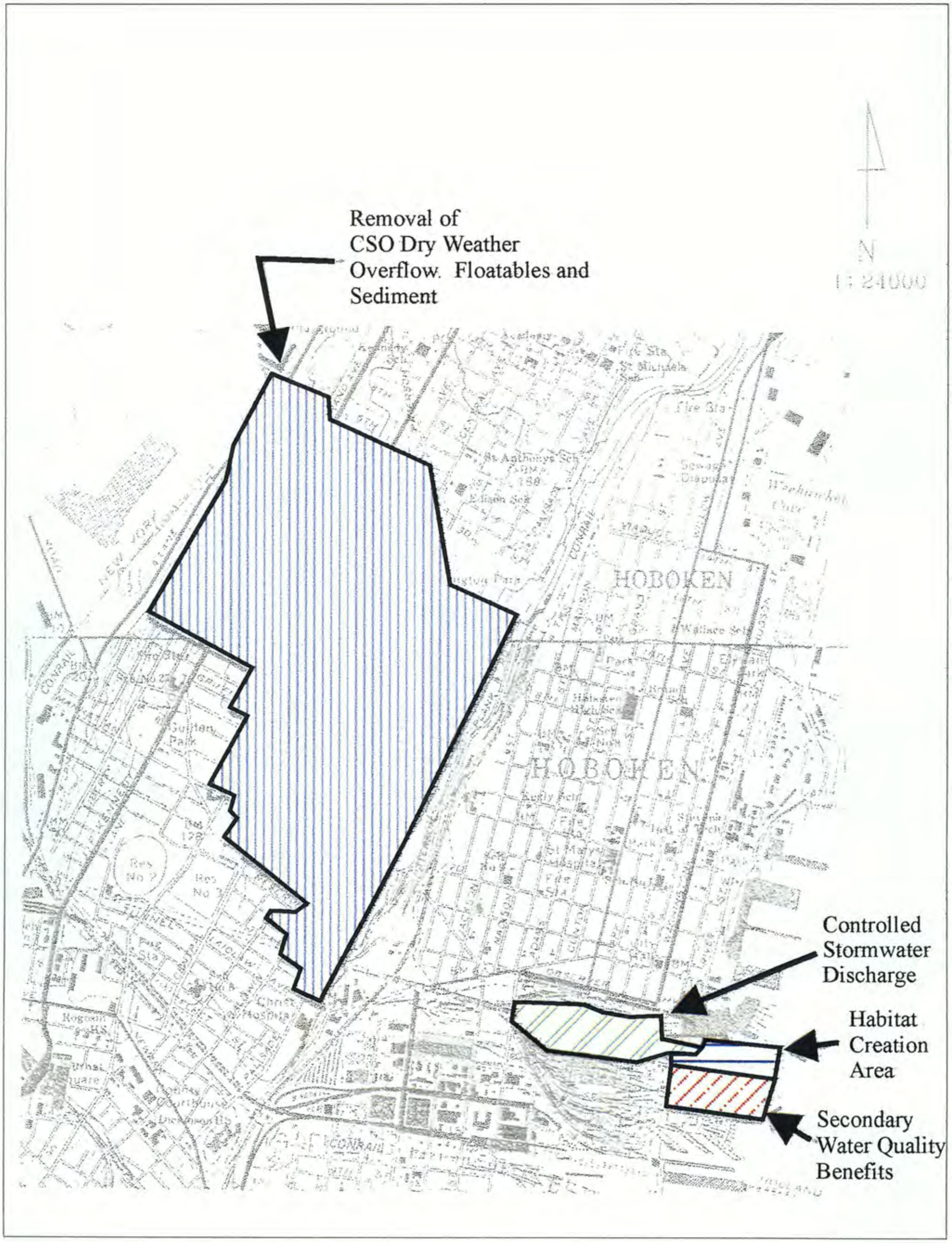


Figure III-5 – Area Improved by Mitigation Plan

- The shoal at the east-end of the canal entrance basin (along the edge of the main river channel) perpetuates this condition. Also because this shoal prevents communication with deep river waters, the waters within the canal entrance basin are stratified. Stagnant areas also occur in the canal entrance basin, particularly in the northwestern corner near a CSO outfall.

- Sediment oxygen demand - Because of the lack of circulation and conditions conducive to the deposition of silts and clays, the oxygen demand of the water is transferred to the sediments and stored. Canal sediments contain such high sediment oxygen demand (SOD) that water quality will be degraded for months or years if the CSO discharges were completely discontinued.

These conditions prevent utilization of the interpier area by most organisms, particularly fish. The mitigation program addresses each of these causes of degraded water quality.

2. AGENCY COORDINATION

This mitigation program was developed with guidance and input from the federal and state resource protection agencies (See Section V – "Agency Coordination and Public Outreach") At on-site meetings with the EPA, NMFS, and the COE (December 11, 1998), and with NJDEP (December 17, 1998) it was agreed that the additional project activities to improve water quality, create fish habitat and expand public access, recreation, and education opportunities could be acceptable mitigation for the filling of the canal when in conjunction with compensatory wetlands creation or enhancement. Accordingly, a mitigation proposal for the creation of compensatory wetlands was developed.

The wetland mitigation plan is also described in detail in Section IV-F – "Wetlands" below. Table III-3 summarizes the mitigation measures and the area affected by each component.

3. HABITAT CREATION PLAN

To mitigate the Long Slip CDF, NJ TRANSIT will establish fish habitat appropriate for this reach based on available data concerning seasonal river populations where none now exists. Improvements to dissolved oxygen levels resulting from reduced pollutant loading combined with increased circulation will restore healthful conditions for fish and their supporting biological communities in the canal entrance basin, the adjacent 7-acre pile field, and the 10.5 acres of open water to the south. (see Figure III-6). The surfaces and crevices of the rip rap armor at the toe of the containment dike will greatly increase available shelter and attachment substrate for various benthic and aquatic species, providing in turn, protected feeding, nursery, and/or spawning habitat for fisheries. Fisheries will benefit from the net positive impact on river life and diversity created by the project. River flows past the canal will be modeled for oxygen and flow, and riverbed conditions will be established to optimize the locale as a fish and benthic habitat.

Table III-3 Summary of Alteration and Mitigation Acreages

Activity	Habitat Alternative (Acres)
Alterations	
Canal (filling)	4.6
Excavation	4.1
Total Alteration	**8.7**
Mitigation Measures	
Created fish habitat	26.1
Improved circulation and DO levels	11.1[(a)]
Improved substrate for shelter and food sources	0.1
Removal of contaminated bottom sediments	36-106[(b)]
Removal of CSO dry weather overflows, floatables, and sediment	>381[(c)]
Controlled non-point source discharge	19
Compensatory wetlands	9.1
Total Mitigation	**483-553**
Net Improvement	**475-545**

Notes:

(a) Adjacent and remaining portions of 37-acre interpier area.

(b) Equivalence of volume contained by CDF to bottom sediment removal depths of 1 to 4 feet, plus project acreage.

(c) City of Hoboken sewer maps are incomplete regarding the total area contributory to the storm sewer outfall in Long Slip Canal and the canal entrance basin. The drainage of the Jersey City CSO is 381 acres.

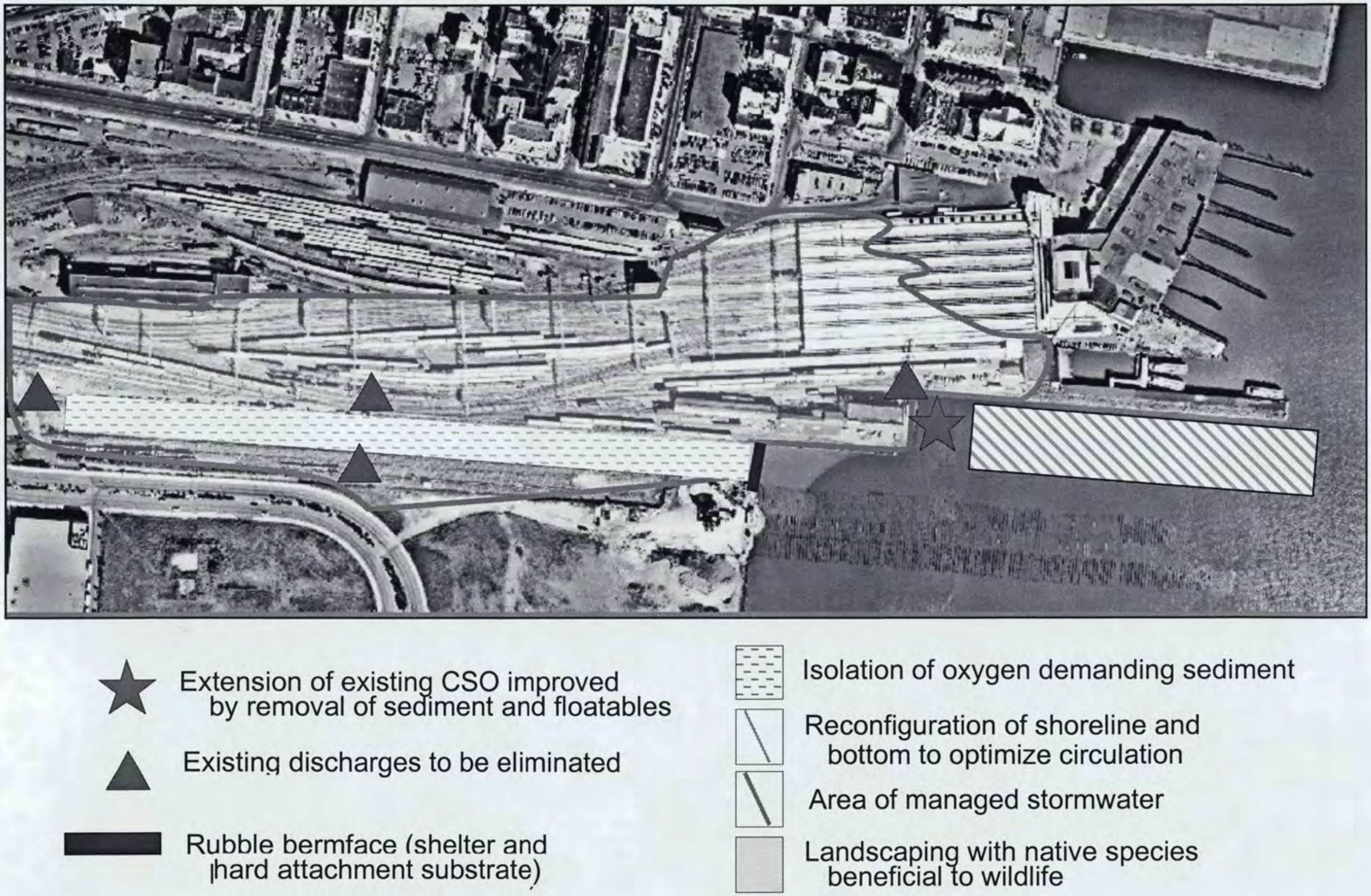
(d) Wetlands would be established off-site.

4. Specific Mitigation Components

The Habitat Creation Plan addresses each cause of degraded water quality. The habitat creation area consists of the canal entrance area, the northern pile field and open water to the south, a total area of 23.3 acres, of which 7.0 acres are open piles. The remainder of the interpier area, 11.1 acres, will also benefit from these improvements but were not specifically modeled. Though the local area will see the greatest improvements, the entire estuary will benefit from the incremental effects of reduced pollutant loading, BOD, and COD resulting from this project. Specifically, this mitigation alternative consists of the following components.

- CSO improvements - The Jersey City and the Hoboken Park Street CSOs will be improved by a net to recover floatables, an in-line storage tank to capture sediment, and repairs to the tide gate. The outfall will be extended to the canal entrance basin where the waters will have a greater potential for rapid dispersion and flushing. Floatables will be recovered from the Hoboken CSO.

Figure III-6 Summary of Measures to Create Interpier Fish Habitat



Dames & Moore

- Non-point source discharges – The proposed walkway and fill will facilitate the containment and treatment of stormwater prior to discharge. Stormwater from the walkway, plus runoff from over 20 acres of the rail yard that now discharges directly to the canal, will be conveyed through oil and sediment separators.

- Sedimentation - Installing the holding tanks and extending the CSOs to deeper, better circulating waters will produce sediment inflow and turbidity in the canal entrance basin. Filling the canal will eliminate scour discharges from the canal.

- Circulation and flushing - Removing the sources of pollution to the interpier area will not address the problems of stagnation and stratification. This requires alterations to the bottom topography that allow canal entrance basin waters full communication with both surficial and bottom waters of the main river channel so that vertical mixing can occur. We propose to accomplish this by removing the shoal along the edge of the main channel at the eastern part of the canal entrance basin. Additionally, the slope of the walkway berm is designed to beneficially distribute wave energy.

Because the mitigation was developed and optimized from an ecosystem perspective, the greatest benefits result from the combined improvements proposed. Pollutant loads will be reduced through the upgrades to the Jersey City and Hoboken CSOs and the control of non-point source discharges. Circulation will be improved through the combination of the realigned shoreline resulting from the walkway and alterations to bottom topography by dredging to remove the shoal at the canal entrance basin. Both steps are necessary to achieve the maximum benefits. Reducing sediment load will improve, but not eliminate the sediment oxygen demand or the stratification that currently exists. Improving circulation without reducing the pollutant load may improve somewhat conditions locally, but the pollutants will move off-site and degrade a larger area. Intuitively, the greatest benefits are derived from the combination proposed here.

The proposed configuration was based on a three-dimensional water quality model developed to assess various alternative configurations. (See Section IV-E - "Water Quality" for a description of the model and results.) In all cases the total area of alteration for the walkway plus the excavation is the same, though the area altered by each varies proportionally within each alternative. The proposed alternative results in the most benefits with the minimum amount of fill. It should be noted that a small additional fill will yield the optimum ecological configuration and the greatest water quality benefits. It would also require up to 50 percent less excavation than the other walkway alternatives, and provide most easily for the disposal/entombment of the excavated material. The resulting excavated slope would be more self-scouring and enduring than under other alternative walkway configurations.

5. Combined Sewer Overflow Improvement Plan

The project site has been developed for over 100 years. During that time there has been considerable expansion and re-arrangement of support facilities, including infrastructure, throughout the site. Historically, economic expediency has overridden the concerns of environmental quality that only recently have lead to the establishment and enforcement of construction and wastewater and stormwater treatment standards. As was common, wastewater and storm drain lines were not recorded or maintained and discharges were not treated. Over the past few years, NJ TRANSIT has identified and eliminated minor discharges from various crew and maintenance facilities. Both the Jersey City Sewage Authority and the North Hudson Sewer Authority, who govern sewer systems in Jersey City and Hoboken, respectively, are developing and implementing plans to comply with the U.S. Environmental Protection Agency's 1995 Final CSO Control Policy enforced through the NJDEP New Jersey Pollutant

Discharge Elimination System General Permit for Combined Sewer Systems issued January 27, 1995 (NJDEP General Permit). This project will contribute to that effort.

Recent field investigations (NJ TRANSIT, 1995a; CH2M Hill, 1996; and JCSA, 1995 and 1996) revealed that Long Slip Canal receives combined sewer overflow (CSO) discharges from two outfalls (see Section IV-E "Water Quality", below). One of these, the Park Avenue Sewer, also known as H0, conveys flows originating in Hoboken and the other conveys flows from Jersey City. In addition, two outfalls from the PATH sump system discharge into the canal via Caisson 2. A detailed description of the existing outfalls and the characteristics of their discharges is presented below in Section IV-E, "Water Quality".

The Hoboken H0 and H1 CSO's will no longer discharge into the canal entrance basin or the NJ Transit Hoboken Terminal site. The NHSA has decided to construct a new outfall as a separate, independent project. As part of that project, the H0 and H1 discharges (into Long Slip canal and the canal entrance basin, respectively) will be eliminated at their regulators in Observer Highway. A new regulator that combines the Observer Highway line with other lines will be constructed. The reconstructed outfall would continue to discharge into the Hudson River north of the Hoboken Terminal and NJ Transit property.

A combination of efforts between NJ TRANSIT and the JCSA will improve the quality and quantity of CSO discharges beyond minimum compliance with the NJDEP General Permit. The measures to be implemented were set forth in the 1995 CSO abatement study (JCSA, 1995) that developed specific measures for DWO elimination and solids/floatables abatement to comply with the US Environmental Protection Agency 1995 Final CSO Control Policy and NJDEP General Permit. In its proposed operations and maintenance (O & M) plan (JCSA, 1995), JCSA indicated that a real-time control, completely automated flow regulator control system will be installed in the 18th Street regulator to correct the current design deficiency. JCSA also proposed to remove or modify the diversion chamber coarse screen, institute system-wide O&M improvement and pollution prevention programs, and upgrade catch basin gratings. JCSA also will maintain the in-line collection system. These improvements will be accomplished through the Long Slip project. NJ TRANSIT will construct the system improvements and after construction ownership will be transferred to the JCSA. A letter of agreement between NJ TRANSIT and JCSA is included in Appendix 1.

The system improvements will consist of both sediment and floatables collection systems and new tide gate. In addition, an alternative for subsequent treatment and discharge to an innovative baffle CSO treatment facility may be constructed in the waterfront basin just east of the 100-foot wide section of Long Slip Canal. Discharges from the PATH sumps will tie into the CSO extension. No further treatment is proposed, since the PATH discharges already comply with their permitted quality standards.

The CSO extension routing alternatives are driven by construction sequence considerations and the need to avoid the Hudson-Bergen Light Rail Transit system alignment. After a review of several options, NJ TRANSIT found the best route will be to extend the Jersey City CSO within the bed of 18th Street and follow the curve to Newport City property along the southern edge of the NJ TRANSIT property (the portion south of the existing canal known as Yard A). Zoning precludes development within boundary setbacks and no loss of convenience or use of property to Newport is anticipated. Since there will be no manholes along this stretch, no need for maintenance requiring access across the property is foreseen. The extension would connect to the existing sewer at 18th Street and Marin. At that point the existing sewer is 10 feet wide. Between Marin and the Newport property, the CSO route would be under the 18th Street sidewalk to avoid known buried utilities that include a 30-inch water supply main, a 15-inch storm sewer, several 8-inch PVC conduits, and a fiber optic cable. The preferred location for the net and tank is off of Henderson St in the west end of the rail yard. The new outfall will be in the deeper, better circulating waters of the canal entrance basin.

6. EXCAVATION PLAN

Up to approximately 80,000 cubic yards will be excavated from the canal entrance basin. As discussed above in Section I "Introduction", the purpose of this work is to improve circulation in the basin and pile field areas by the removal of a shoal at the east end of the basin. The footprint of this dredging will be approximately 270 feet wide (in the north-south direction) and 900 feet long (east-west), covering about 4.1 acres of the entrance basin. A nearly 15-foot wide no-dredge buffer will be held along the north and south so that existing pier and piles, respectively, will not lose toe support. The typical slope of the cut will be about 1:10. All dredging will be outside of the Hudson River federal navigation channel and will not occur in areas deeper than 30 feet MSL. Figures III-7 and III-8 below illustrate the bottom topography before and after excavation. The impacts and benefits of this excavation are presented below in Section IV-E "Water Quality" and Section IV- "Ecologically Sensitive Areas".

Best management practices for dredging recommended by *The Management and Regulation of Dredging Activities and Dredged Material in New Jersey's Tidal Waters* (NJDEP, 1996) will be used. The dredge will be a closed clamshell bucket to minimize material losses and the associated turbidity. Bottom sediments will be dredged in lifts so that material unsuitable for ocean disposal will be separated from the underlying clean fine grained material. Surficial dredged sediments that are likely to be unsuitable for ocean disposal will be loaded onto barges - that will be off loaded into the canal and the material discharged in slurry form through a hinged bottom or sides. Stiffer, underlying clean material may require alternative methods for

placement. Hydraulic methods will not be used because the large volume of water entrained effectively increases the volume of material requiring disposal. Deeper, uncontaminated, fine-grained materials may be used for capping the CDF.

7. MONITORING PROGRAM

Following construction, NJ TRANSIT will establish a monitoring program to ensure the effectiveness of the habitat creation program (see Section IV-E "Water Quality").

8. COMPENSATORY WETLANDS PLAN

MIMAC and NJDEP approved a proposal by NJ TRANSIT to purchase 9.12 acres of the Marsh Resources, Inc. mitigation bank in the Hackensack Meadowlands. (See Section IV-F "Wetlands").

9. PUBLIC WALKWAY

The walkway alternatives were developed to serve two functions within the constraints of available space and existing land use, public safety, the geometry of the site, and the requirements of the HBLRT. First, the walkway will provide waterfront public access and recreational

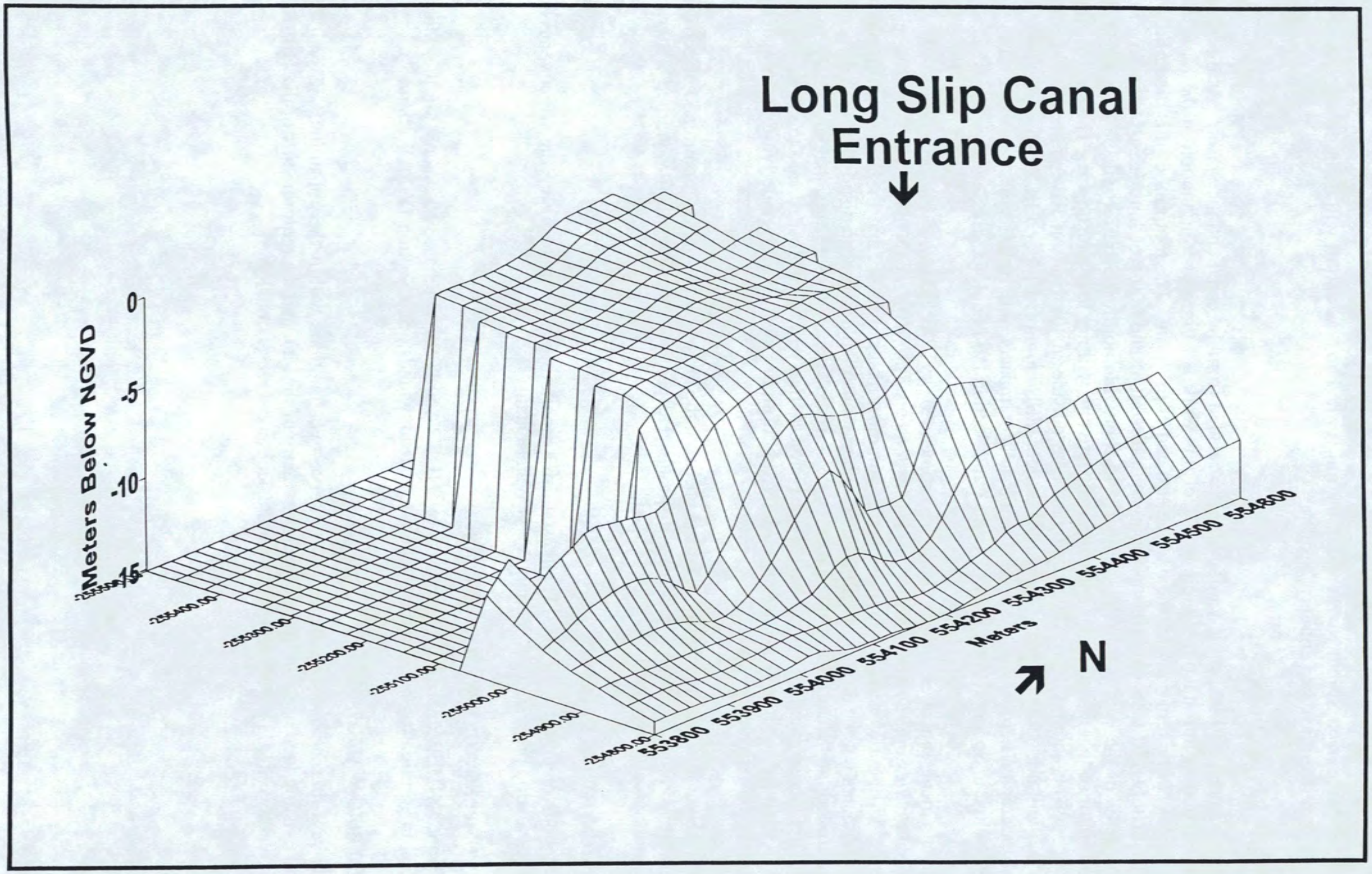


Figure III-7 - Existing Bottom Topography

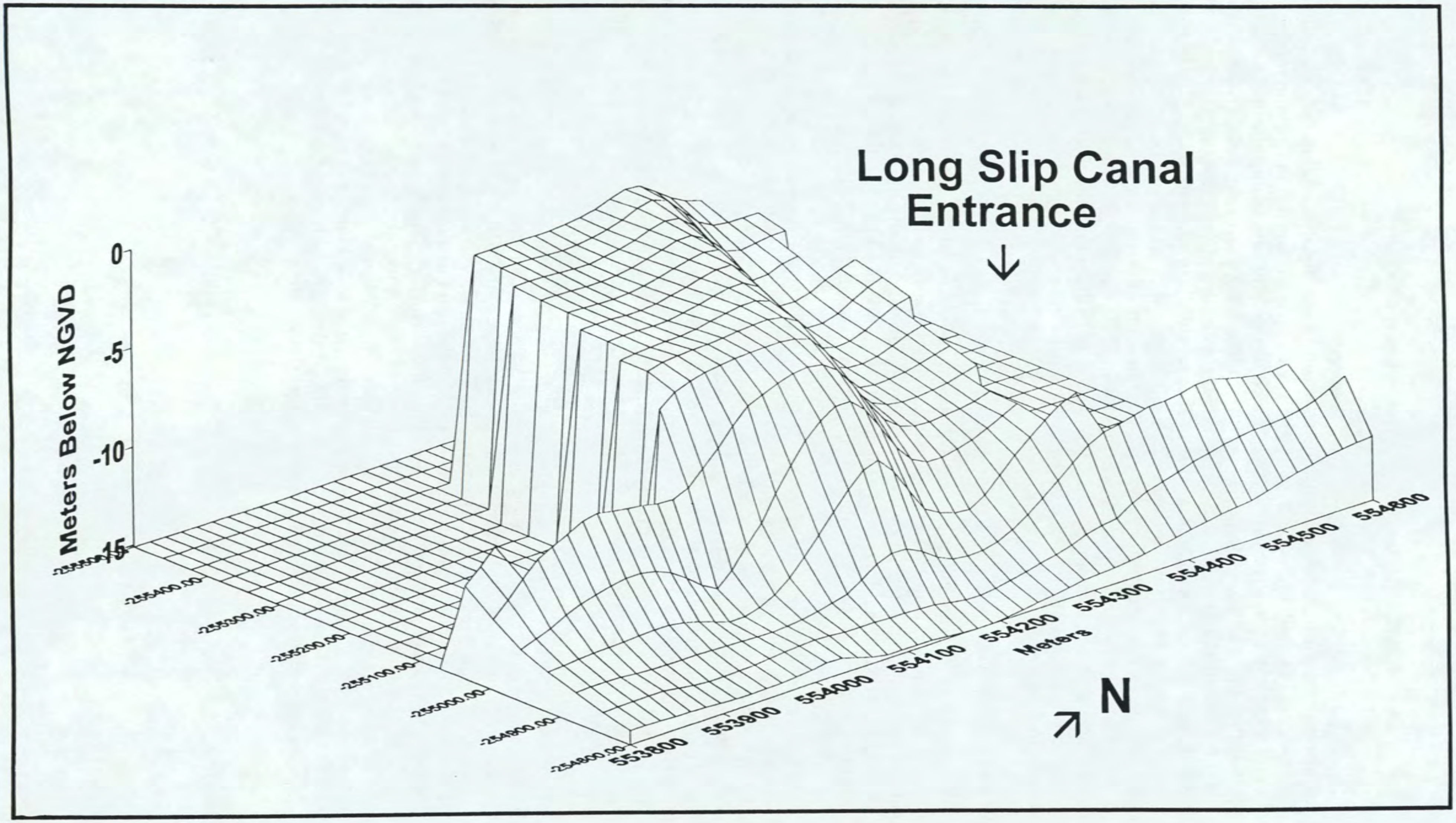


Figure III-8 - Proposed Bottom Topography opportunities to commuters and local residents. It also will create direct access to the terminal for Newport City residents. Second, the walkway will be a key element of the Habitat Creation mitigation plan . Each component of that plan is controlled or affected by the walkway alignment and construction method (i.e., whether the walkway is on piles or fill). Optimizing the ecological benefits of this alternative requires consideration of the walkway within the dynamics of the canal entrance basin, the adjacent interpier area, and the open Hudson River. The three walkway alternatives presented below provide a range of habitat improvements balanced against various levels of alteration to the canal entrance basin required to achieve these benefits. The three-dimensional numerical model used to evaluate the alternative walkway configurations is described in Section IV- E "Water Quality". Note that the modeling was completed on alternatives developed prior to the siting of the HBLRT terminal in the canal entrance basin. The model results provided guidance needed to optimally incorporate the HBLRT terminal into the habitat creation plan.

a) Walkway Alternatives

The following walkway configurations were developed and evaluated to determine the optimal configuration for rail yard use, public access, integration with the sewer system improvements and the HBLRT and that yields the highest water quality in the entrance basin and adjacent interpier area. Each alternative is described below and illustrated in Figures III-9, III-10, and III-11. Table III-4 at the end of this section presents the results of the evaluation of the relative merits of each alternative.

Walkway Alternative 1 – the Preferred Alternative - Walkway Alternative 1 would be a 950-foot long on-grade walkway that is fully integrated with the HBLRT terminal (see Figure III-9). This is the preferred alternative because it requires no additional fill. Only the southernmost 100 feet where it crosses the canal entrance berm would be on fill. The walkway will have direct access to the HBLRT terminal and will contain pedestrian plazas for sitting and viewing. All waterfront between the Immigrant Building and the Canal berm will be available for public access. The required bikeway may utilize the access road planned for the north side of the HBLRT terminal in order to avoid conflicts with pedestrians. The minimum combined walkwaybikeway width will be 30 feet, but this minimum will be exceeded for most the length.

Walkway Alternative 2, - This alternative minimizes additional fill while providing a wide range of ecological, public access, recreation, education, transportation, and construction benefits. The walkway would extend from the Immigrant Building along the outside edge of the HBLRT terminal and tracks to the southern canal bulkhead (see Figure III-10). The 950-foot long walkway would be constructed on a rip-rapped dike. Its 30-foot width would include both pedestrian and bicycle paths and be wide enough to accommodate light to medium-weight service and security vehicles. Approximately 55,000 cubic yards of fill can be contained within the dike. The source of this fill would either be the sand used to surcharge the dredged materials placed in Long Slip Canal or material excavated from the canal entrance basin habitat area. The nearly one acre of new land created would further support off-peak train storage. In addition, the land would house the floatable and sediment removal equipment for the Hoboken CSO and allow truck access for removal of sediment and debris.

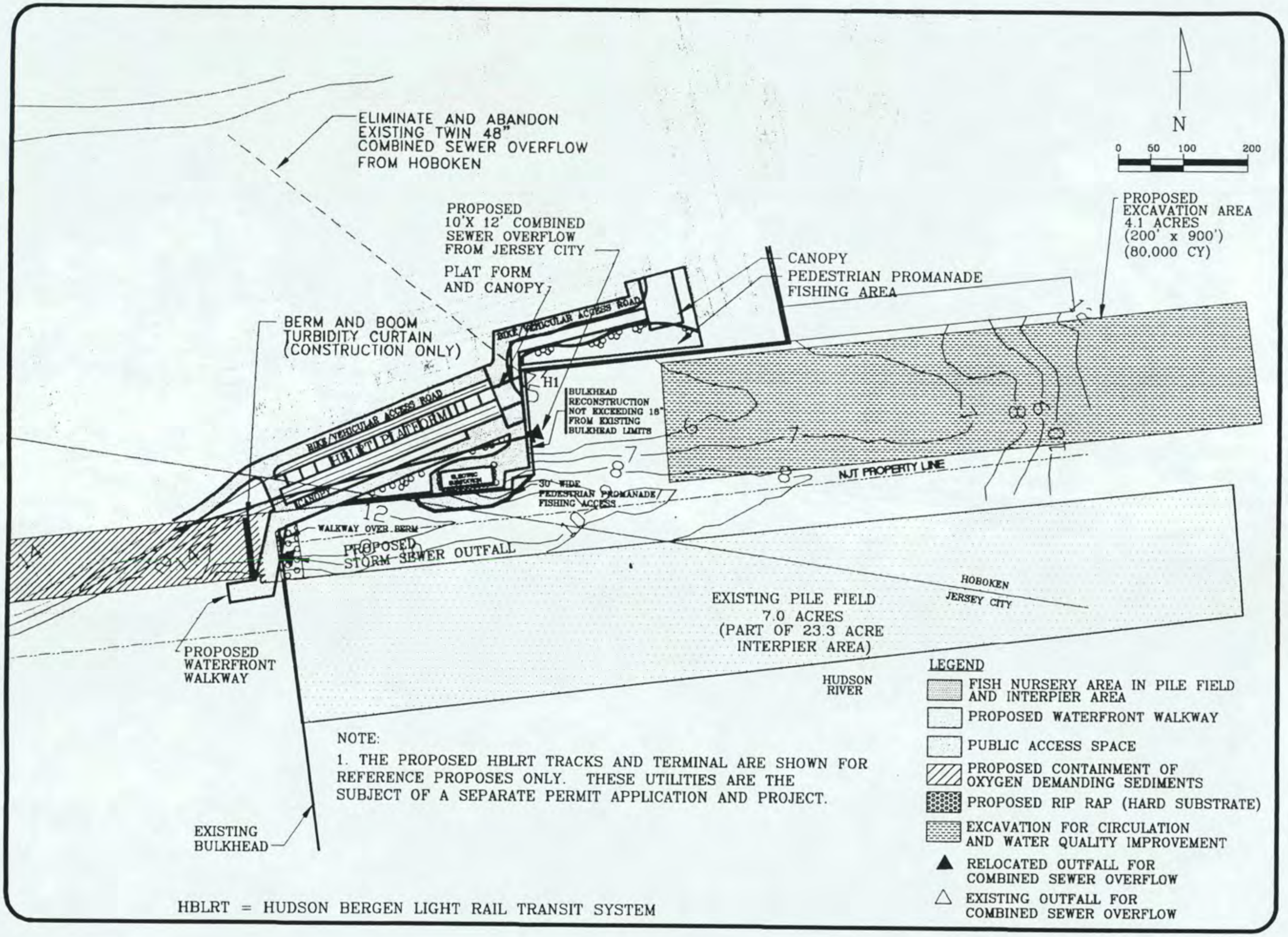


Figure III-9 Walkway Alternative 1

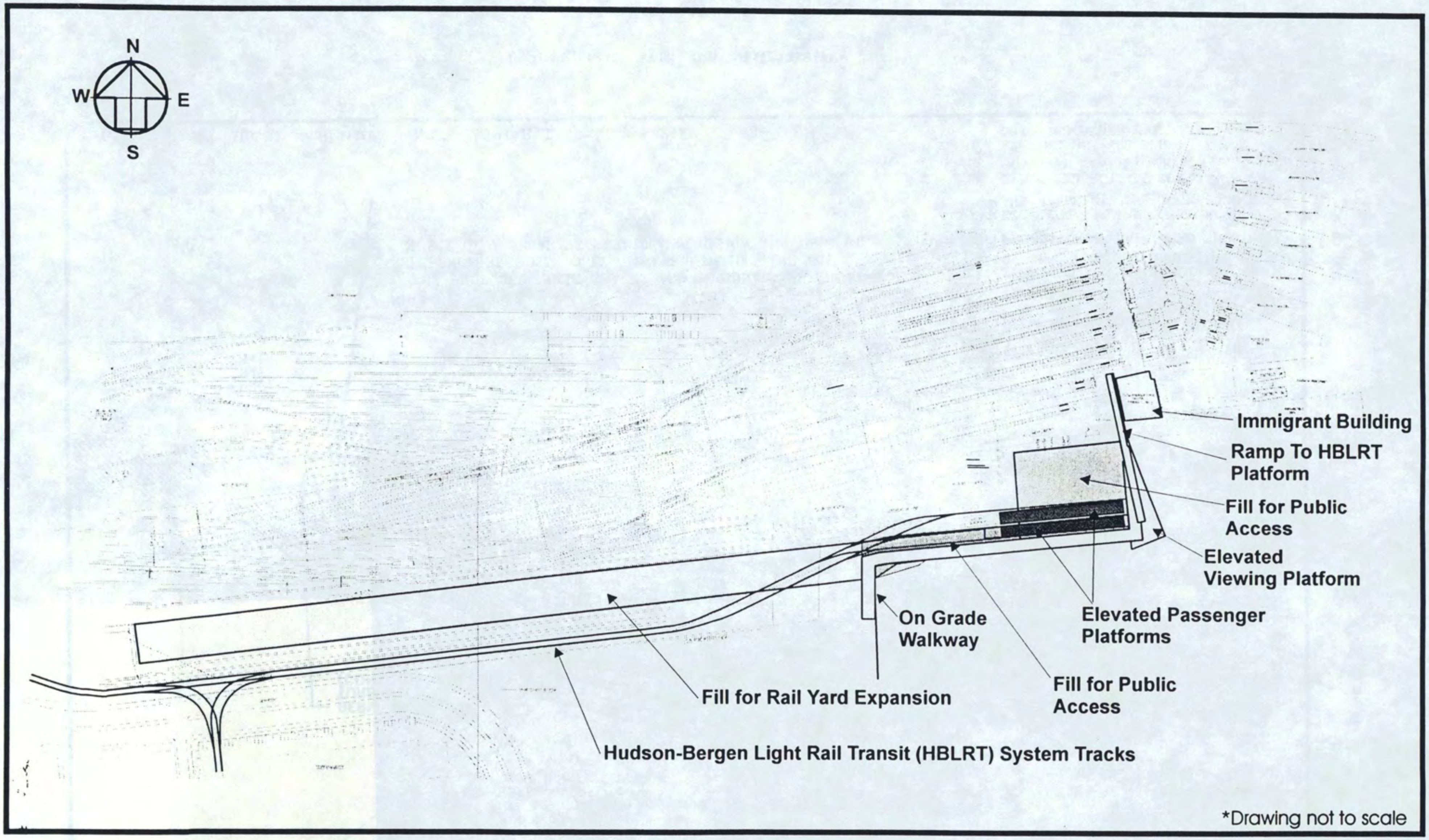


Figure III-10 - Walkway Alternative 2

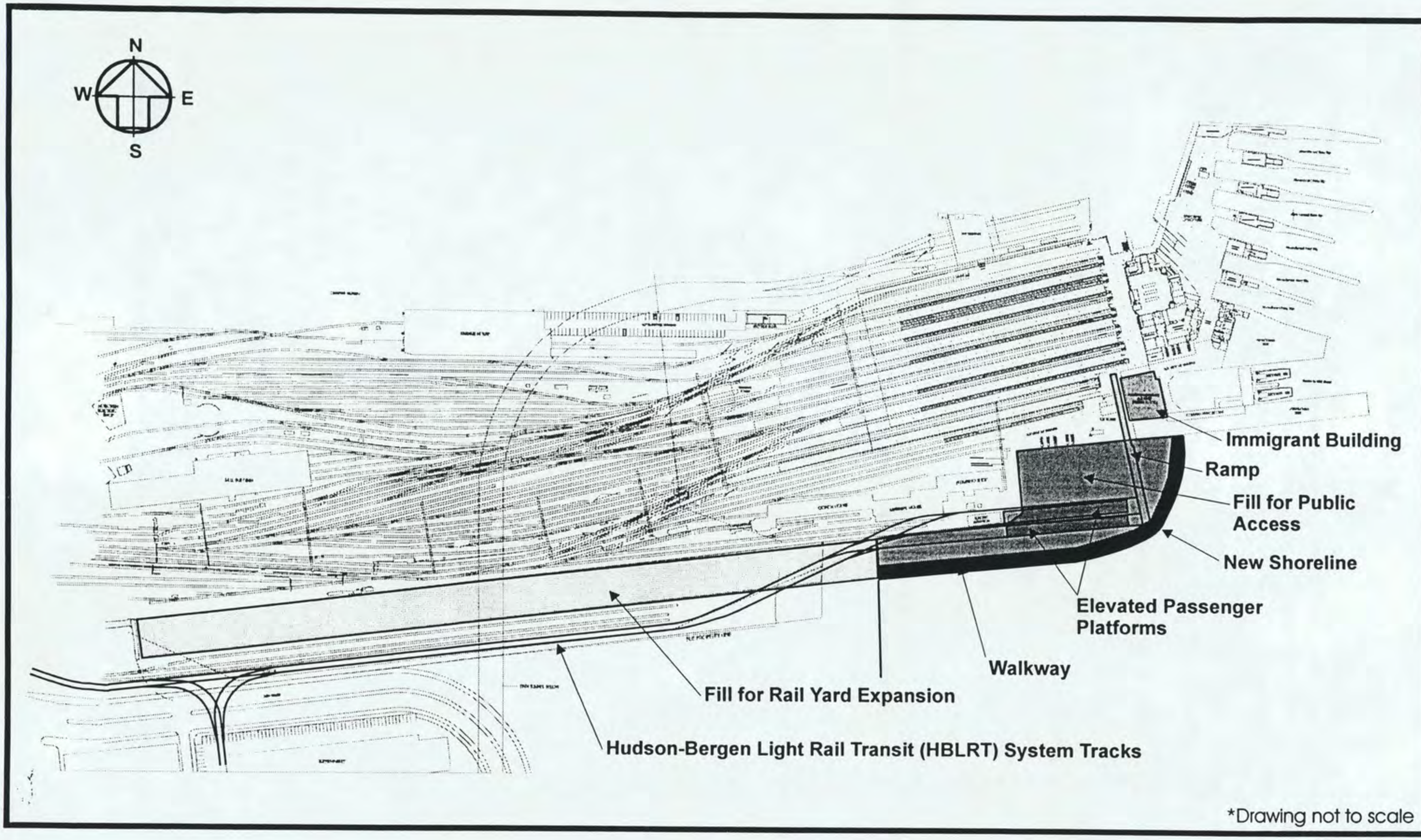


Figure III-11 - Walkway Alternative 3

Walkway Alternative 3 - This walkway layout is the optimal ecological alternative because it maximizes both environmental and social benefits. It would have the same endpoints as Walkway Alternative 2, and also would be 30 feet wide. It would be constructed on top of a rip rapped dike. The 950-foot long structure would arc to the edge of the pile field and then parallel the edge of the piles to the existing bulkhead (see Figure III-12). Approximately 73,000 cubic yards of fill could be contained within the dike (in addition to the volume contained within the canal). The source of this fill would be either the sand used as surcharge for dewatering the Long Slip Canal fill or additional dredge sediment.

b) Evaluation of Walkway Alternatives

Alternative 1 provides the least alteration of open waters, addresses CSO compliance, and improves water quality in the canal entrance basin. This alternative allows NJ TRANSIT to meet the minimum yard expansion requirements, creating the approximately 55-62 midday train storage slots defined in relevant planning studies cited in the permit application. Alternatives 2 and 3 offer 62-67 storage slots by virtue of the additional fill sought outside the mouth of the Long Slip (behind the walkway). Accordingly, while Alternative 1 provides some measure of improved operability of the yard as projects now in construction come on line, Alternatives 2 & 3 bring the yard most nearly to its optimum design.

While Alternative 1 meets the basic objectives of the project, it ranks lowest regarding environmental quality from several respects. Alternatives 2 and 3 yield successively improved environmental quality in the waters of the canal entrance basin and the adjacent interpier area (see Section IV-E "Water Quality", below).

Alternatives 2 and 3 better address the existing conditions that degrade the interpier waters and make them unsuitable for fish habitat. For example, the Alternative 1 walkway does not fully address the stagnant north west corner of the canal entrance basis. Currently, that portion of the basin receives the discharges from the Hoboken Regulator H1 combined sewer. Field data and analysis confirmed by the model found the area waters to be stagnant and stratified (Guida, 1997; Dames & Moore, 1997). That this is the shallowest area of the basin, probably is the result of the sediment-laden CSO discharges and the lack of circulation and flushing. Modeling results indicate that some stagnation will remain even after the shoal to the east is excavated. Walkway Alternative I may also introduce shadow impacts. Alternatives 2 and 3 both eliminate or minimize these conditions.

Alternatives 2 and 3 facilitate additional mitigation measures that will improve water quality. The filled area of Alternatives 2 and 3 provides easily accessible space for siting and servicing the trash net and sediment tank for the Hoboken combined sewers. Filling prescribed by Alternatives 2 and 3 eliminates an additional 2.8 to 4.2 acres of sediment oxygen demand, isolates over 55,000 cubic yards of dredged material not suitable for ocean disposal and enhances circulation in the canal entrance basin.
Finally, the fill proposed under the Alternatives 2 and 3 will provide structural support, allowing the CSO to be extended farther east at relatively low cost. The cost savings to the taxpayer for this improvement is estimated at several million dollars.

Although Alternative 1 meets the objectives of a limited rail yard expansion and enhances environmental quality, Alternative 1 provides the least engineering and environmental benefits. Alternative 2 requires the minimum practicable amount of fill and provides much greater cost savings, service, and ecological benefits. This assessment, summarized in Table III-4, found that each alternative improves the existing condition, and that Walkway Alternative 3 (the filled public access area) yields the optimum ecological and social benefits. Walkway Alternative 2, the Proposed Alternative, provides comparable benefits but to a lesser degree reflecting the reduced area of new fill. Specifically, these provide the following benefits:

- CSO improvements –Walkway Alternatives 2 and 3 facilitate the extension of the outfall will be extended to the canal entrance basin where the waters will have a greater potential for rapid dispersion and flushing.

- Sediment oxygen demand - The highly oxygen-demanding sediments in the canal and portions of the canal entrance basin within the walkway footprint would be buried and isolated from the system by containment berms and capped. Between 133,000 to 230,000 cubic yards of dredged material not suitable for ocean disposal from elsewhere in the estuary would be removed from the ecosystem and isolated in the canal. Up to 73,000 cubic yards of surficial sediments east of the walkway would be excavated and isolated within the public access area and walkway.

- Non-point source discharges - Walkway Alternatives 2 and 3 would facilitate the containment and treatment of stormwater prior to discharge. Stormwater from the walkway and public access area, plus runoff from over 20 acres of the rail yard that now discharges directly to the canal, would be conveyed through oil and sediment separators.

- Circulation and flushing – Walkway Alternatives 2 and 3 eliminate a stagnate area of the canal entrance basin. Alternative 3 provides the optimal configuration of bottom topography that allow canal entrance basin waters full communication with both surficial and bottom waters of the main river channel so that vertical mixing can occur would address the interpier area problems of stagnation and stratification. Additionally, the alignment and slope of the walkway berm are designed to beneficially dissipate wave energy.

Some difference in performance between Walkway Alternatives may emerge in the longer term. Alternatives 2 and 3 are predicted to yield similar results under low DO concentrations. The design of the Walkway Alternative 3 excavation may prove more likely to be self-maintaining for a longer period due to its steeper slope. The amplitude of the tide and magnitude of currents entering the cut from the Hudson River will be identical, whereas tides and currents at the west end of the Alternatives 1 and 2 cuts will be weaker compared with the Alternative 3 cut. Gradual re-shoaling due to deposition of fine-grained sediments within the interior of the Alternatives 1 and 2 cuts may be somewhat more likely compared with Alternative 3.

All alternatives that include fill eliminate the costly rehabilitation of the existing bulkheads that would be needed if they remain exposed. Walkway Alternative 3 provides the greatest storage capacity for excavated materials, reducing or eliminating the potential need for off-site disposal. The fill alternatives all provide additional area for public access that could be developed as railyard, educational, recreation or retail (such as concessions) uses.

Table 0-4 Summary of Walkway Alternatives Assessment

Characteristic	Existing	Walkway 1	Walkway 2	Walkway 3
Construction				
Walkway length (feet)	NA	950	950	950
Walkway width (feet)	NA	30	30	30
Foundation	NA	Existing fill	Fill	Fill
Usable area (acres)	0	0.1	1.7	3.1
Area of fill [1] (acres)	NA	0	2.8	4.2
Excavation (acres)	NA	4.1	4.1	4.1
Excavation (cubic yards)	NA	80,000	80,000	80,000
Storage behind walkway (cubic yards)	NA	0	55,000	73,000
Created Habitat (acres)				
Rip rap[2]	0	0	0.8	0.9
Canal entrance basin[3]	8.6	8.6	6.5	4.4
Open piles[3]	7.0	7.0	7.0	7.0
Open water south of north pile field[3]	10.5	10.5	10.5	10.5
Shadow impacts	NA	2	None	None
Wave attenuation	Low	Low	Slight	High
Water Quality *(percent of model area)*[3]				
Spring conditions[4] of DO $\geq$ 5.0 mg/l	30	92	NA	100
Spring conditions of DO $\geq$ 9.0 mg/l	5	30	NA	98
Summer conditions of DO $\geq$4.0 mg/l	30	92	NA	98
Summer conditions of DO $\geq$ 6.0 mg/l	0	15	NA	35

Notes:

1 Consists of public access area, walkway, and berm.
2 Area of rip rap available as substrate and shelter (MHW to mud line).
3 Area within model boundary, a 26-acre area consisting of the canal entrance basin, the north pile field and the open water immediately south of the north pile field. An additional 11.1 acres of adjacent interpier open piles and open water also will benefit from the water quality improvements.
4 Spring conditions represent an annual average; summer conditions represent annual extremes.

IV. ENVIRONMENTAL EVALUATION

A. LAND ACQUISITION AND DISPLACEMENTS

The Build Alternative will occur entirely within the existing boundaries of the Hoboken terminal property. No displacement of persons or properties will result. NJDEP determined that in a June 6, 1996 letter that all tidelands were conveyed to NJ TRANSIT (see Appendix 1). However, a 50-foot wide strip in the canal entrance basin north of the pile field will be obtained from the abutting owner in the south, Harbor Development Corporation, in order to construct the walkway. Additionally, a 7500-foot easement along the north boundary of the Newport Center property will be needed for the Jersey City Sewer extension. These are not anticipated to be problematic because NJ TRANSIT has the right of eminent domain and because any future development of the Newport Center property will be required by NJDEP to connect to the Hudson River Waterfront Walkway. The new sewer easement could serve as that public connection.

Approximately 5 acres will be acquired for the construction of compensatory wetlands. Several sites located along the lower Hudson River and Kill van Kull currently are being evaluated by the NJ TRANSIT real estate department (see Section IV-F "Wetlands"). The land will be vacant and undeveloped. The taking will involve no displacements or demolition.

B. LAND-USE AND ZONING

All project activities will occur within the existing boundaries of the Hoboken terminal. No change of use is proposed. This site has been a rail yard for over 100 years; that use will be continued and enhanced. Surrounding land-uses, primarily commercial and industrial, are compatible and take advantage of the transportation opportunities offered by the facility.

The site is zoned for Industrial (I2) use in Hoboken and in Jersey City the site is zoned as Newport Redevelopment District. This zoning supersedes any other zoning classification and is considered a special classification. However, since the property is owned and operated by a state agency, municipal zoning regulations do not apply per Formal Opinion No. 4 - 1978 of the Attorney General of New Jersey.

C. AIR QUALITY

This section evaluates the significance of potential air quality impacts of the proposed project. The current status of air quality in the vicinity and region of the project is discussed and potential impacts related to emissions from project are summarized and compared to identified significance criteria.

1. EXISTING SETTING

a) Relevant Pollutants

Federal and state regulations have established standards for a group of six air pollutants that are used to classify air quality. The specific pollutants are as follows:

- Carbon Monoxide (CO) - a colorless and odorless gas primarily associated with the incomplete combustion of fuels;

- Nitrogen Oxides (NO_X) - a class of compounds that includes nitrogen dioxide (NO_2) and nitric oxide (NO), also primarily related to combustion;

- Ozone (O_3) - a principal lung and eye irritant found in air of urban environments, formed in the atmosphere from a series of reactions involving nitrogen oxides and hydrocarbons in the presence of sunlight and usually a concern during stagnant summer weather;

- Particulate Matter (PM-10) - sometimes called inhalable particulates, suspended particles in the air with aerodynamic diameter smaller than or equal to 10 microns in size, airborne particles in this size range are of concern because of the potential to lodge in breathing passages;

- Sulfur oxides (SOx) - a class of compounds including sulfur dioxide and sulfur trioxide, primarily related to the combustion of fuels containing sulfur, mostly associated with burning of fossil fuels to produce electricity; and,

- Lead (Pb) - a stable, persistent compound that accumulates in living organisms and the environment.

These pollutants are found in our atmosphere primarily as result of human activities and the emissions from various mobile and stationary sources. When combined with dispersion affects related to climate, metrology, geography, and upwind air quality, the quantity of air emissions and distribution of emission sources is the primary factor that influences the air quality of a region. Therefore, assessment of the impacts of the proposed project focuses on the emission of air pollutants.

b) Air Quality Standards and Pollutants

The criteria for clean air or good air quality, is that the air in an area is found to have low concentrations of the six pollutants presented above. Areas are classified as either in attainment of, or various degrees of non-attainment of, national ambient air quality standards (NAAQS) that have been established for these "criteria pollutants". The Federal and State ambient air quality standards are summarized in Table 1 of the "1995 Air Quality Report" prepared by New Jersey Department of Environmental Protection (NJDEP, August 1996), a copy of which is included in Appendix 2 of this assessment. If a region in a state is classified as non-attainment, the state must submit to the Federal EPA for approval, a State Implementation Plan, or SIP, which demonstrates how the State will bring the region in to compliance with the NAAQS.

c) Existing Air Quality in the Project Area

The Northern New Jersey/Metropolitan New York region is classified as severe non-attainment for ozone. Ozone is a regional concern because of its persistence and ability to be transported over distances. Ozone can be concentrated in the urban environment over a period several days of hot and stagnant weather conditions. These periods are known as ozone episodes. Monitoring data collected and maintained by the NJDEP indicates that ozone is the only pollutant that consistently exceeds the ambient air standards in the Northern New Jersey/Metropolitan New York region. As shown in Table 10 of the 1995 Air Quality Report (copy included in Appendix 2), several cities with monitoring stations near the proposed project site (e.g. New Brunswick, Bayonne) recorded violations of the ozone standard 1995.

The project area is also in non-attainment of the carbon monoxide NAAQS, although the number and severity of the violations has been decreasing in recent years, primarily due to more effective controls on motor vehicle exhaust emissions. Carbon monoxide is more of a short-term local impact concern because it tends to breakdown quickly and does not tend to accumulate over several days. The North

Bergen monitoring station recorded an 8-hour average concentration of CO of 10.4 ppm during one day in 1995. There have been no violations of the standard in the area since.

EPA in 1997 revised the NAAQS for Ozone by reducing the concentration and increasing the averaging time to a value of 0.08 ppm over an 8-hour period. NJ must now adjust how monitoring data is evaluated according to the new standard and develop a revised SIP to meet the new standard. At the same time EPA also revised the NAAQS for inhalable particulate; however, currently there is not enough monitoring data to establish the attainment status for the project area.

d) Air Quality Significance Criteria

The above summarized non-attainment status of the area for the proposed project and the following three air quality regulatory programs may be used to develop criteria useful in evaluating the significance of air quality impacts of a proposed project.

1. Prevention of Significant Deterioration (PSD): Large stationary emission sources proposing to locate in an attainment area for a pollutant must demonstrate compliance with the PSD program as promulgated in regulations at 40 CFR 52.21. The PSD program contains Major Source Thresholds, which trigger the need to perform a more in depth analysis (see Table IV-1).

2. Non-attainment New Source Review (NNSR): For areas not in attainment for a specific pollutant, new stationary sources of that pollutant must comply with an EPA approved state implemented New Source Review program. New Jersey has established an approved NNSR program with definitions of a Major Source that indicates emission thresholds which require more rigorous review and mitigation of potential emission increases.

3. General Conformity Rule: The Clean Air Act Amendments of 1990 included a program referred to as the General Conformity Rule, which basically requires that no federal action adversely affect the attainment or maintenance of NAAQS in the region of the federal action. The General Conformity Rule became effective on January 31, 1994 and the EPA has issued guidelines to conduct a conformity determination. The guidelines include emission levels for the criteria air pollutants called De Minimis Thresholds. If a project's reasonably foreseeable emissions can be shown to be less than these thresholds, a conformity determination is not required.

Table IV-1 PSD, NSR Major Source and General Conformity Thresholds (tons per year)

Regulatory Program	NOx	VOC	SOx	CO	PM_{10}
NNSR Major Source Thresholds	25	25	100[1]	100	100
PSD Major Thresholds	N/A[2]	N/A	250	N/A	250
Conformity De Minimis Thresholds	25	25	100	100	100
Lowest Threshold - Significance Criteria	25	25	100	100	100

[1] Since the project area is in attainment of SOx and PM_{10}, NNSR does not apply; however, N.J.A.C. 7:27 Subchapter 18 concerning NNSR does regulate sources of these pollutants which exceed 100 tons per year regardless.

[2] N/A means not applicable. As explained in the preceding sections, the project area is not in attainment of the ozone or carbon monoxide standards; therefore PSD does not apply to these pollutants. NOx is a precursor to ozone, so it is also a non-attainment pollutant.

The lowest thresholds for a pollutant from all three programs in the above table are proposed as the emission rate based criteria for evaluating the significance of the potential air quality impacts of the proposed project. If these thresholds are exceeded for a pollutant, a more in depth analysis would be required using air dispersion modeling to estimate if project emissions would cause a violation of the applicable state and national ambient air quality standards. Therefore, the significance criteria used for this assessment are sometimes considered screening level criteria for evaluating the potential for a project to cause significant impacts to air quality.

2. PROJECT IMPACTS

There are two categories of potential air quality impacts of the proposed project. One category relates to the long-term operational impacts. These potential impacts would relate to any increased activity that would result from or be facilitated by the completion of the Long Slip Canal Habitat Creation Project. Short-term project impacts would relate to the air emissions from construction equipment (discussed in below under "Construction").

The objective of the Long Slip Canal Habitat Creation Project is not to facilitate or encourage any increase in long-term activities that would cause air emissions. The reclamation of the canal and yard A to allow increased train storage and a train maintenance and inspection area will not cause additional train traffic or increases in any other emission causing activity. The issue of train frequency and other regional transportation related impacts of the Hoboken Terminal Rail Complex have been addressed in several previous studies including:

- NJ TRANSIT, 1981. *New Jersey Rail Equipment Maintenance Facilities Study,* Final report Project No. IT-09-0058, TS F-212: prepared by Seelye, Stevenson Value & Knecht,Inc., New York, NY.

- NJ TRANSIT, 1992. *NJ TRANSIT Yard Siting Study, Evaluation of Alternate Sites*: prepared by Parsons Brinckerhoff, Quade & Douglas, Inc., New York, NY.

- NJ TRANSIT, 1995d. *NJ TRANSIT Corporation Train Storage Yard Improvements Project, Hoboken Yard Final Concept Design Report*: prepared by Parsons Brinckerhoff, Quade & Douglas, Inc. New York, NY.

- NJ TRANSIT, 1996. *Hudson-Bergen Light Rail Transit System, Hudson and Bergen Counties, NJ, Final Environmental Impact Statement /Section 4(f) Statement:* prepared by US Department of Transportation Federal Transit Administration and NJ TRANSIT, August, 1996, 2 vol.

- NJ TRANSIT, 1997. *General Design Consultant Services for the Rehabilitation and Redevelopment of the Hoboken Terminal and Yard Complex NJT Contract No. 94CA035, Task 2700 - Rail Operations Study Final Task Report:* prepared by Rail Transportation Systems, Inc., New York, NY.

This assessment relates to the filling of the Long Slip Canal and construction of the train yard and sewer improvements and building the proposed walkway. Because the increased storage capacity and operational efficiency derived from the rail yard improvements will decrease the need to move trains while in off-peak storage, the project may facilitate a long-term decrease in train movements and therefore actually lower the air quality impacts of Hoboken Terminal and Yard Complex operations.

3. Operational Benefits

One of the objectives of the proposed project is to improve the combined sewer overflow (CSO) discharge system and outfalls. This will have significant beneficial affects on the air quality in the vicinity of the project by eliminating the current sources of odors from the Hoboken and Jersey City CSO.

As briefly explained in the section above on operational impacts, the proposed project has the potential to increase the operational efficiency of the Hoboken Terminal Rail Complex. One obvious operational benefit of the proposed project would be that the extra space and additional off-peak train storage made available by filling Long Slip Canal would generally tend to reduce the number of times a train would have to jockeyed within the yard to accommodate the rail transit schedule. Because one of the planned uses of the recovered land is to house a train inspection and maintenance operation, the need to move trains to remote locations to perform these services will be eliminated. Both of these benefits will reduce train travel, and thereby reduce the related air emissions.

Another less obvious benefit is that the proposed project, by improving the operating efficiency of the Hoboken Terminal Rail Complex, will facilitate the regional rail network system rehabilitation. As part of the efforts to improve the network-wide public transit infrastructure and operating efficiency, the proposed project will help achieve air emission reductions incorporated in those Transportation Implementation Plans.

4. Summary of Findings

This analysis concludes that the Long Slip Canal Habitat Creation Project would not cause a significant impact on air quality within the area or region of the proposed project. Because the emission rates of constructing the proposed project are less than the *De Minimis* emission rates of the General Conformity Rule implementation guidelines, the project is also found to conform to the Clean Air Act. Long term air quality benefits, both local and regional are expected from the proposed project due to elimination of current sources odor and enhancements to the public transportation system.

D. Noise

The potential for the proposed project to cause significant noise impacts is evaluated in this section. Noise is most often defined as unwanted sound as perceived by a receptor, or person, hearing the unwanted sound. Sound levels can be measured, but the variability in the subjective and physical response to sound complicates the analysis of impacts on receptors. People judge the relative magnitude of sound perception in subjective terms such as "loudness" or "noisiness".

Physically, sound pressure magnitude is measured in a logarithmic scale, in units called decibels (dB). Because the human hearing system is not equally sensitive to sound at all frequencies, a frequency-dependent adjustment called A-weighting has been devised to allow measurement of sound that is similar to the way it is perceived by humans. The quantification of sound in A-weighted units is known as dBA. The following are examples of how this scale applies to typically experienced sound levels:

- A typical quite living room is about 40 dBA,
- A lawn mower outside, or a food blender inside, each are about 75 dBA, and
- The level of sound near the sidewalk adjacent to heavy traffic is about 85 dBA.

In evaluating noise levels for purposes of impact assessment, various descriptors for have been established, two of which L_{eq}, and L_{dn} are used in this assessment. The "energy equivalent noise level", or L_{eq}, is the level of constant sound in dBA units which, in a given situation and time period, has the equivalent sound energy as does the time varying sound over the same time period. The L_{eq} is recommended by the FTA guidelines ("Transit Noise and Vibration Impact Assessment", FTA April 1995) for assessing the noise impacts of transit projects on non-residential land uses (see Appendix 3).

Residential land uses are often referred to as sensitive receptors for purposes of noise impact assessment. The noise level descriptor used in evaluating projects for the potential impacts on residential receptors is the day-night average sound level, or L_{dn}. The L_{dn} applies a "penalty" of 10 dBA to nighttime noises occurring between 10:00 p.m. and 7:00 a.m. The L_{dn} is recommenced by the FTA for use in evaluating noise impacts of transit projects on residential land uses.

1. SIGNIFICANCE CRITERIA

To put these descriptors of noise levels into perspective, they can be compared to US Department of Housing and Urban Development (HUD) site acceptability criteria for residential uses, EPA protective sound level guidelines, and FAA regulations on airport noise compatibility planning. L_{dn} is the descriptor of choice for these federal agencies and their respective site acceptability noise levels and categories are summarized in the following table:

Table IV-2 Federal Agency Day-Night Noise Level Guidelines

Agency	Description of Noise Guideline	L_{dn} in dBA units
HUD	"Acceptable" for Residential Siting this means that noise abatement beyond normal construction techniques does not need to be considered in housing design.	Less than 65 dBA
HUD	"Normally Unacceptable" for Residential Siting, this means that noise abatement should be considered in housing design.	65 to 75 dBA
FAA	Residential land uses are not compatibility criteria	65 dBA or less
EPA	Outdoor noise level (L_{dn}) which little or no expected adverse effects on health and welfare. Note this is not meant to imply that L_{dn} above 55 have an adverse affect on health.	55 dBA or less

These guideline levels can be useful in evaluating the compatibility of a proposed project. However because the vicinity of most projects have a background or baseline sound level, a more useful value for assessing impacts would be a level of acceptable additional noise. Human perception of marginal noise level increases may be categorized as follows in Table IV-3:

Table IV-3 Perception and Significance of Marginal Noise Level Increases

Project Noise Level Increase	Subjective Perception	Significance
0 to 3 dBA	Minor noise increase, if any change is perceived	Insignificant Project Impact
3 to 10 dBA	Moderate, a noticeable increase	Significance depends on baseline noise level and proximity of sensitive receptors
10 dBA or more	Noise is about twice as "loud" for each 10 dBA	Significant Project Impact

The above general categories of marginal noise levels will used as the significance criteria for the noise assessment of this proposed project.

2. EXISTING SETTING

The acoustical setting, surrounding land uses, and the existing sound levels at noise receptor locations is an important factor in assessing the impact of a project. If a potential impact is possible for a proposed project, the ambient pre-project noise levels can be measured to describe the existing conditions.

The vicinity of the proposed project is characterized primarily by the existing Hoboken Terminal Rail Complex. Surrounding land uses to the south include an undeveloped site and a commercial center at distances of approximately 100 to 200 feet. To the east is the Hudson river and to the west are the rail tracks leading to the terminal. To the north is the main Hoboken Terminal Rail Complex with several onsite buildings. The nearest sensitive receptor to the proposed project is a residential area to the north of the rail complex on the other side of Observer Highway and bounded on the east by Hudson Street. These residences are located more than 400 feet to the north of where the main project construction activity would occur.

Ambient sound level monitoring was conducted in the area of these closest sensitive receptors for the preparation of the Hudson Bergen Light Rail Transit System Final Environmental Impact Report (NJ TRANSIT, 1996). Measurements (location ID number 10) were taken at the Hoboken Terminal, at the corner of Hudson Place and Hudson Street. The following existing noise level measurement data for this location is taken from Table 3-17 of the referenced FEIR:

Date	Time	L_{eq}	L_{dn}
3/23/95	6:20 a.m.	66	71
3/23/95	12:25 p.m.	65	
3/23/95	5:10 p.m.	63	
6/15/95	11:54 p.m.	64	

These values will be considered the existing conditions for this noise impact assessment.

3. IMPACTS OF NO BUILD ALTERNATIVE

No-Build will increase rail traffic due to need. The project will not affect the long term activity level of the Hoboken Rail Terminal Complex. The transit and terminal activity levels including train number and frequencies have been documented and assessed in previous studies (NJ TRANSIT, 1981, 1992, 1995d, 1996, and 1997).

4. IMPACTS OF BUILD ALTERNATIVE

The potential noise impacts of the Build Alternative are generated only by the construction activities (see Section N, "Construction " below). Increases in noise levels are not anticipated (NJ TRANSIT, 1995d) because the project will not affect the long term activity level of the Hoboken Rail Terminal Complex. New train traffic will not be introduced. Off-peak train movements within the yard may decrease due to the additional space for storge and maintenance provided. The transit and terminal activity levels including train number and frequencies have been documented and assessed in previous studies (NJ TRANSIT, 1981, 1992, 1995d, 1996, and 1997).

5. SUMMARY OF FINDINGS

Using the above established significance criteria, the results of the analysis described herein, this assessment concludes that the proposed project will not have a significant noise impact at the identified closest sensitive receptors. Since other land uses closer than these identified residential areas are less sensitive to noise, and located in areas with high background sound levels, no significant impacts are expected at these receptors.

E. WATER QUALITY

Long Slip Canal and the land areas immediately adjacent to the canal are directly tributary to the surface waters of the Hudson River. The Hudson River is the water body with the greatest influence on the NY/NJ Harbor Estuary and serves as one of the most important tidal estuaries on the East Coast. Despite years of dredging, filling and other alterations, the Hudson River supports a tremendous diversity of plant and animal species and numerous commercial and recreational activities. The Hudson River is tidally influenced from its mouth to the Federal Dam at Troy, NY.

The Hudson-Raritan Estuary has been subject to serious pollution and other modification during the past 100 years (NJ Marine Sciences Consortium, 1987). There have been a number of deleterious changes to the environment and biota in the Hudson River Estuary. These include habitat modification and loss of habitat and increased pollution within the estuary system. Many sources contribute to the pollution of the Estuary. The major sources are uncontrolled point sources such as combined sewer outflows (CSOs). Controlled point sources, such as industries and sewage treatment plants are also important contributors. Floatable debris from various sources is a visible problem as well. Pollution in the form of enrichment by organic wastes and nutrients (primarily from sewage) results in eutrophication and periods of low oxygen content, which make some parts of the system poor habitat for benthic species (NJ Marine Sciences Consortium, 1987).

The Hudson River, in the project vicinity is classified as saline estuarine waters (SE2). The designated uses for these water bodies are listed as:

1. Maintenance, migration, and propagation of natural and established biota;
2. Migration of diadromous fish;
3. Maintenance of wildlife;
4. Secondary contact recreation; and
5. Any other reasonable uses.

1. REGIONAL PERSPECTIVE

The *Inventory of the Fishery Resources of the Hudson River from Bayonne to Piermont - Final Report* (Andrews, 1984) puts water quality indictors, visual clarity, salinity fluctuation and minimum dissolved oxygen (DO) levels at Long Slip Canal within the context of a 26-mile reach extending from Bayonne, NJ, 8 miles south to Piermont, NY, 18 miles north (see Figures IV-1 through IV-3). That report found summer

(August 2, 1983) surface water DO levels of 3.8 mg/l for a pierhead sampling station located south of Long Slip Canal in Jersey City, and 4.1 mg/l for a pierhead sampling station located north of the canal in Hoboken. Although the DO level for the Jersey City sampling station falls short of the NJDEP minimum criteria, it still surpasses the DO level found within the confines of Long Slip Canal during the June 1994 sampling event. NYC reports that coliform improvement over the decade demonstrates CSO (NY side) benefit to Hudson/East Rivers.

2. STRESSORS AFFECTING WATER QUALITY

In Long Slip Canal and in the canal entrance basin, CSO and stormwater discharges, tidal circulation, and sediments influence water quality (see Figure IV-4). The existing condition for each is described below.

a) CSO and Stormwater Discharges

Recent field investigations (NJ TRANSIT, 1995; CH2M Hill, 1996; and JCSA, 1995 and 1996) revealed that Long Slip Canal receives combined sewer overflow (CSO) discharges from two outfalls (see Figures IV-5 and IV-6). One conveys flows originating in Jersey City and the other conveys flows from Hoboken. In addition, two outfalls from the PATH sump system discharge into the canal via Caisson 2. One active Hoboken CSO discharges into the canal entrance basin. Table IV - 4 summarizes the characteristics of these CSOs.

Table IV-4 Summary of Point Discharge Characteristics

Outfall	Owner	Diameter (Inches)	Flow (CFS)	Regulator	Drainage (Acres)	Construction	Source of Discharge Data
Path sumps	PANYNJ	8	0.02	N/A	<0.5	Steel	flow data
Jersey City outfall	JCSA	120	467.5	RE-19	381	Concrete	Manning's eq.
ParkAvenue Sewer	Hoboken	48 x 48 square	98.9	HO	NA	Wood	Manning's eq.
Twin Sewers	Hoboken	30 x 66 (each)	Unk.	H1	Unk.	cast iron	N/A
Total to Canal			**566.4**		**>382**		
Total to Canal Entrance Basin			**Unk.**		**Unk.**		

Unk = Unknown

The Jersey City outfall is a coarsely-screened, reinforced concrete 120-inch diameter pipe located at the west end of the canal. The outfall drains the regulator located at 18th Street in Jersey City. A 1993 dry weather inspection (JCSA, 1995) found the regulator's design to be defective. Flow was observed passing through the regulator gate orifice at high velocity with water levels into the diversion chamber exceeding the maximum flow capacity through the orifice. The diversion chamber's water level rose higher than the tide gate's elevated invert.

The Hoboken outfall to the canal discharges from a 4-foot square wood box sewer located on the northern bulkhead approximately 700 feet from the west end of the canal. A 1995 survey (NJ TRANSIT, 1995) indicated the outfall has no regulator. Instead, the line is a relief sewer for the regulator, designated H1, (that discharges from an outfall located, according to construction documents circa 1923, at the terminus of pier bordering the north side of the canal entrance basin.) The purpose is to prevent flooding on Observer Highway by relieving sewer backups during heavy rains. However, discharges to Long Slip occur in nearly all rainfall events (Kiernan, 1997). A weir plate blocks and diverts sewerage flows from the outfall during dry periods. Though it is expected that a receptor pipe would convey the diverted sewerage to the treatment plant, no such receptor pipe exists. The weir plate blocks flows during dry periods and the sewerage backflows into a pipe that will carry it to the treatment plant. Presently, the line is considered part of the municipal collection system and therefore, owned by the City of Hoboken. In June 1998, the North Hudson Sewer Authority will assume ownership. The discharge is not permitted by NJDEP. Regulator H1 originally discharged from the east end of Pier 1. That outfall is inactive, possibly due to collapse of the line in the yard. The discharge now occurs in the northwest corner of the canal entrance basin.

Two sump pumps discharge drainage and seepage from the PATH tunnels from two 8-inch steel pipes at Caisson 2 located on the south side of the canal, approximately 850 from the west end. The combined drainage area of the two pipes is less than one acre. Flow measurements indicate an average daily flow of 5,500 gallons per day and an estimated maximum flow of 13,200 gallons per day (PANYNJ, 1994). The NJPDES permit (#NJ0076988) issued for this discharge included a stay of effluent limitations to accommodate elevated levels of TSS, TOC, and total zinc. Elevated levels ceased in 1994 after all galvanized piping and fittings were replaced with non-galvanized components (PANYNJ, 1994).

The information contained in Tables IV-5 and IV-6 is the only data available regarding the pollutant loads of discharges to the Long Slip Canal. Data from the Hoboken CSO discharges are unavailable. Monitoring studies are underway to characterize the pollutant loads received by the canal from the Hoboken CSO.

Table IV-5 Pollutant Loading from Jersey City 18th Street CSO

Source [1]	DWO (MGD)	BOD Concentration (mg/l)	BOD Daily Load (lbs/day)	TSS Concentration (mg/l)	TSS Daily Load (lbs/day)
JCSA	0.08	150	97	182	118
1979 est.	9.37	150	11,722	182	14,223
Grab Sample		3,482		3,770	

Notes
1. JCSA (1995) estimate based on field observations.
"1979 est." is computed estimated published in the 1979 201 Wastewater Facilities Plan
Grab sample taken from first flush of 2/24/97 precipitation event by NJ TRANSIT.

Table IV-6 PATH Sump Discharges at Caisson #2

Date	PH	TSS (mg/l)	TP (mg/l)	TOC (mg/l)	Ni (mg/l)	Zn (mg/l)
5/94	7.78	21	1.2	NA	<0.02	0.20
6/94	7.69	31	7.3	29	<0.02	0.097
Permit limits	6.00 -9.00	50.00	15.00	50.00	1.50	1.00

Source: PATH, 1994

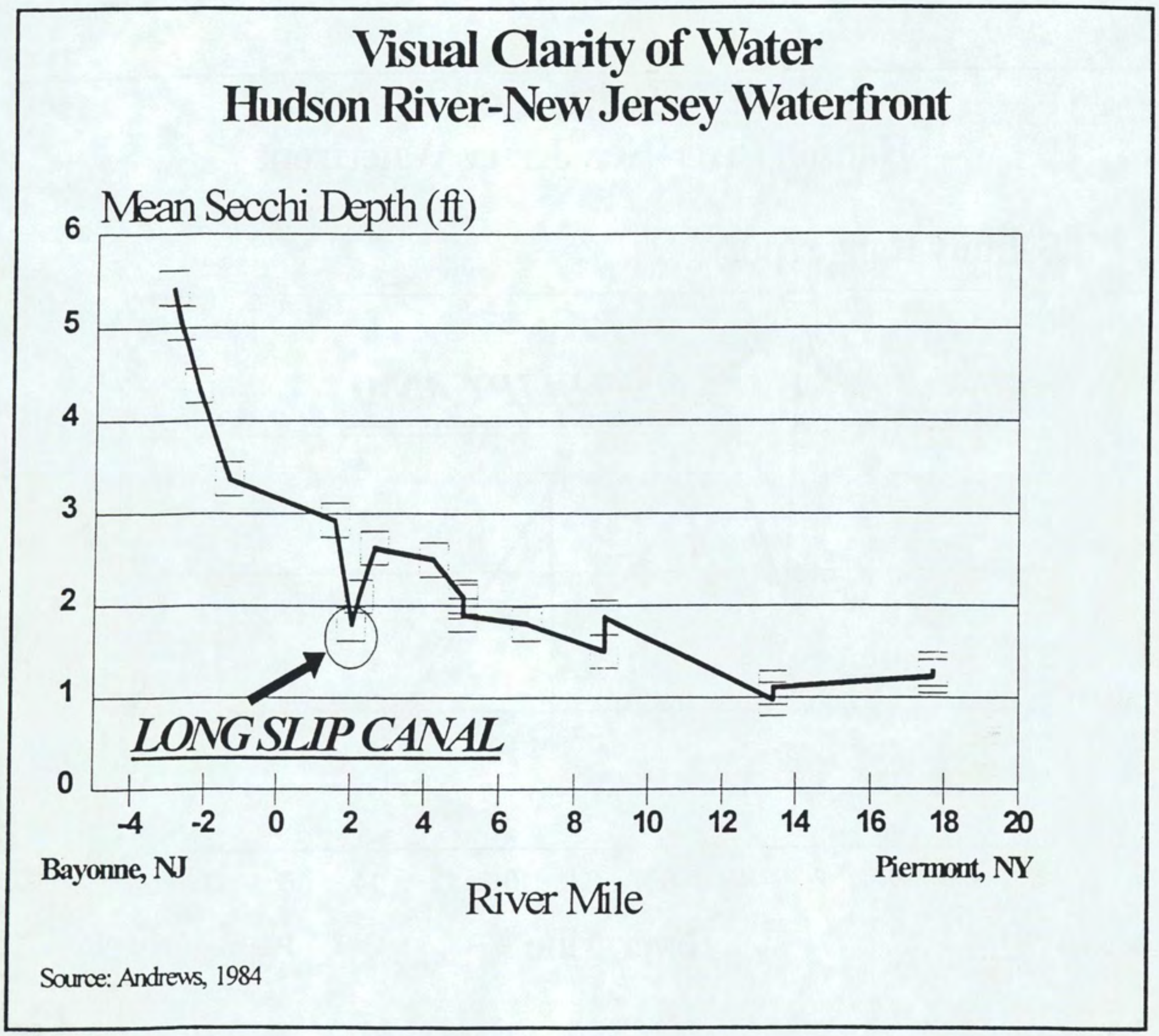


Figure IV-1 · Visual Clarity of Water

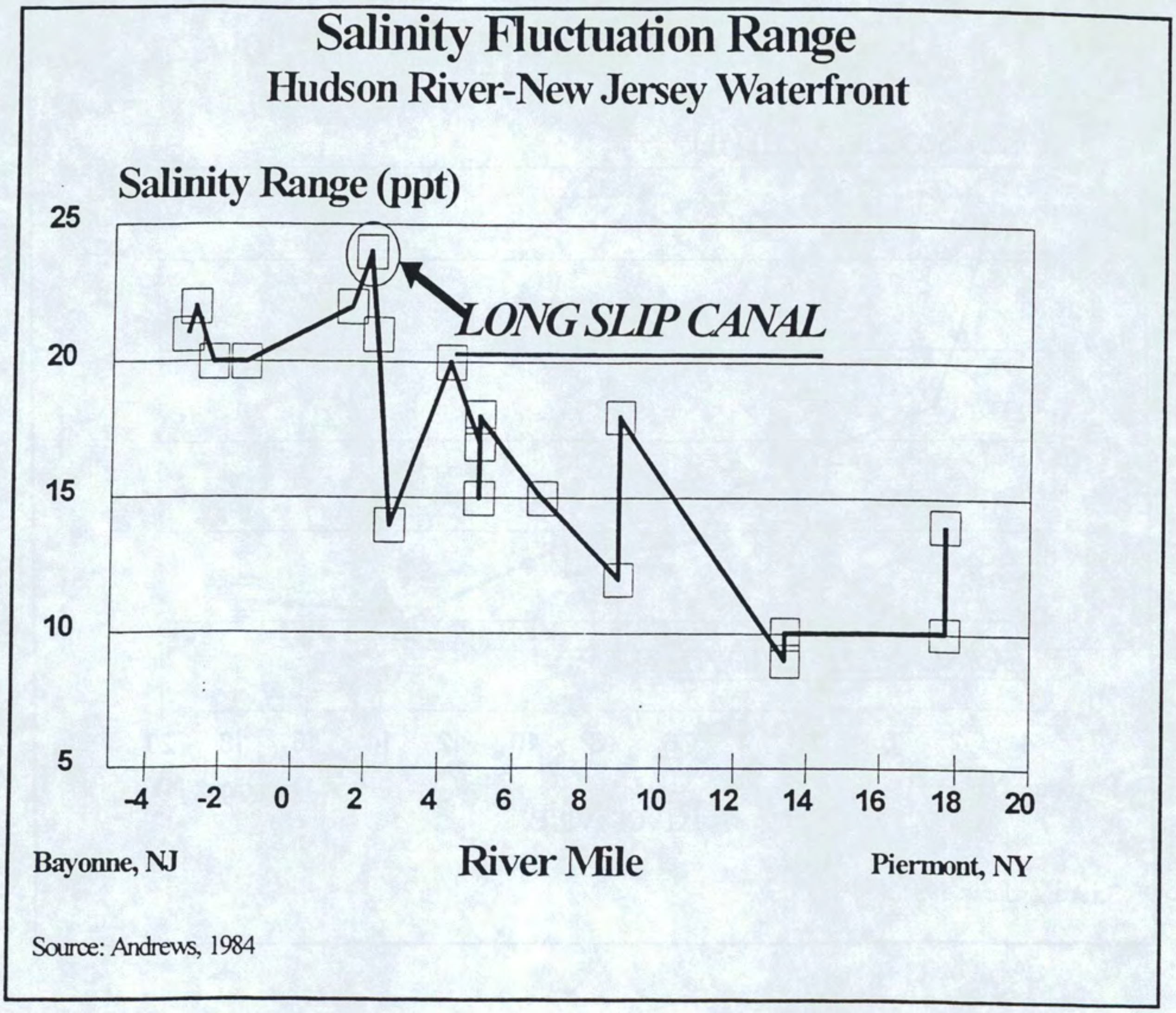


Figure IV-2 - Salinity Fluctuation Range

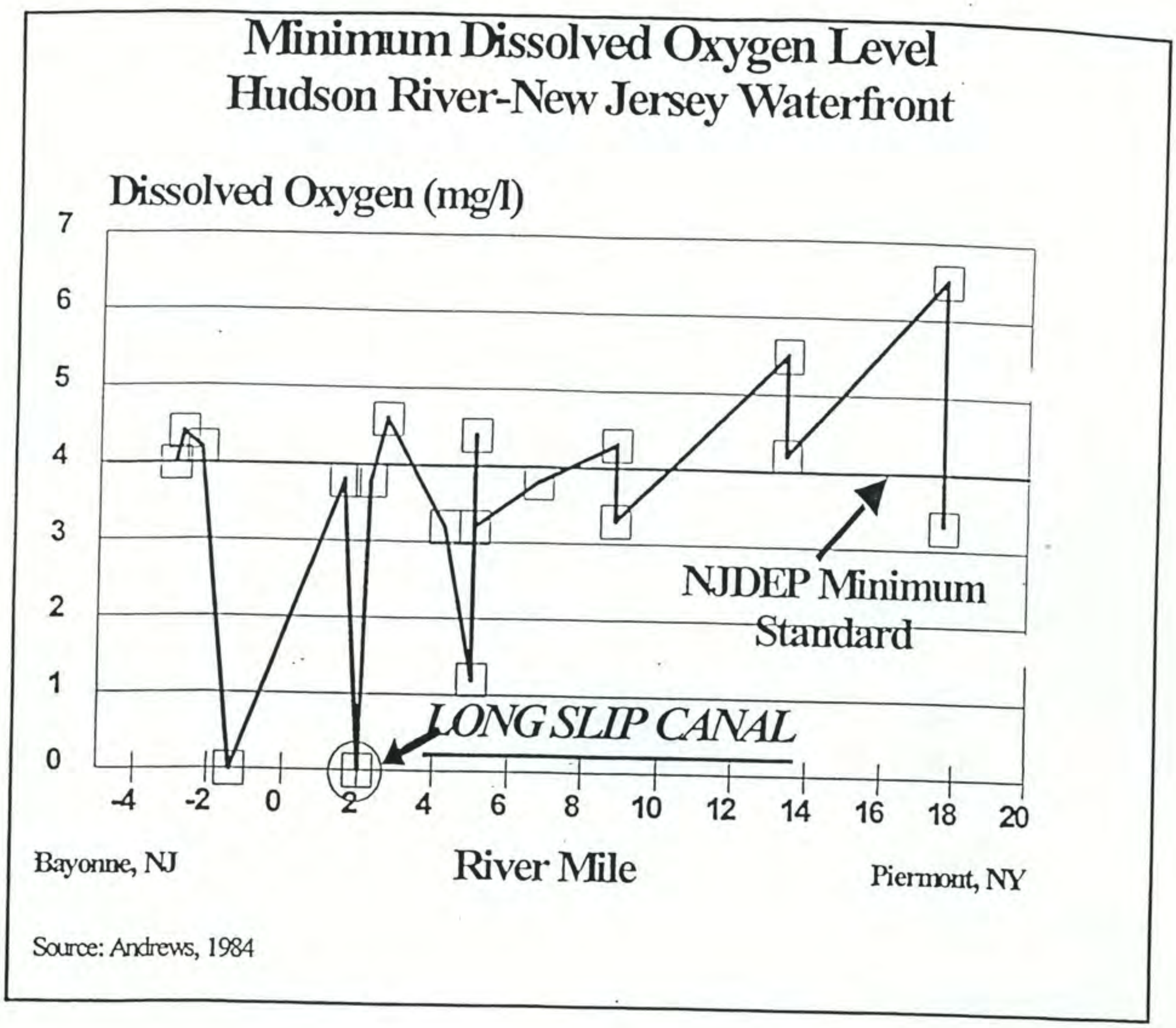
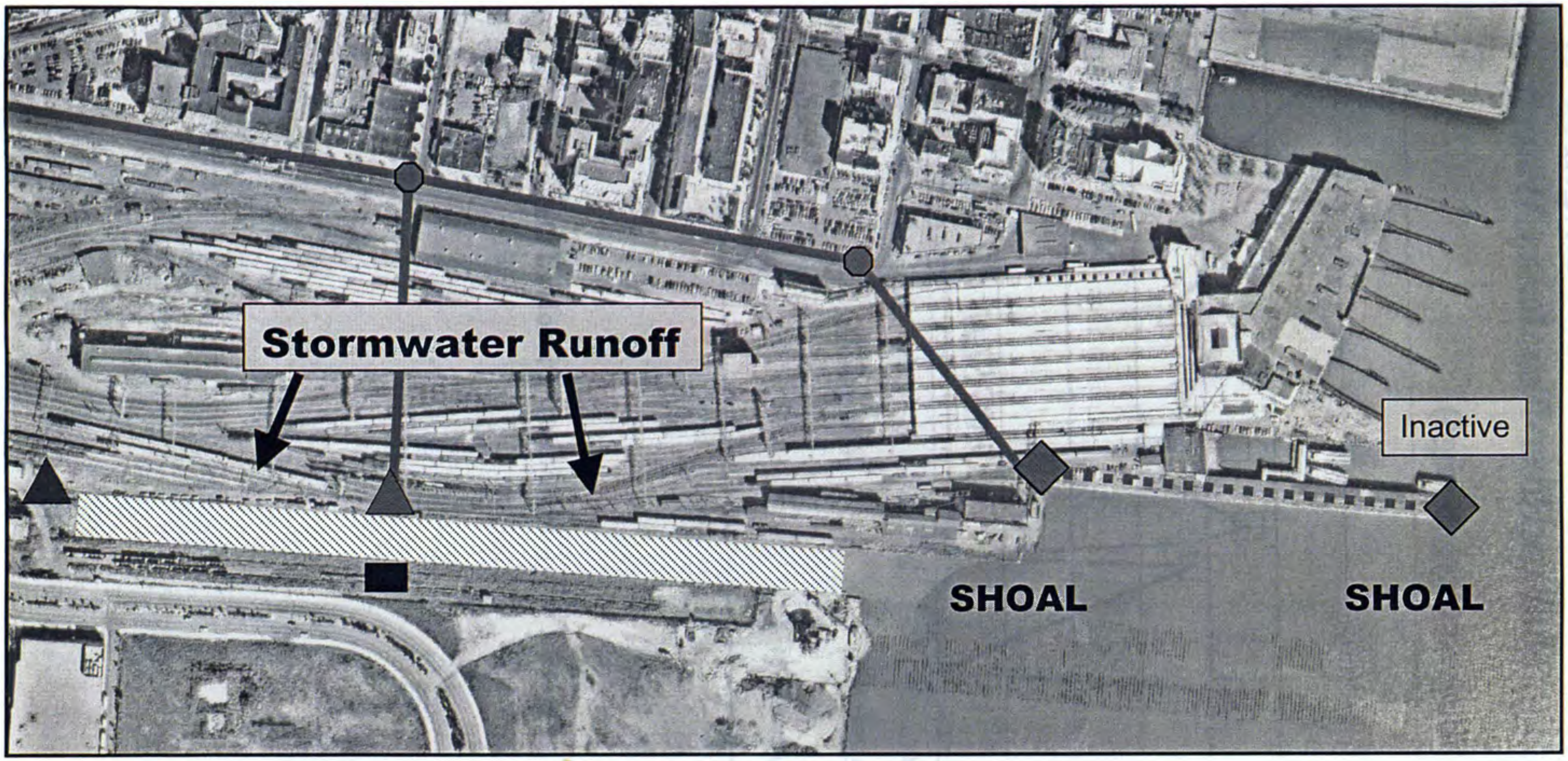


Figure IV-3 _ Minimum Dissolved Oxygen Level

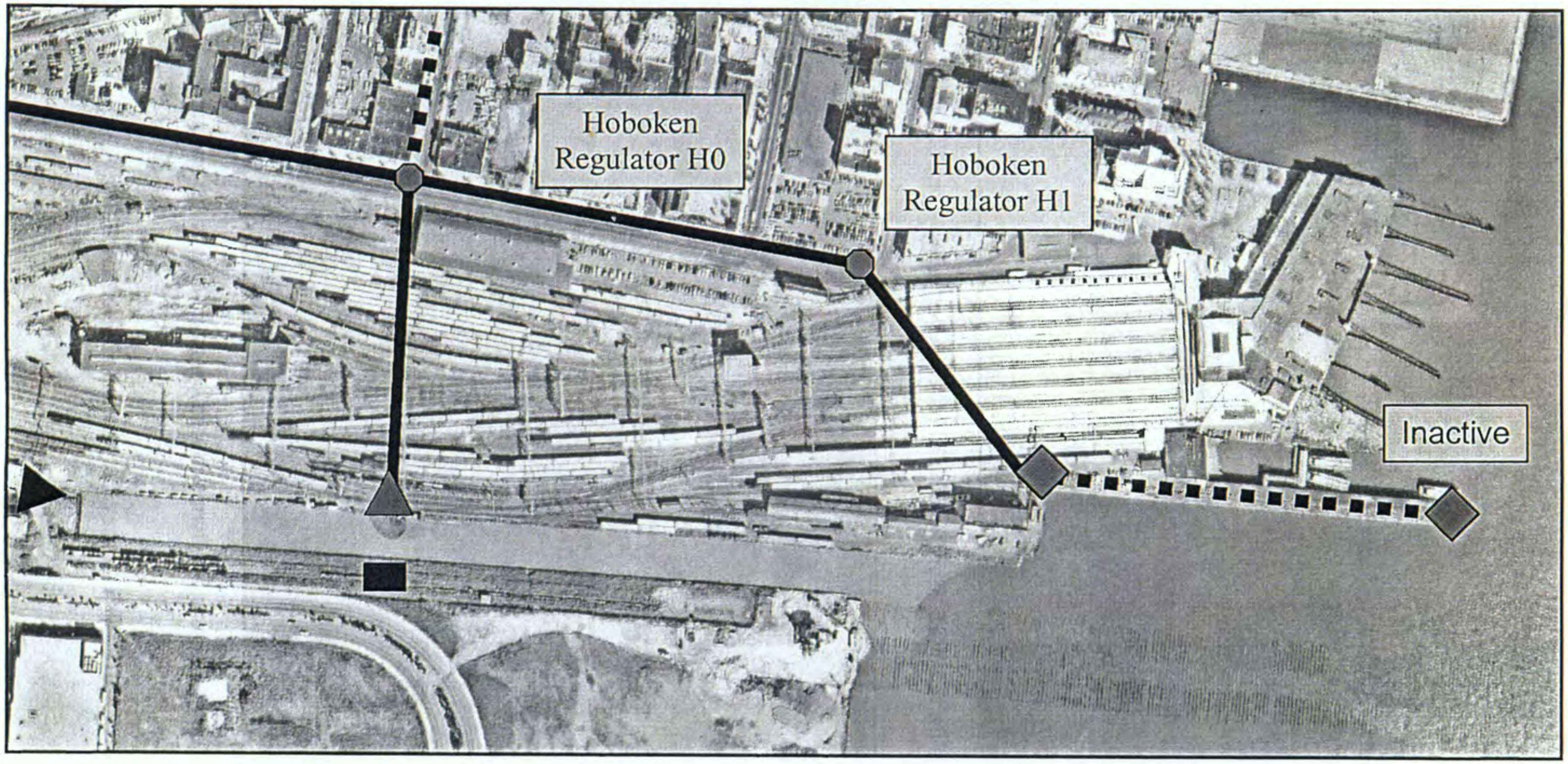
Figure IV-4 Stressors to Water Quality



◆ Hoboken Observer Highway CSO ▲ Jersey City CSO

▲ Hoboken Park Avenue CSO ■ PATH Caisson #2 Sump

Figure IV-5 Point Discharges

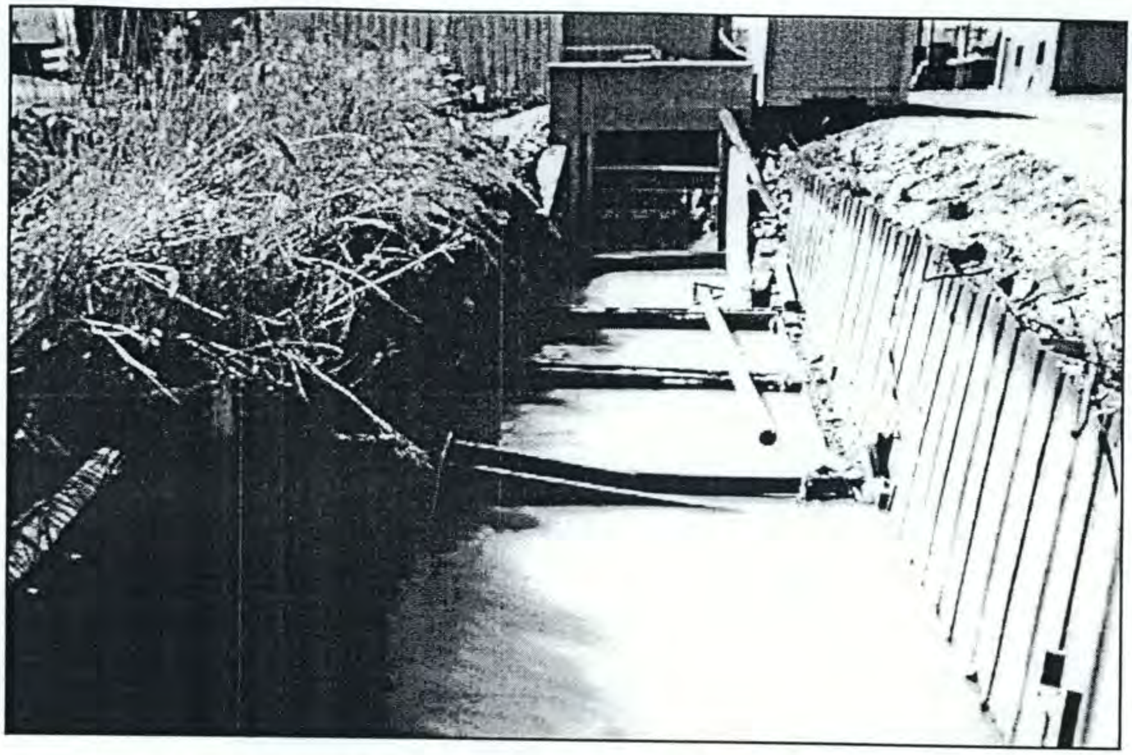


Jersey City CSO

PATH Caisson #2 Sump

Hoboken Observer Highway CSO

Hoboken Park Avenue CSO



Outtfall of the Jersey 18th Street combined sewer at west end of Long Slip canal

Outfall of the Hoboken H0 storm sewer in Long Slip canal north bulkhead

Figure IV-6 Jersey City and Hoboken Outfalls

b) Tidal Circulation

Two high and low tides occur each day. The range between mean high and mean low tides is approximately 4.5 feet. Very high and very low tides (spring tides) occur twice each month, and these differ from each other by 5.4 feet. The very weak tides (neap tides) which also occur twice a month differ from each other by only 3 feet (Havens and Emerson, Inc., 1979).

The magnitudes of tidal flows vary dramatically across this reach of the Hudson River. Furthermore, there is stratification with respect to salinity and residual flows (residual flows are the water movements if tides are subtracted). As shown in Figures IV-7 and IV-8 that summarize published observations, currents are stronger near the surface and in the ebb direction, while the near bottom currents are stronger in the flood direction (Dames & Moore, 1997). Currents at mid-depths are weaker and not dominated by either flood or ebb tides, reflecting the reduced influences of the freshwater discharge of the Hudson River that affect surface waters and the bottom friction that affects bottom waters (Dames & Moore, 1997). As dramatically clear in these figures, the entrance basin and canal receive very little tidal exchange. Shoaled sediment in the canal entrance basin (see Figure IV-9 and IV-10) limits the exchange of surface waters and precludes exchange with bottom waters (Guida, 1997). The resultant poor circulation and density stratification leading to stagnation (low oxygen) in bottom waters is believed to be the principle water quality problem in Long Slip Canal and its waterfront basin (Guida, 1997).

c) Sediments

Sediments, particularly silts and clays, can trap and retain organics and other pollutants resulting in a persistent oxygen demand that often continues to degrade water quality well after sources such as CSOs are eliminated. By weight, the organic faction of sediments ranges from nearly 40 percent at the canal's west end to about 10 percent in the entrance basin (Guida, *et al.*, 1995). These organics have the largest impact on canal and adjacent waters primarily because they support large seasonal population's microbial decomposers that progressively reduce dissolved oxygen levels during the warm months. Buried un-decomposed organics are fermented anaerobically releasing methane gas that further depletes oxygen from the water column. Biogas production, particularly at the west end of the canal is at such a level that confinement by burial or decking will create a fire/explosion hazard, if precautions are not taken. Guida *et al.*, (1995) estimate if all CSO discharges would cease, biogas production would continue for several months to a year.

Sediment testing in the western third of Long Slip Canal has turned up moderate levels of contamination with lead, copper, zinc, arsenic and various aromatic hydrocarbons, but no detectable PCBs and only traces of chlorinated hydrocarbons. TCLP (leachate) tests with these sediments met New Jersey ID-27 criteria for non-hazardous industrial waste (NJ TRANSIT, 1995). Since this part of the canal is scheduled for closure by this project, the data has no direct bearing on the canal entrance restoration project, except that it probably represents a worst case situation locally, as all sites sampled lie directly between the two CSOs that discharge into the canal. Perhaps of greater relevance to possible sediment contamination issues is a more widespread and intensive survey of sediment toxicity in the entire Hudson-Raritan Estuary (Long, *et al.*, 1995). In this study sediments from locations throughout the estuary were tested both for their toxicity toward amphipods, bivalves and bioluminescent bacteria, and analyzed for a full range of organic and metallic contaminants. Polynuclear aromatic hydrocarbons (PAHs) appeared to be contaminants most clearly correlated to toxicity toward amphipods and bacteria. Sediments from the lower Hudson River, while clearly contaminated, were among the *least* toxic in the estuary. Most tests, in fact, showed sediments from the first 18 miles of the river (the Battery to Dobbs Ferry) to be non-toxic. These results suggest that well-planned and executed habitat restoration is likely to succeed on the Hudson River waterfront without interference from residual environmental toxicity

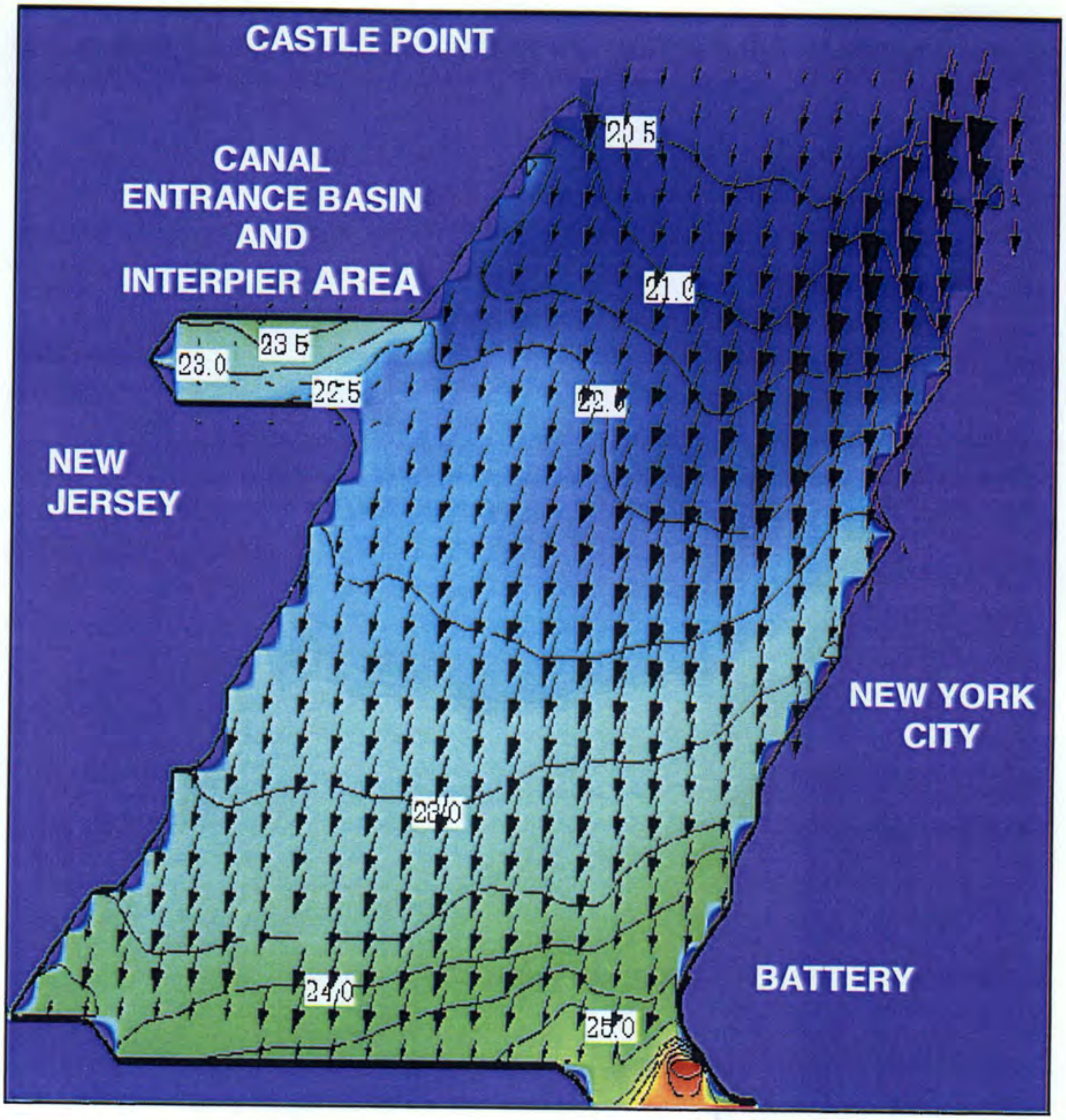


Figure IV-7 - Hudson River near-surface currents and surface salinity during a flood tide on May 1, 1996. Arrows indicate direction and relative magnitude of flow. Relative salinty is indicated by the color gradient where purple (in the north) is less saline than red (in the south) (after Dames & Moore, 1997).

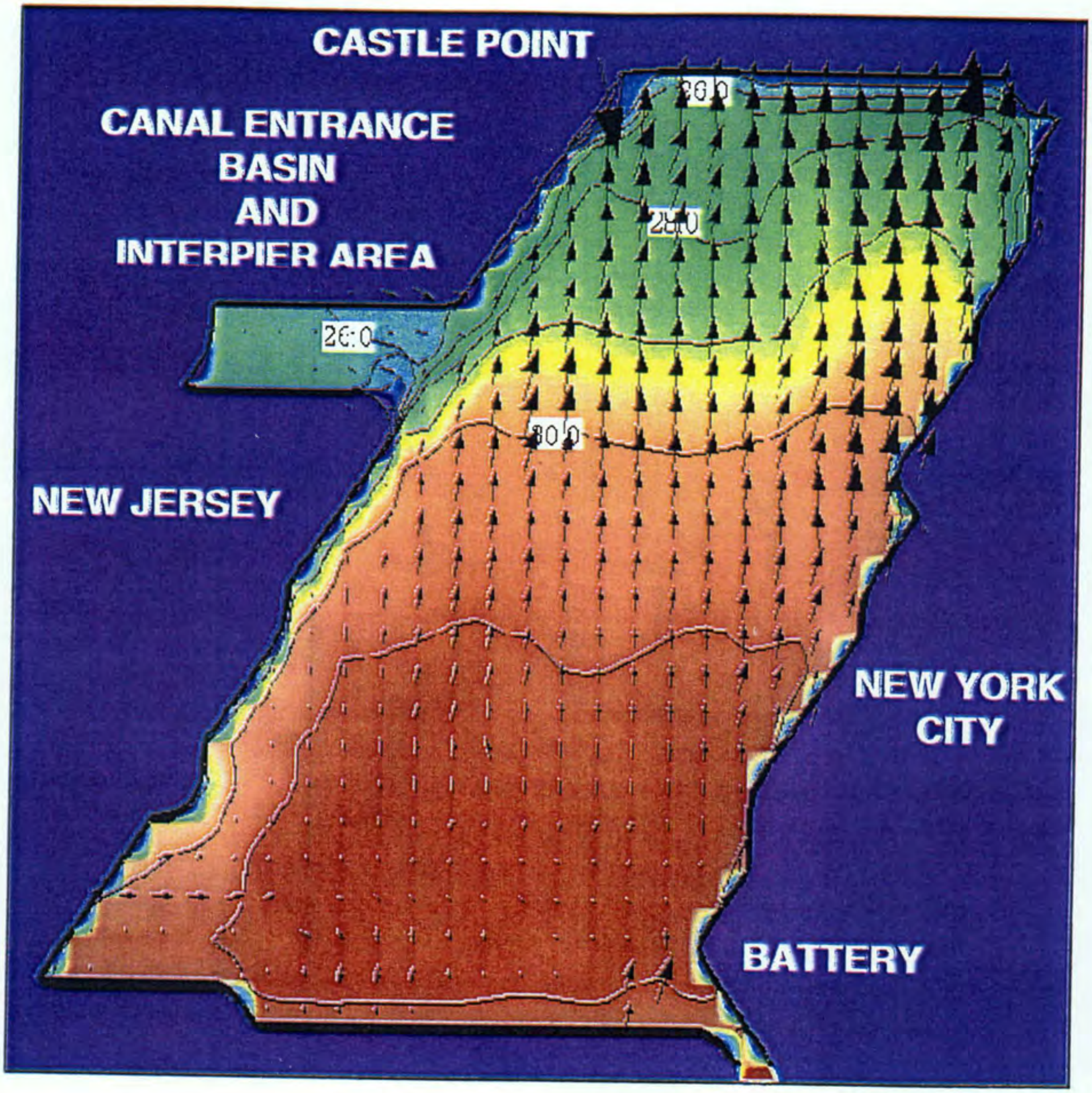
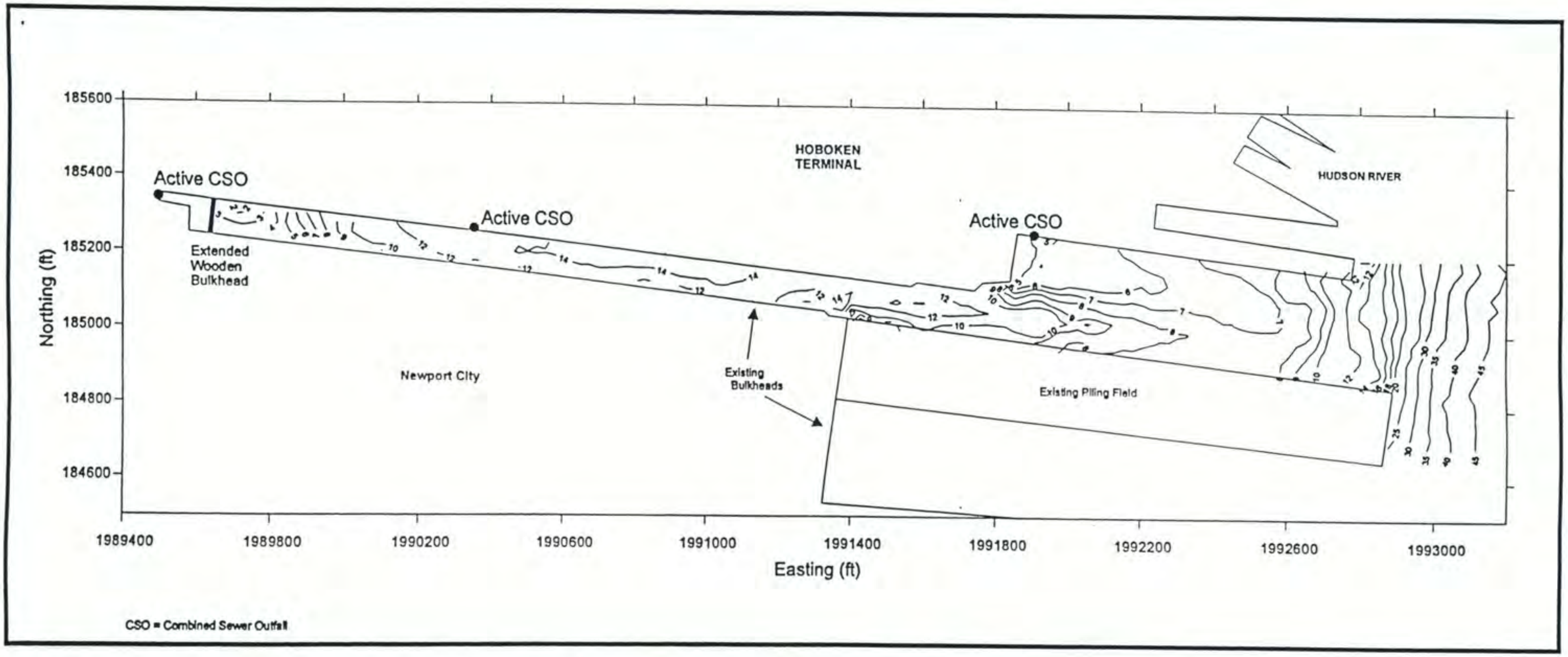


Figure IV-8 - Hudson River near-bottom currents and bottom salinity during a Flood tide on May 1, 1996. Arrows indicate direction and relative magnitude of flow. Relative salinty is indicated by the color gradient where green (in the north) is less saline Than red (in south) (after Dames & Moore, 1997).



Note: All depths are in feet below the USGS-29 datum (NGVD29)
Coordinates shown are state plane grid - NYS Long Island 3104 zone (NAD27)
Contours are generated with Surfer software package (Golden Software, Inc.)
Based on field survey conducted on 26 August 1996
Source: Lawler, Matusky, & Skelly Engineers)

Figure IV-9 - Bathymetry of Long Slip Canal and the Canal Entrance Basin

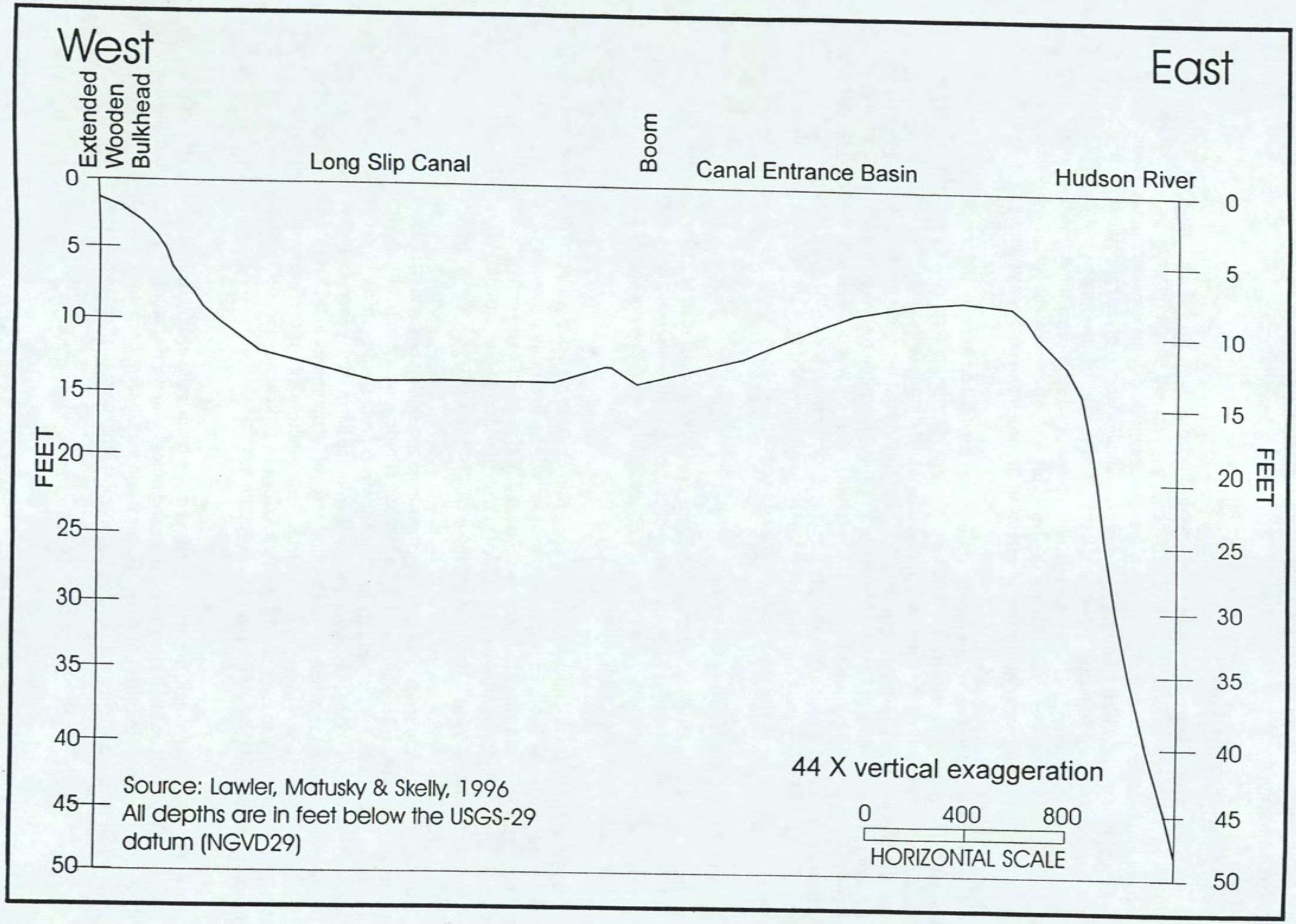


Figure IV-10 - Topographic Profile Using Bathymetric Survey Along Center of Long Slip Canal

(Guida, 1997). This would not be the case in the East River or Newark Bay, both of which contain highly toxic sediments.

3. EXISTING WATER QUALITY

Surface water sampling of Long Slip Canal was performed between June 3, 1994 and January 9, 1995 (NJ TRANSIT, 1995). Water temperature, salinity, dissolved oxygen, and secchi disk depths were collected from surface and bottom waters at each station. The results indicate that the concentrations of compounds and physical indicators for which all of the surface water samples were analyzed are below the regulatory standards (where published standards have been established), with the periodic exception of dissolved oxygen (DO) and fecal coliform. However, these data do not provide information on spatial variation in three dimensions and so were insufficient to determine the effects of the basin's geometry and bathymetry on the existing water quality or the effects of the project on post-construction water quality.

To obtain this data, a grid of twelve monitoring stations was established to cover the northern part of the canal entrance basin and the northernmost pile field, the area most influenced by the canal. Both bottom and surface waters were sampled. These data found present conditions in the canal itself include chronic, continuous low dissolved oxygen (0 to 2.5 ppm) throughout the water column during summer as a result of poor circulation and intense bacterial oxygen consumption resulting from the deposition of organic matter on the canal bottom by active CSOs (Guida, 1997). Present conditions in the adjoining canal entrance basin were found to be strongly influenced by the presence of the canal, basin bottom topography, tidal hydrology and changing river salinity (see Figure IV-11). Complete copies of these data and Guida's 1995 and 1997 reports are contained in Appendix 5.

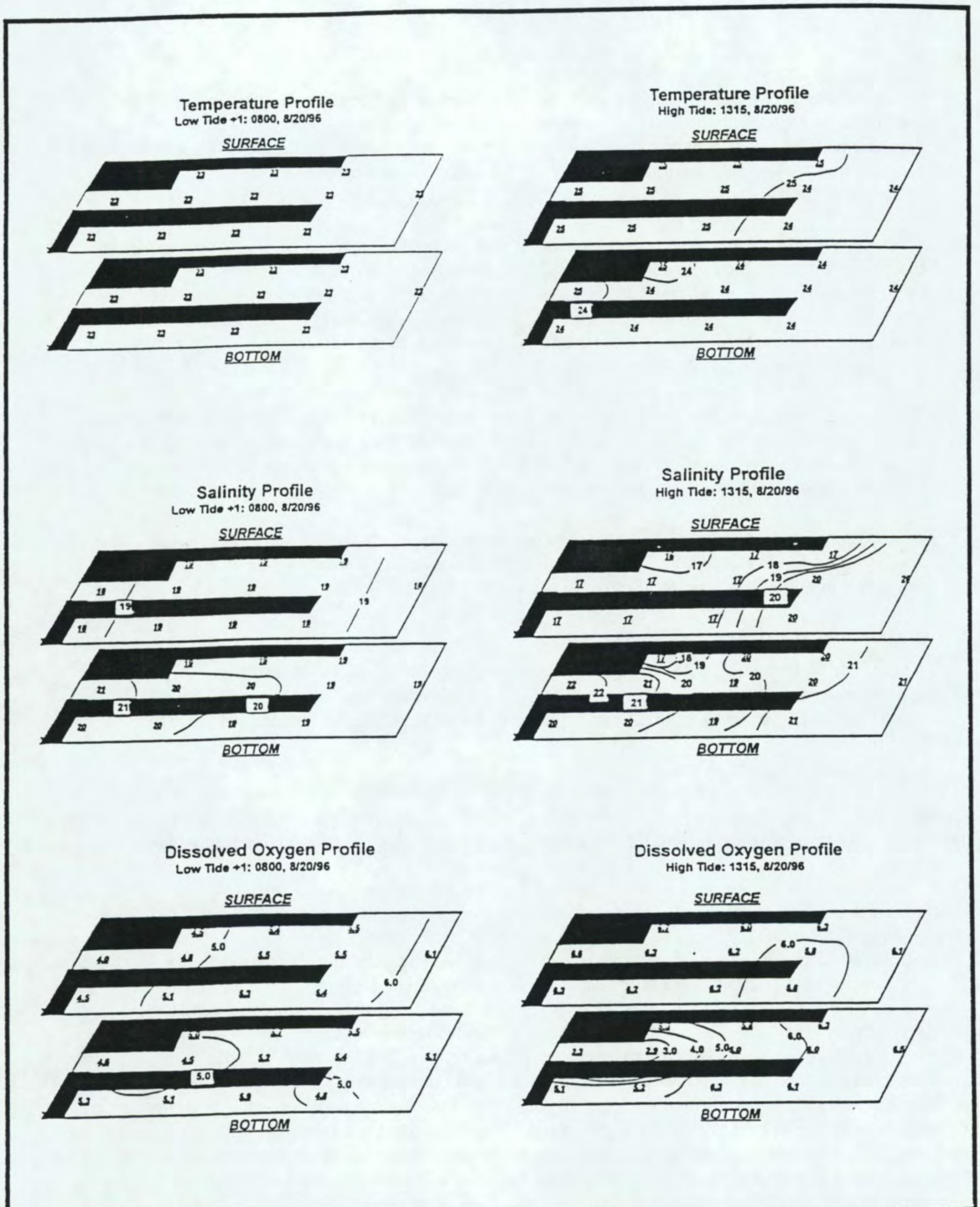
a) Patterns Observed in Data Collected

These data, as well as the results of other studies (Andrews, 1984 and Able, *et al.*, 1995), indicate that Long Slip Canal is a major source of water quality degradation to the entrance basin and the adjacent interpier area. Guida, *et al.* (1995) and Guida (1997), generalize the following characteristics of canal and entrance basin waters from this data:

- High salinity-high density tidewater enters Long Slip Canal at high tide, sinks to the bottom, and is stripped of oxygen by bacterial respiration, then spreads back out into the bottom of the waterfront basin. A shallow north-south hump on the bottom of the outer (eastern) end of the basin blocks tidal flushing of this stagnant bottom water. Low D.O. on the basin bottom (usually below NJ minimum of 4.0, often below 2.0 mg/l) results in an impoverished biota there.

- Measured salinities ranged 7 to 24 parts per thousand (ppt) during this study. Bottom salinities were generally 1 to 6 ppt higher than those at the surface, contributing the bulk of the density differences leading to stratification. Tidal salinity oscillations are expected in an estuary with both substantial tides and river flows. Salinities inside the canal entrance basin were generally higher than those in the river during low tide, when the river salinity was at its minimum, and lower than the river during high tide, when the river salinity was maximal. This pattern suggests that exchange between the canal entrance basin and river is sufficiently impeded by topography that water quality changes in the basin lag behind those of the river by several hours.

- Salinities at the canal mouth, the deepest station in the basin, remained at the nearly the same values during the tidal cycle while values in the river and outer basin were changing. This suggests the lag times in water turnover in the bottom of the canal and the adjacent deep inner basin area are even longer than for the basin in general, showing no substantial change after six hours.



Source: Guida, Zeroka & Choudhury (1995)

Figure IV-11 - Temperature and Salinity Profiles

- The pattern of pH values strongly suggests that dissolved oxygen concentration is primarily controlled by biological processes (respiration and photosynthesis) during warm weather. This suggests that the key to avoiding low D.O. in this environment is to avoid contact with areas of very high organic content and respiratory activity...like the bottom sediments of Long Slip Canal (Guida, *et al.*, 1995; NJ TRANSIT, 1995). No values of pH below 6.95 were measured.

- Vertical profiles of water density clearly demonstrate pockets of high density water accumulate in the deep portions of the inner canal entrance basin and remain there despite tidal exchange of overlying water. In several cases this inner basin water is the densest in the entire sampling...even denser than water at the bottom of the river. This is a strong indication that it is either the relic of a past high tide or the result of evaporation after. Either scenario requires long residence in the canal and basin environment.

- These same vertical profiles also clearly show a lens of low density water that extends from surface to bottom around station A2 in many profiles, but becomes shallower and more spread out as it moves south. This is the influence of the Hoboken CSO which was apparently discharging continuously or nearly so during the period of the study.

- The oxygen-depleted water did not appear to be "wastewater" (which should be exceptionally turbid and with low salinity), but rather, tidewater that had had extended contact with organic-rich sediments and their oxygen-consuming microbiota in Long Slip Canal.

b) Analysis of Existing Conditions

Analysis of the water quality within Long Slip Canal indicates that these waters and those of the adjacent interpier area exist in a severely degraded condition, well below that of open Hudson River waters. The studies also revealed that Long Slip Canal is a source of reduced water quality in the entrance basin.

The canal is currently accumulating sediments from CSOs. Also, eddy currents from the Hudson River result in deposition of river-borne sediments within the entrance basin of the canal. CSO treatment activities associated with the filling of the canal will reduce sediment loads to the Hudson River channel.

In its present configuration, the canal serves as the receiving water body for two CSOs, one each from the municipalities of Jersey City and Hoboken, depositing organic debris and causing the sediments beneath its western end to have an extremely high organic content. Additionally, high salinity water can become trapped in the deep bottom of the canal for periods exceeding a full tidal cycle, exposing it to anaerobic sediments with high microbial activity for more than six hours at a time, thus rendering it severely oxygen-depleted. This oxygen-poor, high salinity water is prevented from mixing with overlying water by strong density gradients that form as a result of tidal salinity fluctuations in the river and is probably exacerbated by the discharge of fresh water from the two CSOs in the canal and a third CSO at the canal entrance. Bottom contours allow the low-D.O., saline water from the canal bottom to spread out over the western part of the canal entrance basin and southward through a piling field, located outside the mouth of the canal, but prevent drainage eastward toward the river basin. The result is an extremely depauperate benthic community in the canal and western canal entrance basin, and a degraded habitat for fish that probably includes at least part of an otherwise valuable piling field.

To summarize, surface water quality at the site is the product of a complex interaction between:

- chronic inflows of sediment and pollutant loading from dysfunctional sewer and stormwater management systems;
- a shoreline configuration and bottom topography that restricts circulation, encourages stratification and precludes adequate flushing; and,
- the high sediment oxygen demand resulting from the build-up of organics in the canal sediments.

4. IMPACT ASSESSMENTS

a) No Build Alternative

Under the No- Build Alternative, the CSO's will continue to discharge into the canal and canal entrance basin, degrading water quality and preventing use of the valuable interpier area by federally-managed fish. While the JCSA has agreed to a two-year schedule for compliance with the NJDEP General Permit for CSOs, without the Long Slip project it will be several years before the NHSA will be able to bring the Park Avenue and HI outfalls into compliance. The sewer authorities' improvements are likely only to comply with the minimum general permit requirements and are not likely to include sediment removal as proposed under the Build Alternative. Furthermore, non-point source discharges will continue untreated, the oxygen demanding sediments will remain, and circulation problems in the canal entrance basin will not be corrected. Sediment will continue to be scoured from existing fill until NJ TRANSIT is able to spend $11 million for the need bulkhead rehabilitation. In summary, the No Build Alternative, at greater cost, will substantially delay water quality improvements and will not achieve the same level of water quality.

b) Build Alternative

A central focus of this project is the enhancement of water quality in the canal entrance basin and in the adjacent pile fields and interpier area. Fish, particularly the juveniles of stripped bass and several other managed species, will be the primary beneficiaries as the improved water quality will open the interpier area as viable habitat. As discussed in Section III - "Build Alternative", a multi-faceted program that addresses water quality from an ecosystems perspective was developed. To summarize, that program consists of:

- Reducing pollutant loads;
- Removing sediment and floatables from existing CSO discharges;
- Redirecting point discharges to waters of higher pollutant loading capacity;
- Removing sediment oxygen demand in canal and canal entrance basin; and,
- Altering the shoreline alignment and bottom topography to a naturally sustainable configuration that optimizes circulation, mixing, and flushing.

It is the combination of these steps that is necessary to achieve the optimum benefits. Reducing sediment load will improve, but not eliminate the sediment oxygen demand or the stratification that currently exists. Improving circulation without reducing the pollutant load may improve conditions locally somewhat, but the pollutants will move off-site and degrade a larger area. Though the local area will see the greatest improvements, the entire estuary will benefit from the incremental effects of reduced pollutant loading, BOD, and COD resulting from this project.

(1) Reduced Pollutant Loading

Local and regional water quality will be improved by reduced pollutant loads resulting from the improvements to the Jersey City and the two Hoboken CSO discharges that will eliminate dry weather flows, reduce the quantity of sediment discharged, and eliminate existing discharges of floatables. The two CSOs that discharge into the canal will be improved to exceed the minimum requirements of the 1995 New Jersey Pollutant Discharge Elimination System General Permit for Combined Sewer Systems. Though data regarding pollutant loads is insufficient to quantify these reductions, the project impacts to the canal entrance basin certainly will be improved water quality as indicted by raised D.O. and lowered turbidity levels.

Currently, many portions of the canal bulkhead in the canal and along the west end of the entrance basin are deteriorated and collapsed to such extent that tides and waves are scouring the fill material. Filling the canal will eliminate scour discharges from the canal bulkheads. The proposed walkway will eliminate scour discharges from the entrance basin bulkhead. Another source of turbidity in the canal entrance basin is the resuspension of sediments washed by stormwater into the pile field adjacent to the canal entrance from stockpiled soil on the Newport City property that is unprotected by soil erosion and sediment control measures. Wave energy in the canal entrance basin is somewhat focused and intensified by the entrance basin geometry so that the material is continually resuspended. By diffusing the incoming wave energy, the proposed walkway alignment will also effectively isolate this additional source of turbidity.

Presently stormwater is unmanaged, except in paved areas of the terminal. Most of the rail yard outside the passenger loading areas is unpaved. Though most stormwater infiltrates, periods of exception precipitation or high tides wash minor amounts of sediment, fugitive grease, oil, heavy metals and other contaminants from the yard and rail facilities directly into surface waters (NJ TRANSIT, 1996). Filling the canal and creating the walkway allows the capture of surface runoff and its discharge through pollution control chambers (oil/grease and sediment separators) prior to discharge. Walkway alternatives that include fill will capture and treat runoff associated with HBLRT facilities as well.

(2) Removal of Sediment Oxygen Demand

Excavation and filling proposed by the project will eliminate the oxygen demand of organics or pollutants in sediments both in the canal and the entrance basin and will reduce demand in other parts of the estuary. Filling proposed by the project will eliminate up to 4.6 acres (area of canal fill) of fine sediments that contain an abundance of organics whose decomposition contributes to the low levels of dissolved oxygen observed (Guida, 1997). Up to 4.1 additional acres of surficial sediments will be excavated from the entrance basin and placed in the CDF. The excess capacity of 150,000 cubic yards within the proposed CDF is equivalent to 23 to 93 acres of sediments unsuitable for ocean disposal, based on dredge depths of 4 to 1 feet, respectively. These will come from and benefit other parts of the estuary. Altogether 36 to 106 acres, also respectively, of oxygen demanding sediment will be isolated by the project (23 to 93 acres plus 10.2 project areas).

(3) Improvements to Circulation

Finally, through the filling of the canal, the excavation of the shoal, and the alignment of the walkway, the project will re-shape the shoreline and bottom. The Build Alternative is designed to improve circulation within the canal entrance basin and the adjacent interpier area eliminating existing areas of stagnation and stratification while minimizing filling. Eliminating stagnation and stratification is equivalent to increasing the pollutant loading capacity because pollutants are diluted and dispersed instead of concentrated as in the existing condition. The re-shaped basin achieves these benefits by increasing the cross-sectional area along the main channel of the Hudson River through which tidal waters can pass and by facilitating direct communication with all depths of the river.

5. PREDICTED EFFECTIVENESS OF MITIGATION– EDFC MODEL RESULTS

To test and "fine-tune" the habitat creation mitigation strategy, a water quality model to assess the impacts of program alternatives compared to the existing condition was developed by Dr. Gary Zarillo, a coastal geologist at the Florida Institute of Technology, using the Environmental Fluid Dynamics Code (EDFC). Because the lower Hudson River estuary is partially stratified, exhibiting strong vertical differences in salinity and flow patterns, a three-dimensional numerical model is required to adequately represent the existing and post-construction conditions. The EDFC has been extensively tested and documented in similar situations. Water quality samples taken during May and August 1996 were used as the baseline condition to calibrate and model various configurations of mitigation. (Appendix 4 contains a full description of the EDFC, its application to the project site and the results obtained.)

The model was run to simulate 30-day periods in May and August under four alternative conditions, the no-build and each of the three walkway alternatives described in Section III "Alternatives" above. May D.O. valves are equivalent to average annual valves and August valves are equivalent to annual worst-case conditions. Two discharge locations were modeled for the preferred alternative (Walkway 3) for May; the best of these, a discharge in the center of the entrance basin was used for the August run. The scope of the modeling included the canal entrance basin and the piling fields situated within the inlet that contains the canal, and the main river between 3,000 feet upstream and 2 miles downstream. Included in the Build Alternatives was the proposed excavation.

Distinct differences in D.O. resulted from each of the alternatives evaluated. For the No-Build condition, stratification of D.O. remained strong throughout the simulation. Near-bottom D.O. values were well below near surface D.O. values. After excavation and with a walkway across only the canal entrance (Walkway Alternative 1), near bottom D.O. values slightly increased, but near surface D.O. values slightly *decreased* signifying improved vertical mixing. The greatest improvements to D.O. values resulted from the proposed walkway alignment (Walkway Alternative 3). Zones of poor flushing on the northwest side of the entrance basin preserved under the other alignments are eliminated. Circulation was much improved under this alignment such that D.O. values did not fall below 8 mg/l anywhere in the canal entrance basin area during May. Similar results were obtained for August runs. Representative results are presented in Figures IV-12 and IV-13. These are summarized in Figures IV-14. Complete results are attached in Appendix 4.

6. MONITORING PROGRAM

NJ TRANSIT will establish a monitoring program to ensure the effectiveness of the habitat creation program following construction. The program will focus on water quality parameters. The program currently is being developed, but will likely consist of continous monitoring of bottom water temperature, conductivity, and dissolved oxygen levels over a three-year period.

7. COMPENSATORY WETLAND PLAN

The nearly 30-acres of on-site fish habitat creation will be augmented by approximately 5 acres of compensatory wetlands created off-site. These created wetlands will improve Hudson River water quality by renovating surface water runoff, i.e., removing suspended sediment and nutrients, thereby reducing non-point pollutant loads to the river. Section IV-F "Wetlands", below, describes the wetland reation plan in detail.

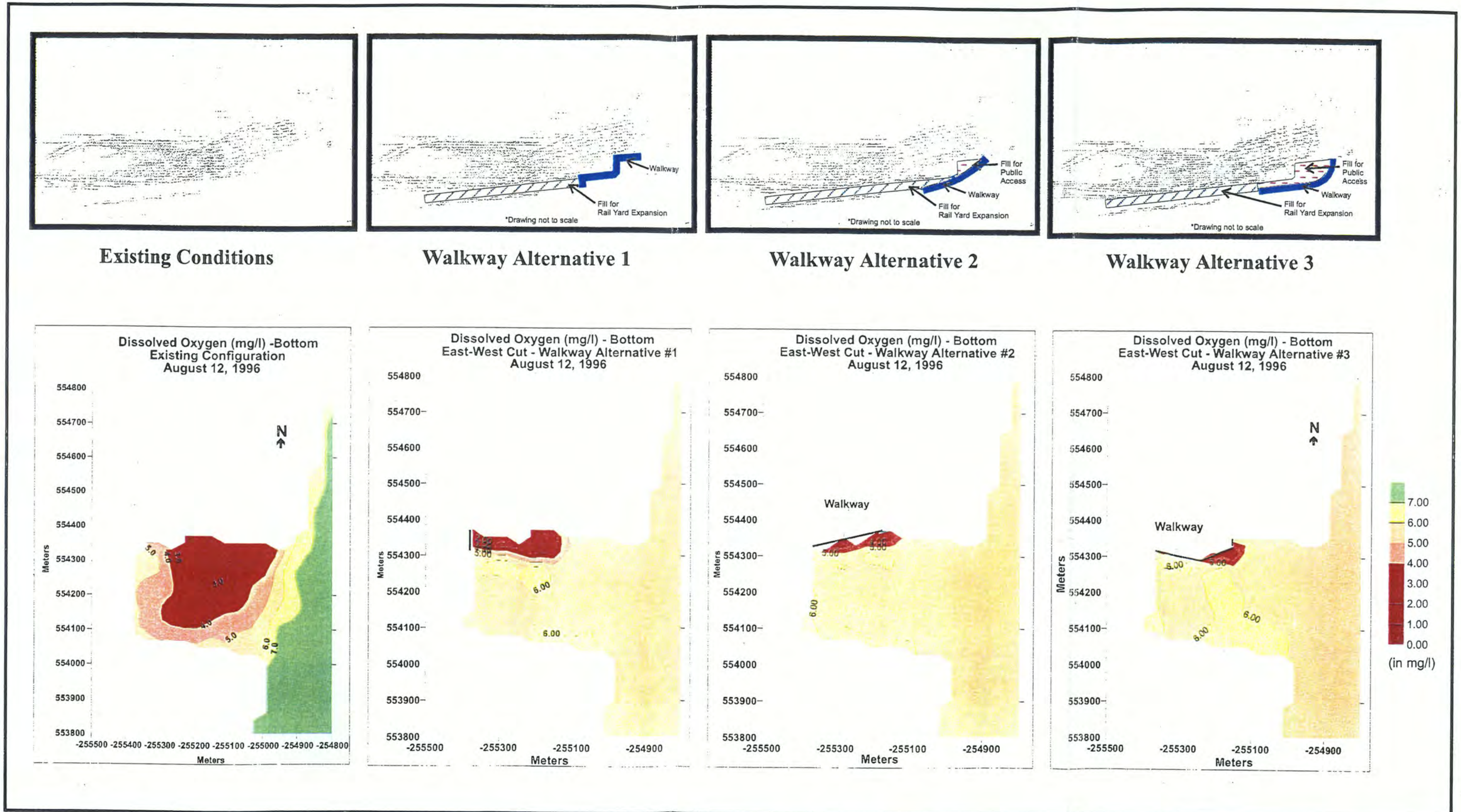


Figure IV-13 - Dissolved Oxygen Concentration - Bottom Water
August 12, 1996

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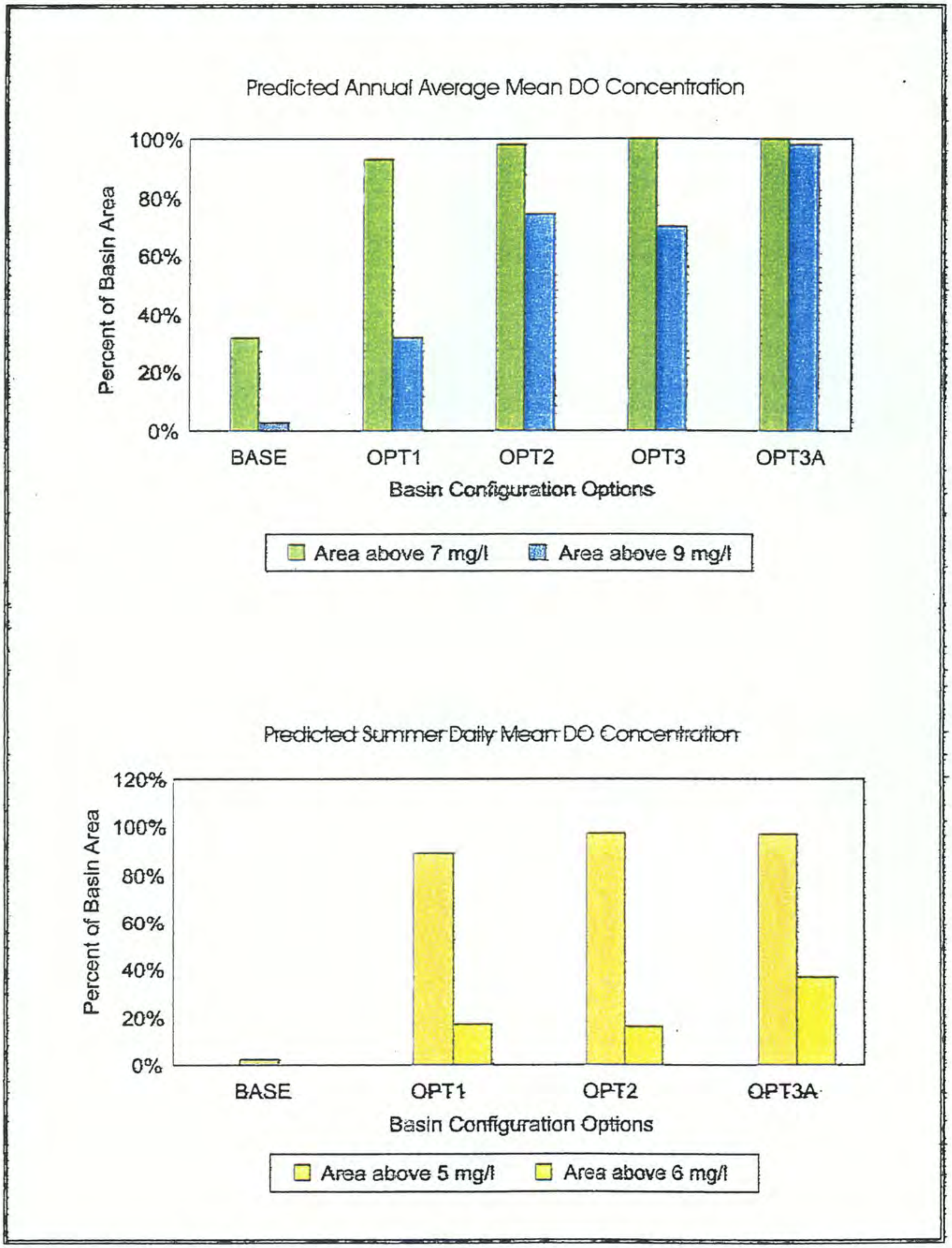


Figure IV-14 Dissolved Oxygen Predicted Average Annual and Summer Daily Concentrations - Bottom Waters

8. GROUND WATER

Groundwater is present in two zones, an overburden system consisting of unconsolidated fill and natural sediments overlying a bedrock system (BEM, 1996). The fill is 4 to 18 feet thick and overlies approximately 10 to 60 feet of organic silts and clays. These natural sediments have low permeability and effectively separate the surficial groundwater from that contained in the underlying permeable sands. The site lies in a regional zone of groundwater discharge to the Hudson River from an assumed regional divide at the Palisades Ridge to the west (BEM, 1996). At the site, ground water is encountered at depths of 3 to 6 feet below grade in the vicinity of the canal (see Appendix 3). Field monitoring by Dames & Moore in 1996 found tidal oscillations in the water table that was easily measurable near the river, but decreased in magnitude sharply landward. Because of this tidal influence, groundwater contours could not be mapped with certainty. General flow directions at the site appear to be towards the canal. Precise flow directions across the site may be indeterminable because of preferential flow paths created by heterogeneity within the fill and by utility trenches and other structures that could serve as drainage conduits. The hydraulic conductivity in the fill is expected to be high overall due to the coarse nature of the material (BEM, 1996).

Groundwater within the geographic region of the project area is not extensively used as a source of water supply. There are no USEPA-designated sole source aquifers in Hoboken and Jersey City (NJ TRANSIT, 1996). There are no aquifer recharge areas designated for special protection in Hudson County (NJ TRANSIT, 1996). Salinity and pollution preclude the use of groundwater as a source of potable water for the municipalities within the geographic region (ASGECI, 1996). The groundwater zones are classified as Class IIA suitable for potable supply with conventional treatment. However, the systems appear to satisfy the technical requirements for reclassification as Class IIB because the groundwater quality is highly degraded, remediation is not practicable, it is not used as potable supply, the overburden aquifer is not impacting a Class I or II aquifer, the overall lack of remediation does not pose a risk to the public (BEM, 1996).

Havens and Emerson, Inc. (1979) report that regionally some groundwater is used as a source for industry. None are known in the immediate vicinity of the site. Since such use would require a dependable, preferably artesian flow, it is surmised that such withdrawals are made from the bedrock system.

The Build Alternative will alter groundwater flow patterns in the limited adjacent to the canal, since flows will no longer discharge into the canal. During construction, such alterations will be temporary and primarily related to dewatering of dredged material, particularly when the surcharge is applied. The extent, magnitude and directions of alterations to ground water flows cannot be precisely determined for several reasons. First, the pathways of preferential flow resulting from the fill's heterogeneity and buried engineering structures within the fill cannot be predicted. Second, the potential for leakage of the existing bulkheads varies along its length according to the amount of deterioration. Finally, information is still being collected regarding the physical characteristics of existing sediments within the canal.

Adverse effects to groundwater quality are not anticipated. Groundwater within the fill and surficial aquifer are locally and regionally contaminated (BEM, 1996). General groundwater flow directions are towards the river. Consequently, and because industrial users are not likely to withdraw from overburden systems, the impacts of any possible temporary flow alterations during the filling and surcharging operations are not likely to extend beyond the rail yard boundaries.

F. WETLANDS

1. EXISTING CONDITIONS

No vegetated wetlands occur at Hoboken terminal. No wetland areas were identified within the confines of Long Slip Canal or on adjacent lands by NJDEP mapping or during field investigations related to this project.

Wetlands under federal jurisdiction are identified in the field using the three parameter approach outlined in the Federal Manual for the Identification and Delineation of Jurisdictional Wetlands (Federal Interagency Committee on Wetland Delineation, 1989). Wetlands are defined by the Environmental Protection Agency and by the Corps of Engineers for administering the Section 404 permit programs as "those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and in normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs and similar areas". In accordance with the Federal methodology, areas that contain hydrophytic vegetation, hydric soils, and wetland hydrology were identified as wetlands.

Long Slip Canal and the canal entrance basin are wetlands classified as a estuarine, subtidal open water system (U.S. Department of the Interior, 1979). Depths within the canal are about -12 to -14 feet NGVD (1983). At the canal's west end, however, deposits of sediment discharged by the Jersey City CSO grade upwards and are nearly exposed at low water. As seen in Figures III-7 and III-8 above, the canal entrance basin bottom shoals to about -6 feet NGVD in the center of the basin before dropping sharply east of Pier 1 to the main Hudson River channel.

In addition to groundwater discharges through the bordering bulkheads, they are "fed" by CSOs on the west and north, by the PATH sump on the south and by a CSO and the Hudson River on the east. Long Slip Canal discharges eastward into the canal entrance basin interpier area that in turn is connected to the Hudson River. As described in detail in Section IV-I, aquatic life grades from significantly depauperate interpier communities in the east to seasonally absent in the western end of the canal. Wildlife usage is restricted to tolerant waterfowl.

2. IMPACTS OF THE NO-BUILD ALTERNATIVE

The No-Build Alternative will not avoid wetland impacts. The necessary rehabilitation of presently failing bulkheads defining Long Slip will require filling on the order of 1 acre (NJ Transit, 1994). Though in the future, the JCSA and the NHSA will make the CSO discharges comply with the NJDEP General Permit on CSOs (within two years for the Jersey City CSO, but there is no definite compliance schedule for the Hoboken sewer), the discharges into the canal will continue. These discharges and the highly oxygen-demanding bottom sediments will maintain the current anoxic conditions (Guida, *et al.*, 1995). Sediment will not be removed from the CSO discharges and will continue to fill the canal. Stormwater runoff will continue to discharge untreated into the canal. Without the isolation of Long Slip Canal from the ecosystem and the canal entrance basin excavation to restore vertical mixing and circulation, the water quality in the adjacent 37-acre interpier area will remain highly unsupportive of aquatic and benthic communities (Guida, *et al.,* 1995; Guida, 1997; Dames & Moore, 1997, 1998, 1999). Without the opportunity offered by the development proposed by NJ Transit, there is no incentive or justification for the comprehensive and expensive restoration needed.

3. IMPACTS OF THE BUILD ALTERNATIVE

The project will fill Long Slip Canal's 4.6 acres of subtidal waters. The project also will recontour about 4.1 acres in the canal entrance basin and excavate 80,000 cy of accumulated sediment. Detailed descriptions of the resulting impacts to water quality and to aquatic communities are presented in Section IV -E "Water Quality", and Section IV-I "Ecologically Sensitive Areas", respectively. The effects of these activities are entirely beneficial and restorative to the quality and wetlands values of adjacent waters and the lower Hudson River estuary.

There is no practical alternative to filling that will yield the same social economic or environmental benefits. At the December 11, 1998 meeting, representatives of NMFS and USFWS agreed that the statutory tests of need, avoidance and minimization were satisfied by the development program.

4. MITIGATION PROGRAM

At the December 11, 1998 meeting, the NMFS and USFWS agreed to recommend that their agencies accept the water quality improvements plus compensatory wetlands at a less than 1:1 ratio as full mitigation of the canal fill. Subsequent consideration by the agencies determined that a 1:1 ratio was appropriate.

a) Water Quality Improvements

The objective of the mitigation program is the restoration of water quality to levels that will fish and aquatic communities may utilize create The mitigation program comprehensively addresses the several causes of degraded water quality in the canal entrance basin and adjacent interpier area. A detailed discussion of the specific measures to restore water quality is presented in Section IV-E "Water Quality", above.

b) Compensatory Wetlands

Dames & Moore surveyed available sites in the project vicinity potentially suitable for the compensatory wetlands required to mitigate project impacts. Preliminary sites were identified along the Hudson, Hackensack, and Elizabeth Rivers, the Kill van Kull and in Newark Bay. This survey was refined based on meetings and follow-up conversations with the US Fish and Wildlife Service (USFWS), National Marine Fisheries Service (NMFS), and the Baykeeper that yielded the following minimal siting criteria:

- A total of 4.6 acres is needed (a 1:1 ratio of compensatory wetlands to altered wetlands);
- NMFS requires the wetlands to be tidal wetlands; (USFWS does not impose that requirement);
- The wetlands should be as close as possible to Long Slip Canal, preferably along the lower Hudson River or the Kill Van Kull.

The current study utilized previous siting surveys, the NJDEP Geographic Information System data, aerial photography, and site reconnaissance by air and ground to inventory and evaluate potential sites. This study resolved three candidate sites that meet the above criteria. The remaining vacant lands along the lower Hudson River or Kill Van Kull are currently under development. The candidate sites are:

- The Caven Point Peninsula Area on the south side of Liberty State Park in Jersey City, NJ (Block 1497 Lots 1D and 1E);
- The Workbench Site on Port Jersey, Bayonne, NJ, (Block 400, Lots 3,4); and,
- Port Johnson, Bayonne, NJ (Block 476).

These three sites are under review for acquisition by the NJ Transit real estate division. Preliminary wetlands creatrion plans were prepared for each site. Subsequent investigation found environmental or regulator encumberances on each that precluded acquisition and development within the timeframe of the project.

Having exhaustively and unsuccessfully searched for a wetlands creation site that can be guaranteed, NJ Transit committed to purchasing compensatory wetlands credits at the existing Marsh Resources, Inc. (MRI) mitigation bank in the Hackensack meadowlands. The MRI mitigation bank in the Hackensack appropriate meadowlands is now the only available mitigation bank whose service area includes the project site. To determine the mitigation acreage that would be required at the bank, Dames & Moore performed an Indicator Value Assessment of Long Slip Canal using methodology published by the Hackensack Meadowlands District Commission (See Appendix 5). That analysis found that the mitigation ratio is 0.8 acres of mitigation bank to each acre altered by the project (0.8:1). The proposal to purchase credits at the MRI was presented to the MIMAC February 17, 2000. MIMAC approved the proposal, but NJDEP Land Use Regulatory Program increased the required acreage to 9.12 acres, a 2:1 ratio.

G. FLOODING

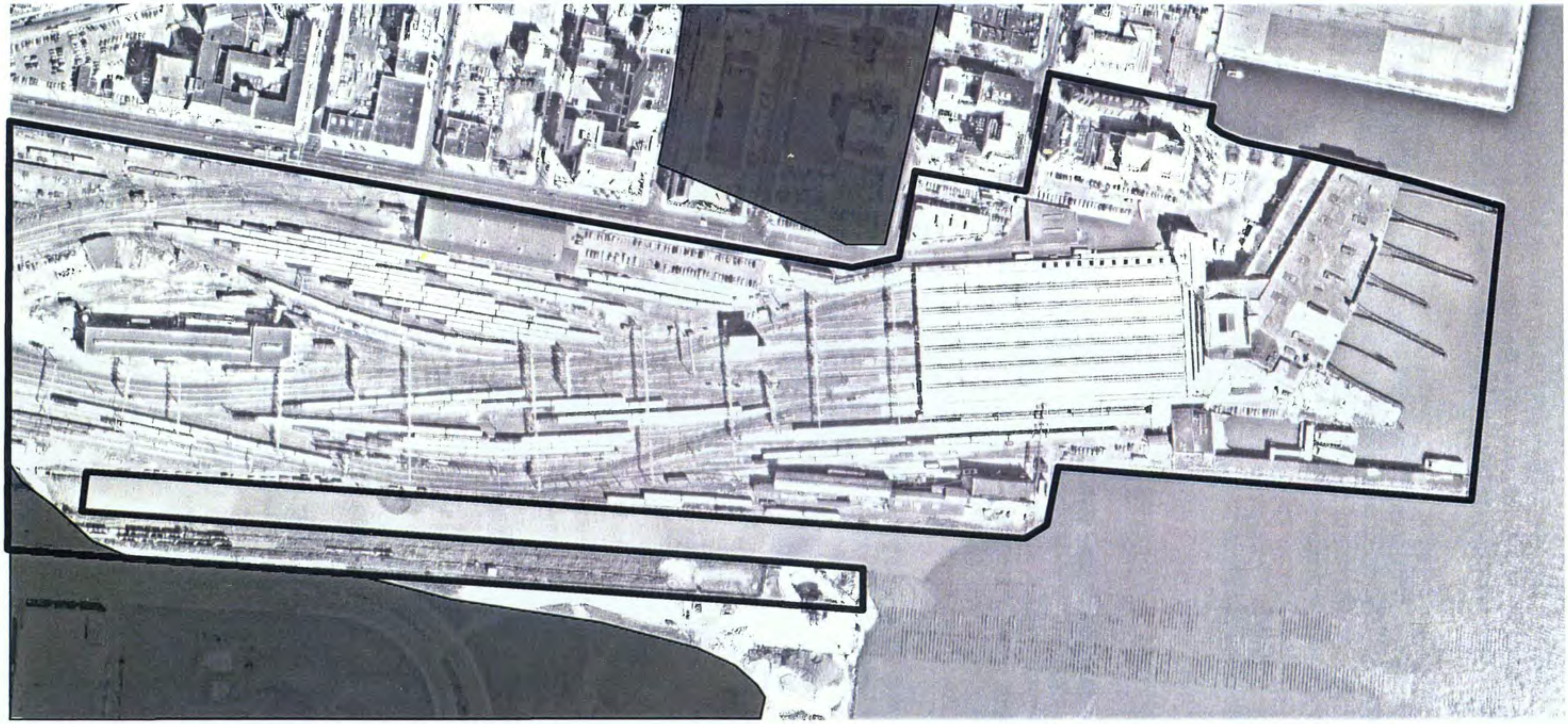
1. FLOOD PLAIN IMPACTS

The Flood Insurance Rate Maps published by the Federal Emergency Management Agency (FEMA) (FEMA, 1982 and 1984) indicate that Long Slip Canal and lands immediately adjacent to the canal are contained within the 100-year floodplain of the Hudson River (see Figure IV-15). This portion of the floodplain is classified as "A-Zone" - flooding not associated with significant wave action. According to the Flood Insurance Studies for the Cities of Hoboken and Jersey City (FEMA, 1982 and 1983), the 100-year flood level of the Hudson River in the area of the project is 9.5 feet NGVD.

The principal flooding in this area is mainly attributed to tidal conditions; fluvial flows from the Hudson River are not a significant contributory source of flooding (FEMA, 1982 and FEMA, 1983). In inland settings, floodplains function to store the increased volume river discharge occurring during a storm to reduce the height of the flood stage downstream. Generally, the placement of fill reduces the storage capacity of a floodplain, thereby increasing potential downstream flood levels. However, in tidal areas, floodplain development is not a concern because the ocean can easily absorb the volume displaced from the river. Since the project site is adjacent to tidal waters of the Hudson River, there will be no adverse temporary or permanent impacts to flood storage or flood flow of the 100-year floodplain as a result of project implementation. Stormwater CZM policies (N.J.A.C. 7:7E-8.7) set the stormwater management goals of minimizing the generation of stormwater, minimizing the rate and volume of off-site runoff, maintaining and simulating natural drainage systems, and minimizing the discharge of pollutants to ground or surface water systems. In addition to complying with these policies for the new construction, the project is designed reduce the pollutant loads of existing stormwater runoff discharged from the site into the Hudson River.

Presently, stormwater is unmanaged, except in the paved terminal areas. The majority of the site slopes gently to the east and southeast to the river and to Long Slip Canal. Most of the site is unpaved, and normal precipitation events infiltrate. Under saturated or flood conditions, surface flows drain east toward the river or to the canal.

Figure IV-15 - Floodplain Boundaries



Areas Outside The 100 Year Floodplain

Hoboken Terminal Boundary

Source: FEMA, 1982; FEMA, 1984

DAMES & MOORE

Creating the CDF will unavoidably increase the volume of runoff generated from the site. However, since site slopes are nearly flat and since the tidally-dominated lower Hudson River that can easily absorb increased volumes, there will be no adverse impacts to adjacent or downstream properties.

Consequently, the stormwater management plan will focus on the renovation of stormwater quality. A combination of best management practices and structural systems are proposed depending on the final walkway design. Under the preferred alternative, catch basins with oil and sediment separators would be used to treat runoff prior to discharge. The runoff will drain into catch basins equipped with a rim that causes ponding to remove sediment. The excess would discharge through outfalls in the berm equipped with backflow preventers. The catch basins would be equipped with sediment traps and oil and grease separators. The remainder would infiltrate through an upper zone of granular fill and drain through the berm. NJ TRANSIT will maintain the drainage system.

H. NAVIGABLE WATERWAYS AND COASTAL ZONES

All work will be within the existing pier and bulkhead line. No portion of this project will affect federally designated or maintained navigation channels. Only the interpier area and Long Slip Canal are within the project scope. Maintenance dredging will deepen the interpier area. LTJG Alna Keanally of the US Coast Guard Waterways Oversight Branch (October 19, 1998 telecon) indicated the she had reviewed the September 28, 1998 Public Notice and found that project would not affect navigation. She requested that during construction

The Long Slip Canal is not currently in use because rail yard activities have changed from waterfront ship-related commerce to commuter rail service between New Jersey and New York City. This conversion was necessary to promote use of public transportation in an effort to reduce automobile transportation on over-congested roads of the metropolitan area and to reduce air pollution associated with automobile use. Because of this conversion, the Long Slip Canal is no longer used to support port-related activities. For this reason, navigational use of the canal ended over 25 years ago and is not likely to resume. The existing ferry facilities currently in use will not be affected by the project.

The project area is within the coastal zone defined in the State of New Jersey by N.J.A.C. 7:7. A consistency statement is under review by the NJDEP Office of Dredging and Sediment Technology (formerly the NJDEP Land Use Regulation Program), as part of the Waterfront Development permit application. Pre-application coordination meetings were held with that office on June 7, 1993, June, 10,1996, and July 17, 1997, and a post-filing coordination meeting was held on April 16, 1998.

I. ECOLOGICALLY SENSITIVE AREAS

The Long Slip Canal is a completely artificial feature created last century from existing filled areas to serve the rail yard. It is adjacent to the Hudson River, separated by an interpier area. "Ecologically sensitive areas" are areas that contain natural features that require protection (UTMA, 1979). Due to the sections that follow existing condition and the impact associated with project alternatives are addressed.

The Hudson River is a critical migratory pathway for diadromous fish to or from seasonal spawning areas. Species of concern include: alewife or river herring (*Alosa pseudoharengus*), blueback herring (*Alosa sapidissima*), American shad (*Alosa aspidissima*), striped bass (*Morone saxatilis*), Atlantic sturgeon (*Acipenser oxyrhynchus*), Shortnose sturgeon (*Acipenser brevirostrum*) and American eel (*Anguilla rostrata*) (USFWS, 1996).

1. EXISTING CONDITIONS

The Hudson River Estuary supports a diverse biota including numerous species of phytoplankton and zooplankton, polychaetes, mollusks, crustaceans, and other benthic faunal species, as well as over a hundred species of finfish, ranging from anadromous spawners and marine migrants to juveniles which depend upon these protected habitats during critical life stages. In contrast with oceanic species, which are subject to more stable environments, estuarine species are tolerant of wide fluctuations in their habitats, even some changes resulting from human activities (NJ Marine Science Consortium, 1987).

The baseline biological study for this project found seasonal and spatial gradients of species composition, diversity and abundance that directly reflect water quality gradients from the relatively clean open channel of the Hudson River to the severely degraded west end of Long Slip Canal, (Guida, *et al.*, 1995) (see Figure IV-16). The complete study including species lists is contained in Appendix 5. The key characteristics of site aquatic communities are as follows:

- The kinds of benthic and fouling communities found suggest a polluted, brackish environment that suffers from severe anoxia in summer, then is progressively colonized during fall as improvements in water quality and the nature of the sediments permit.

- The canal's flora and fauna do not directly provide much in the way of food resources for fish and crabs, though they may do so indirectly, via small forage fish. Food sources for species such as tautog and cunner are largely absent from the western end of the canal.

- The western end of the canal was so polluted in summer that no live organisms were found on the bottom and few were found on the walls. This condition gradually abated toward the east, but even just outside the canal benthic and fouling communities were impoverished as compared with other estuarine locations at the same time of year. Sewer discharge into the western end of the canal was a major cause of this impoverishment; water quality was visibly degraded and bottom sediments near the sewer outfalls were completely anaerobic and full of terrestrial organic debris.

- Except for "exotic" organisms drifting into the canal from the adjacent canal entrance basin, benthic communities in the central and eastern parts of the canal remained impoverished during the fall. Peak densities for animals occurred in late November, an unusual pattern for an estuary in this region, most likely dictated by water quality improvements with cooling temperatures.

- Benthic communities of the western and eastern communities in November were distinct, being composed of almost entirely different lists of species, presumably in response to the very different nature of sediments in the west versus the east and possibly also due to water quality gradients.

- Fouling communities, dominated by bluegrass bacteria and algae, also demonstrated extreme impoverishment in summer, especially at the western end of the canal, then recovered during the fall. A pattern of gradual westward invasion of less pollution-tolerant species was found, but by late November, fouling communities of the western and eastern ends of the study area were still distinctly different, suggesting a lingering west-to-east gradient in water quality.

- No epibenthic crustacean community (important elsewhere as fish food resources) was found.

- No fish or crabs were caught in the canal. Large numbers of fish eggs (mostly wrass and anchovy) found in the canal probably drifted in with tidal currents. Only a few fish and crabs were caught in the canal entrance basin outside the canal (anchovy, killifish, winter flounder, pipefish, and blue crabs).

- Biogas is produced by bacterial decay of plant matter carried into the canal through the combined sewer outfall at its western end. Gas obtained from the Canal in October contained about 80 percent highly flammable methane. Extrapolation from lab experiments, show that the canal could generate 1000 cu. ft. of methane per day during peak summer temperatures, posing a considerable risk of fire/explosion if it were confined (Guida, *et al*, 1995). Gas generation from sediments could continue for four months or more after cessation of sewer discharge.

- The abundance and diversity of communities observed in the canal are low for this reach of the Hudson River as shown in Figures IV-17 and IV-18 (Andrews, 1984). The summaries of 1982-1983 and 1994 studies presented in Table IV-7 indicate that faunal impoverishment is a stable characteristic of the canal and canal entrance basin. The results also suggest that the value of the canal and the canal entrance basin in the overall food chain of the Hudson River estuary is far less than adjacent interpier habitats. By comparing these surveys to communities present in adjacent sites, Table IV-7 suggests the benefits of improved water quality.

2. IMPACTS OF NO-BUILD ALTERNATIVE

The No-Build Alternative requires repair of collapsing bulkhead that endanger current rail operations. However, even after the bulkhead rehabilitation, will be maintained the conditions that created the current stressed and depauperate communities in the canal and canal entrance basin. In the longer term, continued sediment discharges from the CSOs and sediment influx from the water column will continue to shoal the canal, creating increasingly stagnant conditions. As the canal fills through wetland succession, canal waters would be expected to show increased temperature, salinity range and reduced D.O. Eventually the canal will fill completely. Continued sediment discharged from the Hoboken CSO into the canal entrance basin will promote stratification and stagnation The result of these processes will be an escalating deterioration of habitat in the canal and the canal entrance basin.

3. IMPACTS OF THE BUILD ALTERNATIVE

The Build Alternative while accelerating the natural process without the negative impacts on the ecological habitat. This alternative will fill Long Slip Canal. The total area of this fill is 4.6 acres. Existing outfalls for Jersey City and Hoboken CSOs will be extended into the canal entrance basin. Water quality modeling found that removing the canal from the ecosystem considerably improved habitat quality in the adjacent 27-acre interpier area (see Section III-E "Water Quality"). The proposed mitigation program described below is designed to optimize water quality and habitat.

4. MITIGATION OF THE BUILD ALTERNATIVE IMPACTS

a) Basis of Mitigation

The recent Magnuson-Stevens Fishery Conservation and Management Act, amended in 1996 by the Sustainable Fisheries Act, seeks to restore rapidly and severely declining fish populations. This objective will be accomplished through the management of fishing practices and the conservation of habitats where fish spawn, breed, feed, and grow into healthy mature life stages. The United States government has defined habitats that are necessary for these stages of development Essential Fish Habitat (EFH). The protection, conservation and enhancement of EFH will maintain and foster the diversity of fisheries in the United States.

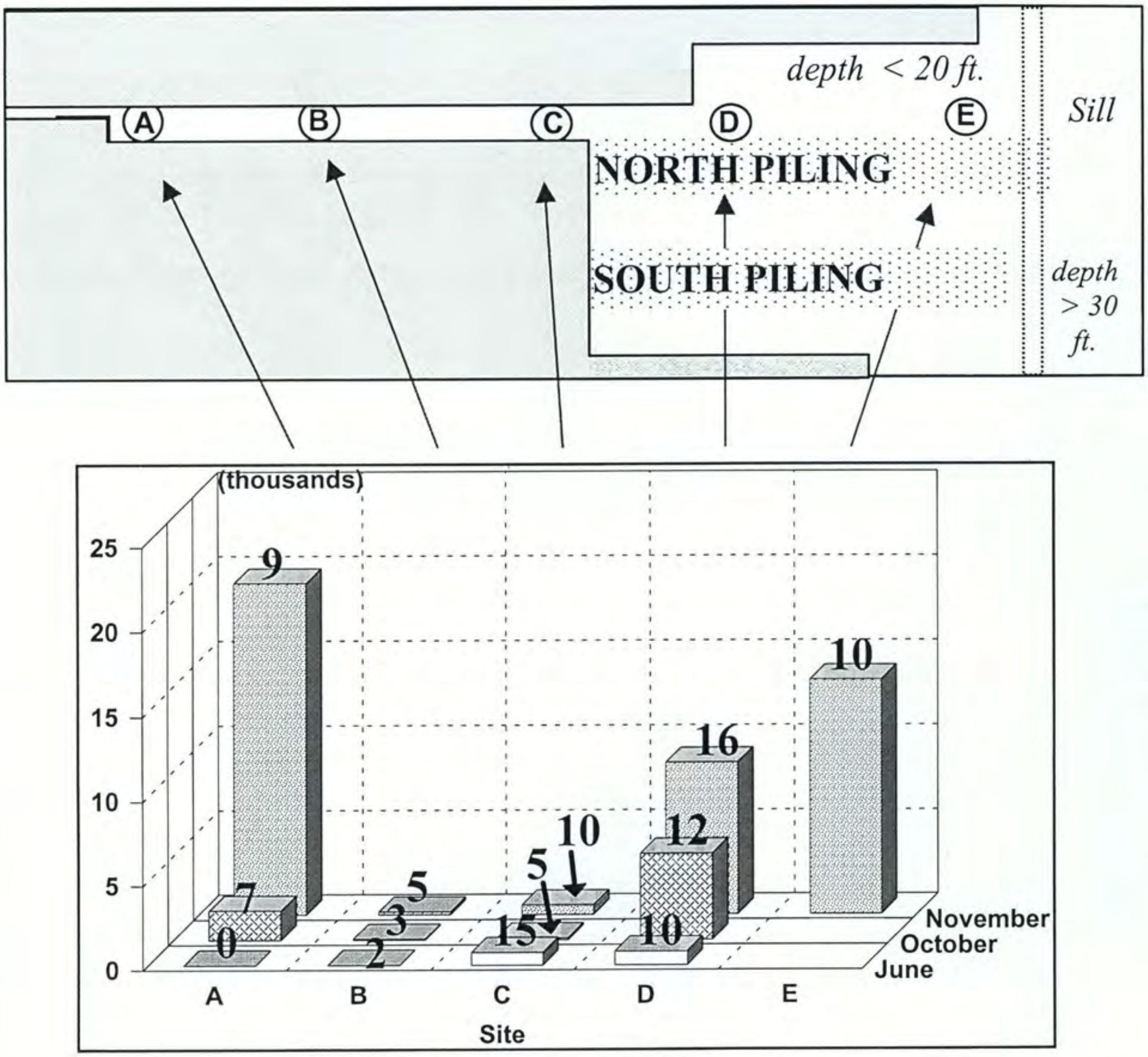


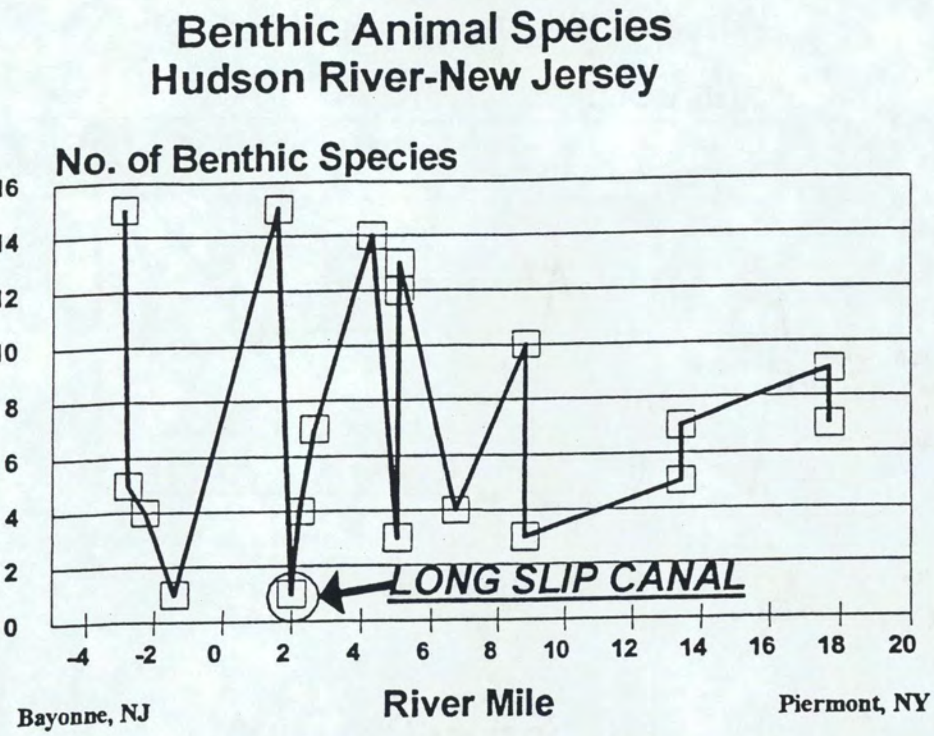
Figure IV-16 - Benthic Flounder Densities

Bars indicate organisms/square meter (thousands). Numbers atop bars are number of animal taxa. Source: Guida, *et al.*, 1995

Table IV-7 Fishes, Crabs & Shrimp in Long Slip Canal Entrance Basin and in Adjacent Hudson River Sites

All Shoreline Stations 1982-83	Long Slip Canal 1982-83	Long Slip Canal 1994	Adjacent Sites 1982-83
Alewife			X
American eel			X
American shad	X		X
Atlantic herring			X
Atlantic menhaden			X
Atlantic silversides			X
Atlantic tomcod	X		X
Bay anchovy		X + eggs	X
Blueback herring			X
Bluefish			X
Butterfish			X
Cunner		eggs?	
Grubby sculpin			X
Mummichog		X	
Northern pipefish		X	X
Northern searobin		eggs	X
Pollack			X
Rock gunnel			X
Striped bass	X		X
Summer flounder	X		X
Tautog		eggs?	
Weakfish			X
White perch			X
Windowpane flounder	X		
Winter flounder		X	X
Blue crab		X	X
Green crab			X
Hermit crab		X	X
Horseshoe crab			X
Lady crab			X
Rock crab			X
Sand shrimp	X		X
Total Species: 39	**7**	**9**	**28**

Source: Guida, Zeroka and Choudhury (1995) and Andrews (1984)



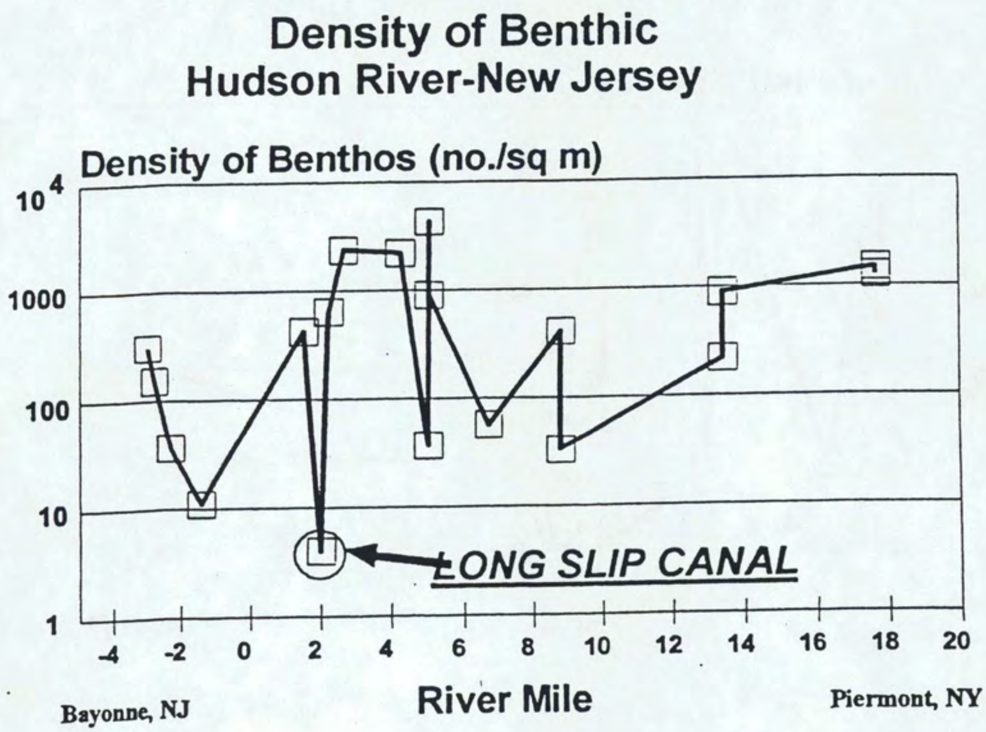
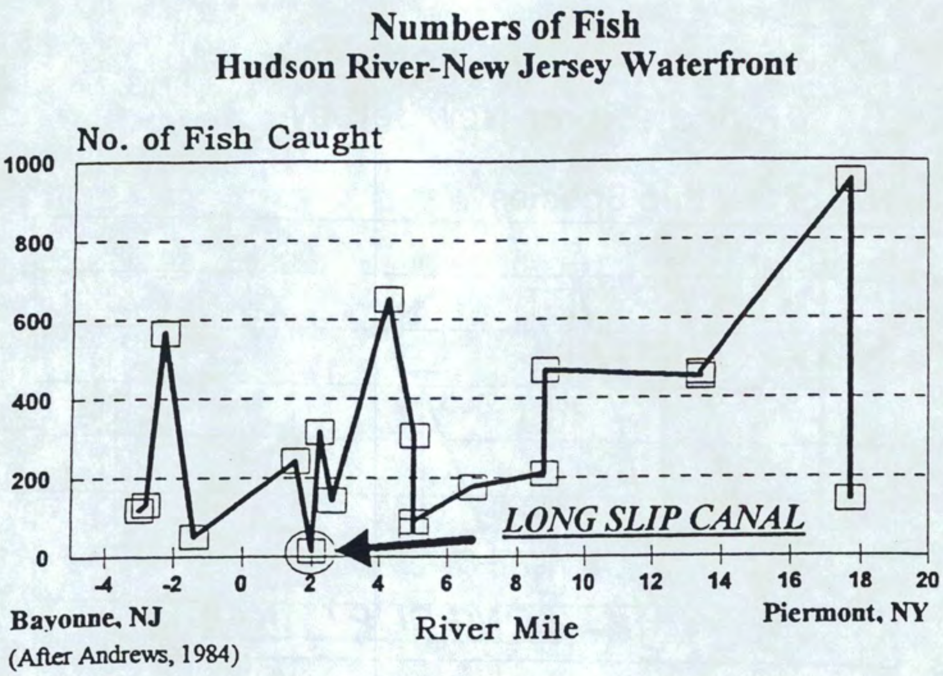


Figure IV-17 - Abundance and Diversity of Benthic Organisms



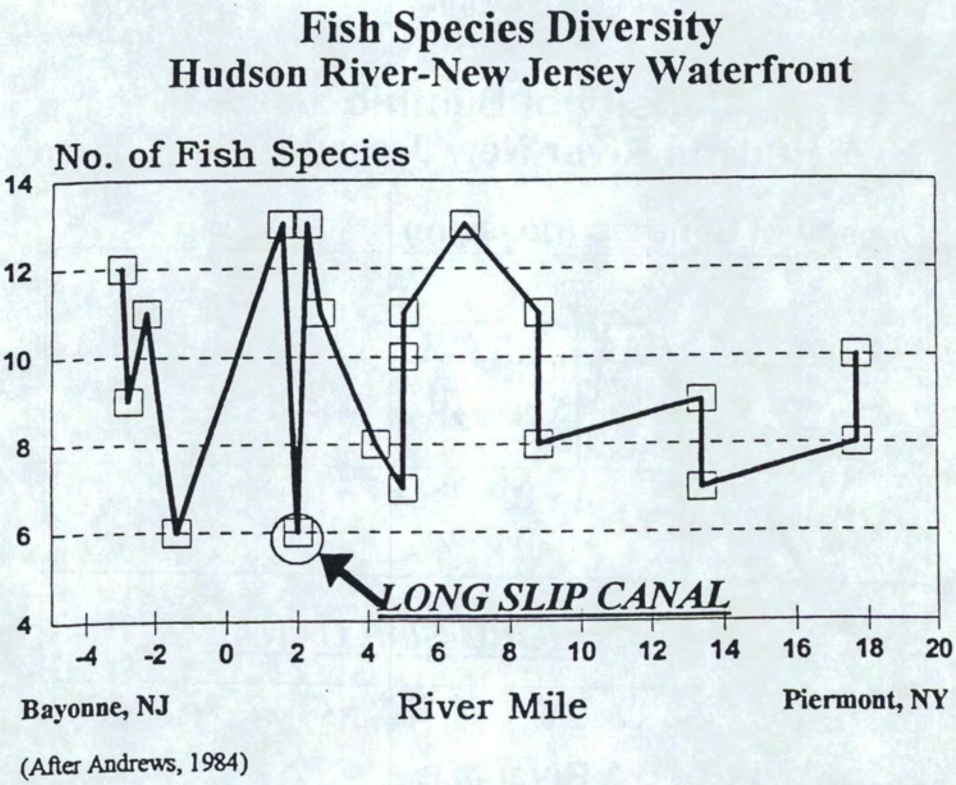


Figure IV-18 Abundance and Diversity of Fish

The National Marine Fisheries Service (NMFS) established eight Regional Fishery Management Councils to promote the conservation and management policies of the Magnuson-Stevens Act by mandating the creation of Fisheries Management Plans (FMP) for species of concern. Fishery Management Plans involve the description and identification of EFH, as well as, adverse impacts on EFH from development activities and actions to conserve and enhance EFH. To date draft fishery management plans have been prepared only for bluefish, summer flounder, black sea bass, scup, butterfish, squid, Atlantic mackeral, Atlantic surfclam and ocean quahog. Of these, occurences of only summer flounder, black sea bass , bluefish, and butterfish have been described in the project area (USFWS, 1996; NJDEP, 1984; Guida, 1997).

The NMFS provides the following recommendations for conservation and enhancement of EFH:

- Enhancement of rivers, streams and coastal areas. EFH located in, or influenced by rivers, streams and coastal areas may be enhanced by reestablishing endemic trees or other appropriate native vegetation on adjacent riparian areas: restoring natural bottom characteristics; removing unsuitable material from areas affected by human activities; or adding gravel or substrate to stream areas to promote spawning. Adverse effects stemming from upland that influence EFH may be avoided or minimized by employing measures such as, but not limited to, erosion control, road stabilization, upgrading culverts, removal or modification of operating procedures of dikes or dams for fish passage and habitat protection, or improvement of watershed management.

- Water quality and quantity. These options may include use of best land management practices for ensuring compliance with water quality standards at state and Federal levels, improved treatment of sewage, proper disposal of waste materials, and providing appropriate in-stream flow.

- Watershed analysis and planning. This include encouraging local and state efforts to minimize destruction/degradation of wetlands, restore and maintain the ecological health of watersheds, and encourage restoration of native species.

- Habitat creation. Under appropriate conditions, habitat creation (converting non-EFH to EFH) may be considered as a means of replacing lost or degraded EFH. However, habitat conversion at the expense of other naturally functioning systems must be justified within an ecosystem context.

b) Measures Proposed

Build Alternative impacts would be mitigated though the creation of Essential Fish Habitat. As shallow benthic habitat areas are not available for the project area, a mitigation program is proposed. This program of water quality improvements directly addresses the stated conservation goals of the USFWS (1996), the Comprehensive Conservation and Management Plan (NY-NJ Harbor Estuary Program, 1996) and the NMFS fishery management plans MAFMC, 1998a, 1998b, 1998c, namely the improvement of water quality and the creation/restoration of habitat. where none now exists (see Section III "Mitigation Plan"). The habitat creation area consists of the canal entrance area, the northern pile field and open water to the south, a total area of 23.0 acres, of which 7.0 acres are open piles. A comprehensive set of activities are proposed to achieve sustainable improvements that include:

- reducing the load of point and non-point source pollutants;
- alterations to the shoreline and bottom to improve circulation, flushing and vertical mixing;
- isolation of sediment oxygen demand; and,
- rip rap to provide hard substrate and shelter.

c) *Anticipated Benefits*

During a 1994 spring-summer trapping study *(*Able,, *e*t al., 1995), an earlier 1982-83 study (Andrews, 1984), about three quarters of the fish caught in waterfront habitats in this region of the Hudson Estuary were accounted for by four species: striped bass, black sea bass, tomcod and winter flounder. Tomcod dominated catches in early summer (mid-May to mid-July), while striped bass and black sea bass became dominant from mid-July to mid-September. Virtually the entire catch of all of these fish consisted of young-of-the-year (YOY) juveniles. While trap design used and seasonal timing of this investigation probably skewed catches toward smaller size fish, this result indicates that shallow waterfront areas in this reach of the river are utilized heavily by a variety of fish as an estuarine nursery.

The preponderance of juveniles of most species in these habitats suggests that the principal beneficiaries of habitat improvement in the Long Slip canal entrance area will indeed be juveniles, not catch-worthy adults...at least not immediately. The Hudson waterfront area now functions essentially as an estuarine nursery area, and habitat improvements will create an improved nursery area...not a fishing hole where you are guaranteed to get the big ones. Some big ones will undoubtedly come in, as they were shown to do in 1982-83, but the whole point of a nursery area is to provide a refuge for juveniles from large predators like adult striped bass and white perch.

Just south of the North Piling Field, trap collections yielded substantial numbers of juvenile fish <u>and</u> even more numerous sand and mysid shrimp (Able,, *e*t al., 1995) preferred food resources for most of the fish species present (see Appendix 5). Although oxygen minima were quite low in summer (<2 ppm), these fish and crustaceans remained abundant, and caged tautog and winter flounder actually grew here (Able, *e*t al., 1995). This growth, together with the abundance of such oxygen-sensitive fish as juvenile striped bass and tomcod (see Appendix 5) here seems paradoxical unless you realize that the experiments used to determine D.O. sensitivity exposed fish to continuous low oxygen concentrations whereas the D.O. pattern at the piling field site was cyclical, varying as much as 3 ppt with each tidal semi-cycle. Tidal D.O. minima were likely associated with Long Slip bottom water moving out of the canal. This apparently good biological condition despite D.O. the minima poses a question about whether increased D.O. resulting from planned basin alterations will really improve the habitat for fish and their food resources. The authors of the 1994 study suggest that such improvements will indeed help: "...for species susceptible to poor water quality and habitat degradation, habitat restoration projects for juveniles may yield long-term benefits and allow increased yields as great as those realized by reducing overfishing." (Able, *e*t al., 1995).

d) *Striped Bass, Tomcod and White Perch*

Striped bass and tomcod certainly qualify under this statement. Juveniles of both of these anadromous species had migrated down from upstream spawning areas in the months following hatching (Able, *e*t al. 1995, Dew and Hecht, 1994). As for susceptibility to poor water quality, feeding and growth in juvenile tomcod are known to be inhibited at D.O. concentrations below 7 ppm and temperatures above 24^{O}C (Grabe,, 1978). While striped bass can tolerate habitats with D.O. values as low as 2 to 3 ppms (Coutant, and Benson, 1990), other evidence suggests they may prefer more oxic habitats. Well-maintained deep interpier zones have been shown to harbor larger populations of striped bass than shallow areas where siltation had occurred, (Cantelmo, and Wahtola, Jr., 1992). In all probability, this is true because accumulated silt forms humps and sills that block good bottom circulation and encourage areas of oxygen depletion as in the canal entrance basin. Removing the silty hump in this case will attract more striped bass as a result of higher D.O. Given the similarity in their life history, ecology and local migratory habits, the same may also be true of the white perch.

Indeed, striped bass are likely to be the primary beneficiaries of water quality improvements in the case of the proposed habitat improvement program because of the timing of their residence in this location.

In 1994, juvenile tomcod dominated catches between May and early July, vacating shallow water habitats just as D.O. minima were becoming severely depressed and before temperatures reached 24° (Able, et al., 1995). This species appeared to vacate all shallow sites at this time, not just the Long Slip waterfront (NJ piling field) site. As the D.O. varied considerably from site to site, temperature, not minimum D.O., was probably the deciding factor in this migration. The lowest D.O. levels in the Long Slip area, and those most different from sites with better circulation, occurred later in the summer, when tomcod were scarce at all shallow locations (mid-July to September). Improved circulation resulting from the proposed modifications of the canal entrance basin would be expected to have its greatest effect on D.O. during this latter period, when striped bass dominate the shallows.

As most of the striped bass occurring in the Hudson probably belong to the local (non-migratory) population, the benefit of improved habitat will accrue primarily to that local population, i.e. it will not be substantially "diluted" by entry of local fish into far-ranging migratory stocks. Any benefit accrued to tomcod and white perch will also be reflected locally, since the local stocks are confined to the Hudson River. Benefits for these fish should become apparent within a short period, as these are all relatively fast-growing species.

e) Tautog and Cummer

The situation with tautog and cunner are very different from that of the two previous species. These are temperate ocean reef fish that inhabit inshore waterfront areas only in the warm season, migrating to rock outcrops and other reef-like structures in deeper water during winter (Olla, *e*t al., 1979.). They both require the shelter provided seaweed and pilings in the canal entrance basin, particularly at night and during periods of stress (Auster, 1989). Unlike striped bass and tomcod, whose diets are rather broad (Gardinier and Hoff, 1982, Grabe,1980), tautog depend heavily on one prey species, the blue mussel, *Mytilus edulis* (Auster, 1989). Cunner eat this same mussel, but are less dependent upon it. Thus a good habitat for both fish, but tautog in particular, should include healthy mussel beds. The vertical concrete walls of the canal and canal entrance basin did not have a healthy mussel population in 1994. Presumably as a result of poor water quality during the June-July peak period for local settlement of *M. edulis* (Seed, 1976), only a few small specimens were found in late fall (Guida, *e*t al., 1995): hardly the kind of population necessary to maintain a tautog population. Unfortunately, the piling fields in the basin were not investigated. Old pilings encourage mussel beds, but it is not known if there are good mussel populations specifically in the Long Slip canal entrance basin. Increased circulation is likely to improve the potential of this canal entrance basin for mussels by improving water quality and increasing planktonic food supply. This potentially should favor the tautog population.

The planned installation of an armored dike to close off the canal entrance should also favor tautog by providing more hard surface for mussel attachment by providing more of the crevices needed for shelter by tautog and cunner alike. In addition to improving food resources and dissolved oxygen availability, increased circulation may favor tautog by reducing inter- and intra-specific competition pressure on juvenile tautog (Auster, 1989). However, these improvements may not yield immediate results, or any results. Tautog populations have been on the decline for several years for unknown reasons. Long-period natural population cycles or overfishing could be causing the observed decline just as readily as limitation of summer habitat. If suitable summer habitat is not the limiting factor, increasing that habitat by water quality improvements may have no effect on this fish stock, and yield no measurable change in the numbers of these fish in the Long Slip canal entrance basin.
If, on the other hand, habitat is the limiting factor, the proposed canal entrance basin improvements will clearly be beneficial to these two wrasses. The benefits will be evident locally, as neither species migrates far from the Hudson estuary, but it may take some time to become evident, as these are both slow-growing fishes.

f) Winter Flounder

This fish is another known to be sensitive to low oxygen, and more vulnerable than others to low D.O. associated with salinity stratification because of its strictly demersal habits (it never leaves the bottom). It is abundant in shallow areas in summer, when increased circulation is likely to provide the most benefit. Winter flounder eat primarily worms, clams and coelenterates, so food availability will not necessarily be affected by improved circulation; worms and clams are already moderately abundant (Guida, *e*t al., 1995). The winter flounder population is local and its growth is moderately fast, so improvement is likely to be evident fairly soon.

g) Black Sea Bass

Improved habitat will probably make the Long Slip canal entrance basin more attractive to this species. This is another fish that, like tautog and cunner, prefers structured (reef-like) environments. Benefits to this population, however, are likely to be too diluted to detect, as the black sea bass in the Hudson belong to a large single migratory stock that extends from Cape Cod to Cape Hatteras. Furthermore, this stock seems to undergo long-period cycles in abundance that may have little to do with nursery habitat. While quite abundant in 1994 (Able, *e*t al., 1995), it was entirely absent in 1982-83 (Andrews, 1984).

h) Bay Anchovy and American Shad

Anchovies and American shad mid-water fish that will probably experience little benefit from improved bottom conditions in the canal entrance basin area.

i) American Eel

Eels are sensitive to low oxygen concentrations, so habitat improvements that raise bottom D.O. levels are likely to benefit these fish when present. Because of their peculiar life history (see Appendix 5), however, the benefit will not be to the most sensitive stage in their life cycle (generally recruitment from the larval stage). In fact, eels caught in these waterfront areas in 1982-83 were all large specimens (10 inches or more) not more vulnerable elvers (see Appendix 5), so there is not likely to be any impact on the stock (which includes the entire species) or on the Hudson River migrant sub-population.

j) Summary

Recent federal and interstate conservation plans (USFWS, 1998 and NY-NJ Harbor Estuary Program, 1996) described habitats and linkages to human activities from an ecosystems perspective and stressed the need for cooperative management of fish and wildlife within the context of their entire environmental and socioeconomic landscape. The draft NMFS management plans prepared under the Magnesun-Stevens Act articulate the specific actions needed to restore depleted fisheries. All these plans prioritize water quality restoration and increased structural diversity as a key element to the success of that effort. As the practical aspects of implementing these objectives develop, there is a growing realization by regulatory agencies that innovative solutions are often needed to overcome the legacy and constraints of historical development, economics and political realities (U.S. Commerce Department, 1998).

The Build Alternative strongly supports the principles articulated by environmental laws and resource agency agendas. The proposed solutions to the current habitat conditions affecting the canal and canal entrance basin are comprehensive, optimal, cost-effective and achieve the ecological objectives of multiple agencies.

J. ENDANGERED SPECIES

The February 25, 1997 field investigation by ASGECI did not identify any federally or state-listed threatened or endangered (T&E) species within the project area nor did it reveal any conditions that would provide suitable habitat for those species. Previous studies performed on Long Slip Canal have not identified the presence of any threatened or endangered species within the canal area (NJ TRANSIT, 1995).

The NJ Natural Heritage Program (NHP) review of its database found, in a letter dated March 19, 1997, that no endangered, threatened or rare species have been identified on, or within the immediate vicinity of (defined as a 0.25 mile radius as per a telephone conversation with Rick Dutko of the NHP) the project area (see Appendix 5). The NHP has records for a State-listed endangered animal species (least tern), and a rare plant species (wild comfrey) identified on lands contained within the confines of the Jersey City, NJ USGS Quadrangle mapping. Neither of these species were found in the project area.

Habitat requirements for least tern generally are coastlines where sand beaches suitable for nesting are close to shallow waters for feeding. In inland areas, least terns are found along rivers with broad exposed sandbars (Kaufman, 1996). The general habitat for wild comfrey is indicated as "open woods" (Newcomb, 1977). No habitat for either of these two species was identified within, or on lands immediately adjacent to, the project area. Therefore, there is no potential for either of these species within, or on lands immediately adjacent to, the project area.

U.S. Fish and Wildlife Service completed a project review pursuent to Section 7 of the Endangered Species Act in October 1998. That review found that the peregrine falcon (*Falco perregrinus*), federally-listed species is known to hunt in the project vicinity the bald eagle (*Halaeetus leucocephalus*) may be an occaisional transient. USFWS concluded that the project was not likely to adversely affect these species.

In that State or federally listed endangered plants or animals are not known to occur, the project will not impact such species. Endangered species occurring off-site will benefit from the improvements to Hudson River water quality resulting from this project.

K. TRAFFIC AND PARKING

Streets that are adjacent to the project include Observer Highway to the north, 18th Street to the south and Luis Marin Boulevard to the west. Luis Marin Boulevard is a main arterial and Observer Highway is a minor arterial.

1. PROJECT IMPACTS

The project is primarily a rail yard modification effort that will significantly improve NJ TRANSIT's operation efficiency. Secondarily, a pedestrian and bicycle promenade will be constructed. Because the primary and secondary aspects of the proposed project will affect rail service and recreational users of the walkway and not vehicular traffic, the project will not induce additional traffic on the adjacent roadways. The proposed project will not divert traffic to nearby sensitive areas such as historic districts and residential neighborhoods.

The proposed project will not generate an increased demand for parking in the area. A parking lot with 100 spaces that is currently located at the project site will be relocated to the area now occupied by Long Slip. The relocated parking lot will result in no net loss of parking spaces.

Local traffic patterns and parking space volume will remain the same. Therefore, no further traffic and parking analysis is warranted.

2. PROJECT BENEFITS

The proposed project will not generate new vehicular traffic or require changes in parking spaces. By improving the capacity and efficiency of public rail transportation, the project will benefit existing local and regional vehicular traffic conditions. The increased number of rail commuters will lead to a decrease in commuter vehicular traffic. Any increase in the use of public rail transportation will extend the project benefits to include improved air quality.

Increasing public access to the Hudson River is a significant project benefit. Current river access is nonexistent and the waterfront walkway, with its recreational users, may be used as a pathway to work or shopping. The walkway also will give Newport Center residents and commuters direct access to the Hoboken terminal ferries and trains.

L. ENERGY REQUIREMENTS AND POTENTIAL FOR CONSERVATION

The objective of the project is increased operational efficiency, off-peak storage and light maintenance at the Hoboken Terminal in order to meet current system needs. These improvements will enable NJ TRANSIT to continue providing reliable rail service. No increase in rail service is proposed under either alternative.

The No Build Alternative will directly and indirectly increase energy consumption. Meeting near-future off-peak storage demands will increase "deadheading" as trains are shuffled about to various sidings. The increased inefficiencies imposed by the No-Build Alternative will increase operating costs and affect the level of service to commuters. Previous studies have indicated that unreliable rail service causes commuters to return to automobiles (NJ TRANSIT, 1992).

The Build Alternative will avoid the adverse impacts of the No-Build Alternative. It will minimize deadhead movements and improve operational efficiency. It will promote the reliable service that encourages automobile commuters to switch to rail.

M. HISTORIC PROPERTIES AND PARKLANDS

1. HISTORIC/ARCHAEOLOGIC RESOURCES

An assessment of the eligibility of Long Slip Canal under Section 106 of the National Historic Preservation Act of 1966 was completed in March 1997 by Drobbin Associates (See Appendix 6). A Phase 1A assessment of the prospects for the presence of archaeological sites and resources was completed by Dolan Research also in March 1997 (see Appendix 6). The following sections summarize the results of these assessments and their review by the State Historical Preservation Office (SHPO) and the US Department of the Interior (DOI).

a) Historical Background of Long Slip

Long Slip was constructed in 1870 and was a major component of the Delaware, Lackawanna & Western Railroad Hoboken Freight Terminal. The Freight Terminal and its Yards were one of the finest rail freight complexes west of the Hudson River between 1902 and 1912. Long Slip is one of the last remnants of the former Hoboken Freight Terminal which, at its peak of operations, extended south to

12th Street, Jersey City. The Hoboken Freight Terminal was located southwest of the Delaware, Lackawanna & Western Hoboken Passenger Rail and Ferry Terminal. Long Slip was significant for its critical role in facilitating the transfer of goods from lighters to freight cars and was a major factor in the success of the Delaware, Lackawanna & Western's export freight traffic. The Slip, owned by NJ TRANSIT, is not currently used for any navigational or railroad purposes. It is used to handle the discharge of stormwater and combined sewage overflows.

In the late 1980s, a major portion of the Hoboken Freight Terminal was demolished by Newport Development Associates to construct Newport City - a high-rise apartment complex. Following the construction of Newport City, several retail establishments were also constructed on the former Freight Yard site. Newport Development Associates also facilitated the construction of 18th Street east of Henderson Street, a new roadway that extends along the current southern border of the Yard.

b) Area of Potential Effect

The "area of potential effect" (APE) is defined as the area in which the proposed project is most likely to have impacts on cultural resources. The APE includes the area that may be affected by direct physical impacts, such as demolition or alteration of a resource, or by indirect contextual impacts such as changes in the visual character of the surrounding neighborhood or in the view from a resource. The potential effects of temporary project actions (i.e., construction noise, dust and vibration) were also considered in the determination of the area of potential effect.

The area of potential effect is delineated as 150 feet from the project and includes portions of the Erie-Lackawanna Railroad and Ferry Terminal, the Southern Hoboken Historic District and the Old Main Delaware, Lackawanna & Western Railroad Historic District. A full description of these resources is contained in Appendix 6.

c) Archaeologic Resources

The Phase 1A assessment indicated a lack of potential for archaeological resources at the site. Since the canal was created in fill material, it does not contain intact archaeological material (Dolan Research, 1997). The study found that the canal construction methods were of a standard design that lacks significance and that "there is low potential for significant prehistoric or historic archaeological remains".

2. COORDINATION WITH SHPO AND DOI

A request for a determination of Long Slip's eligibility under Section 106 for inclusion on the National Register of Historic Places was filed on March 28, 1997. That filing included the Phase 1A assessment. SHPO representative, Kinney Clark, attended a July 17, 1997 pre-application meeting.

In a May 8, 1997 letter, the State Historic Preservation Officer (SHPO) found that Long Slip was not individually eligible for inclusion on the National Register and that it is not a contributing feature of the Southern Hoboken Historic District. However, the entire NJ TRANSIT Hoboken Terminal site, including Long Slip, is eligible as a contributing feature of the Old Main Delaware, Lackawanna, and Western Railroad Historic District. SHPO's action confirms and protects the canal's importance as one of the last surviving remnants of an historically significant transportation infrastructure that helped shape New Jersey's waterfront 50 to 150 years ago (See Appendix 6). Accordingly, SHPO revised the historic district boundaries to include the entire Hoboken Terminal (see Figure IV-19). SHPO concurred that there was "no potential for prehistoric remains within the zones of borrow and fill disturbance" around the canal.

A Section 4(f) assessment was filed in April 1998. In an August 14, 1998 letter, the DOI concurred with NJ Transit that there was no prudent and feasible alternative to the project. A copy of this letter is included in Appendix 6 "Section 4(f) Resources".

a) Impacts of the No-Build Alternative

The status quo will be maintained until the funds become available and the rehabilitation of the deteriorating canal bulkheads is completed. Under these conditions, the No-Build Alternative will adversely affect the historic properties by allowing the already blighted setting to continue to decay. Conservation and public educational opportunities afforded by the walkway will not occur.

b) Impacts of the Build Alternative

In a May 8, 1997 letter, SHPO found that filling the canal "will have no effect on the Southern Hoboken Historic District, no adversely affect on the Erie-Lackawanna (Hoboken) Railroad and Ferry Terminal, and an adverse effect on the Old Main, Lackawanna, and Western Railroad Historic District". Accordingly, the design elements will be compatible in terms of scale, architecture, and materials with nearby historical structures. It is anticipated that these resources will benefit from increased public awareness of the historical significance of the terminal area resulting from the new public access, viewing possibilities and interpretive displays provided by the walkway.

3. PARKLANDS

Hoboken and Jersey City are highly urbanized and deficient in the availability of parklands and recreation space based on federal standards (City of Hoboken, 1995; City of Jersey City Planning Board, 1992). Parklands adjacent to the site include the Hudson River, the Hudson River Waterfront Walkway, and the historical structures within the Hoboken Terminal.

a) Impacts of the No-Build Alternative

No direct impacts to parklands or recreational areas will result from the No-Build Alternative. However, the Hudson River Waterfront Walkway, and its public access benefits, will adversely affected by the continuance of a major gap, the crossing of Long Slip Canal that will not occur under the No-Build Alternative.

b) Impacts of the Build Alternative

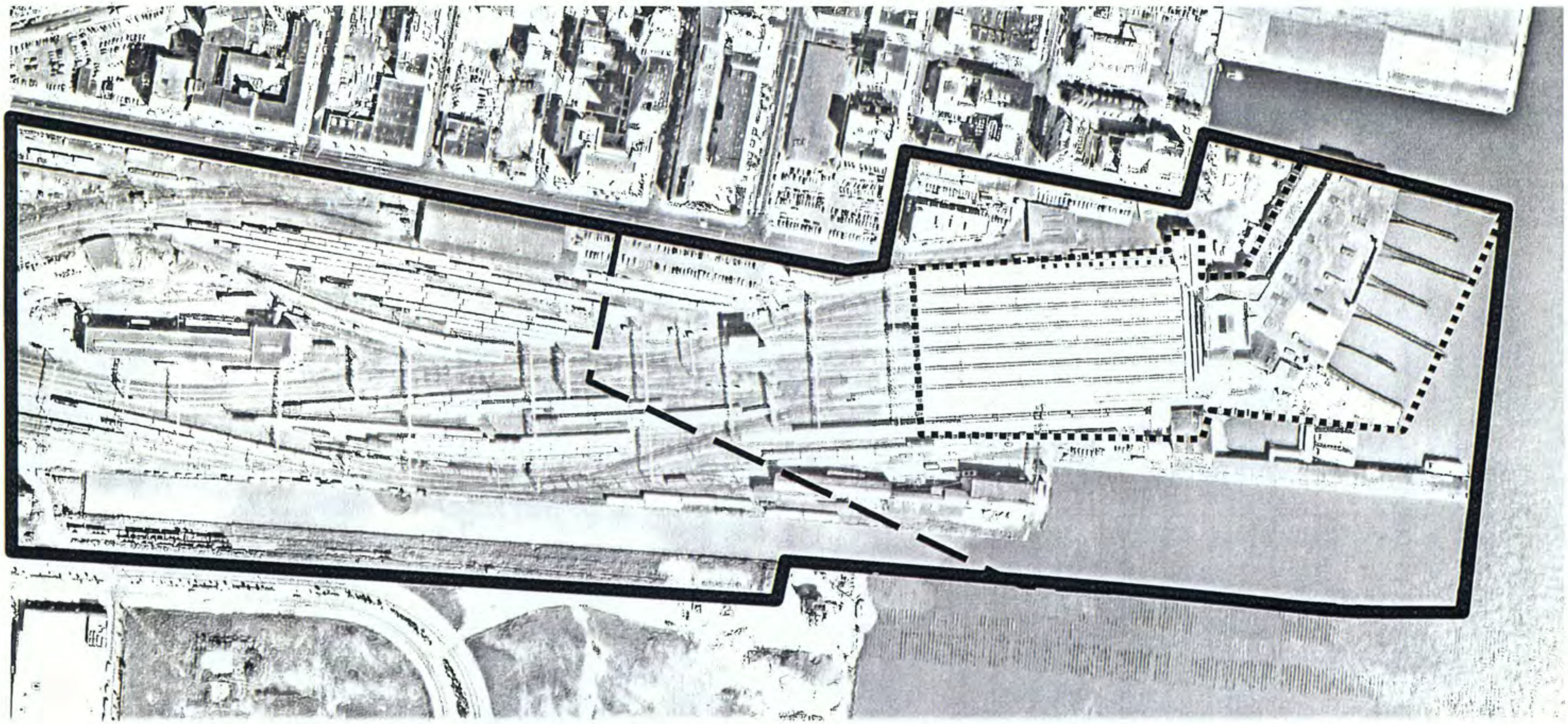
The Build Alternative does not take or adversely affect any existing parklands, including public parks, recreation land, or wildlife refuges. In the May 8, 1997 letter, SHPO found that the Build Alternative will adversely impact a contributing element to National Register properties through the filling of the canal and the resultant changes in appearance. There is no feasible and reasonable alternative to this impact.

However, the Build Alternative, with the proposed walkway, will establish new public outdoor space, adding recreational land to a densely populated area that has very little public parkland.

4. MITIGATION OF IMPACTS TO HISTORIC RESOURCES AND PARKLANDS

In accordance with SHPO recommendations, a Memorandum of Agreement (MOA) was drafted under Section 106 to mitigate the adverse effects of the filling of Long Slip on the Old Main Delaware, Lackawanna, and Western Railroad Historic District (See Appendix 6). The MOA stipulates that mitigation shall consist of:

Figure IV-19 - Historic Resources



Old Main DL & W Railroad Historic District
Southern Hoboken Historic District
Erie-Lackawanna Railroad & Ferry Terminal

Source: NJSHPO, 1997

DAMES & MOORE

- Written and photographic documentation relating to the history and function of Long Slip be conducted as part of the currently ongoing Historic American Buildings Survey and Historic American Engineering Record (HABS/HAER) documentation of the Hoboken Freight Yard.

- NJ TRANSIT will create an interpretive exhibit describing the history and significance of Long Slip as well as the Old Main Delaware, Lackawanna, and Western Railroad Historic District as part of the proposed section of the Hudson River Waterfront Walkway.

NJ TRANSIT also will investigate additional opportunities that may exist where the historic resources of the area can be celebrated, such as incorporating some of the Hoboken Freight Yard construction materials into the proposed walkway.

N. CONSTRUCTION

The bulkhead rehabilitation required by the No-Build Alternative will occur as a separate and independent part of the overall Hoboken Terminal & Yard Renovation project. The currently ongoing renovation includes increasing train storage, facilitating train movements, constructing a Running Repair Shop and accommodating the Hudson Bergen Light Rail Project (HBLRT). No construction plan has been developed for the No-Build Alternative.

The major components of the Build Alternative are summarized in Table IV-8 with the estimated costs and construction periods. These costs and construction periods are likely to change as the design evolves. Note that summaries are not provided because construction of the components will be overlapping, rather than sequential. A description of the construction sequence follows in Section N-2 "Construction Sequence" below.

Table IV-8 Estimated Costs and Construction Periods of Major Project Components

Design Feature	Estimated Cost ($MM)	Construction Period* (Weeks)
Program Construction		
Site work & canal fill	6.1	31
PATH relieving platform	1.8	7
CSO improvements	12.5	24
Subtotal	20.4	--
Mitigation Measures		
Entrance basin excavation	2.4	4
Confinement berm & walkway	4.5	16
Compensatory wetlands	2.0	12
CSO sediment removal	0.8	6
Subtotal	9.7	--
Grand Total	**30.1**	

*Assumes that construction is prior to or concurrent with HBLRT.

1. COORDINATION

The need to coordinate with the other aspects of the overall Hoboken Terminal & Yard Renovation project and the HBLRT, as well as uncertain permit conditions, requires examining definitive and non-definitive issues on a reasonable probability basis in order to develop the most satisfactory construction plan at the least capitol cost. The most difficult are usually non-definitive issues and in particular those having outcomes predicated on emotional expectations. To minimize the bias of personal preferences, a behavioral cross break matrix analysis was developed for evaluation of alternatives. The cross break matrix analysis is a preferred methodology in the field of behavioral research as a means of optimizing judgments in as objective a manner as reasonably possible.

Seventy-five (75) construction options were evaluated on a probability basis of reasonable expectation against twenty-nine (29) categories of potential impact. These parameters were then analyzed on the basis of strategic and operational impact and final position in accord with relative numeric ranking.

The results of the matrix analysis were discussed with NJ TRANSIT, Jersey City Sewerage Authority, North Hudson Sewerage Authority and the New Jersey Department of Environmental Protection. The input from these agencies were then incorporated into the construction plan for the Build Alternative.

2. CONSTRUCTION SEQUENCE

The following table (Table IV-9) indicates the currently envisioned sequence of construction and time frame. Equipment that is not normally encountered in heavy construction but required for this project is also identified.

Table IV-9 Anticipated Construction Sequence

No.	DESCRIPTION	TIME	TASK SPECIFIC HEAVY EQUIPMENT
1	Mobilization upon noticing the Hudson Essex Passaic Extension Service (NRCS) of the intent to commence construction.	Weeks 1-2	None
2	Construct compensatory wetlands	Weeks 2-12	Dozer
3	Construct security fencing and signage about the periphery of the work area and maintain appropriate security practices for the socio/geophysical environment.	Weeks 2-3	None
4	Construct sediment filter fences and hay bale berms at all locations within the work area where sediments may be transported offsite.	Weeks 2-3	None
5	Construct flotation boomed sedimentation curtains at the entry and midpoints of the canal.	Weeks 3-4	Barge mounted crane, dozer
6	Construct relieving platform over PATH tunnel	Weeks 5-12	Hydraulic equipment, crane, drilling rig
7	Excavate canal in area of proposed Hoboken Sedimentation/Screening Chamber and deposit materials in canal on its southerly side near the sedimentation curtain at the canal's entrance.	Weeks 12-14	Barge mounted hydraulic equipment and drilling rig
8	Construct caissons for the Hoboken Sedimentation/Screening Chamber.	Weeks 15-16	Barge mounted crane and drilling rig
9	Install heads onto the caissons for the Hoboken Sedimentation and Screening chamber.	Weeks 16-17	Barge mounted crane and drilling rig
10	Construct caissons for the Hoboken CSO.	Weeks 20-28	Barge mounted crane and drilling rig
11	Install heads onto the caissons for the Hoboken CSO.	Weeks 28-32	Two barge mounted cranes
12	Fly in the Hoboken CSO and install onto the caisson heads.	Weeks 30-34	Two Barge mounted cranes
13	Construct cofferdam and install the Hoboken Junction chamber.	Weeks 32-34	Barge mounted pile driver
14	Construct the Jersey City Sedimentation/Screening chamber.	Weeks 34-42	Pile driver (1 week)
15	Excavate canal entrance basin.	Weeks 38-42	Barge mounted hydraulic equipment
16	Fill canal via scows with the appropriate mix of angular and fine materials to within draft depth.	Weeks 42-50	Two 300 yard scows
17	Construct sheet pile curtain wall at the canal entrance.	Weeks 50-58	Barge mounted pile driver
18	Fill canal to within 2 feet of final grade via 50 yard dump trucks, bringing suitable fill materials to the site.	Weeks 58-72	Two 50 yard dump trucks and two 3 yard clam shells
19	Construct waterfront walkway, including non point discharge controls.	Weeks 72-80	Barge (for cable concrete installation)
20	Permanently stabilize site.	Weeks 80-82	None

3. IMPACTS

Construction impacts will be temporary lasting only as long as the construction period. Impacts of the No-Build Alternative will result primarily from bulkhead reconstruction and would occur independently of the Long Slip Habitat Creation Project. That effort has not been programmed and regulatory approval is not being sought. Therefore, the assessment of its potential construction impacts is not the subject of this EA.

a) Noise

The FTA General Noise Assessment Spreadsheet was used (FTANOISE.XLS) as noise analysis tool to estimate the potential noise impacts of the envisioned construction activity for the proposed project. This spreadsheet[3] is primarily used to assess transportation-related project impacts. However, because the proposed project involves construction activity within the vicinity of several transportation noise sources, the spreadsheet model was deemed appropriate (with adjustments, as discussed below) for assessing the impacts of the proposed project.

First the existing setting was approximated using the spreadsheet, with a "Rail Yard" as one source, and "Automobile" traffic as the second source. The results table of the spreadsheet model for the approximated existing conditions predicts a L_{dn} of 72 which agrees favorably with the observed value of 71 presented in the Exiting Settings Section. Printouts of the spreadsheets used in this assessment are provided in the Appendix 3.

To estimate the potential noise that the construction equipment would create one of the transportation type sources provided in the FTA spreadsheet had to be adapted. It was assumed that the construction equipment would be similar in noise generation capabilities as a diesel commuter bus. The source characteristics such as speed and number of busses per hour were adjusted until the estimated L_{eq} impact on a receptor at 50 feet was 77 dBA (inputting 60 miles per hour and 240 buses per hour gave this result, essentially similar to a steady, loud construction noise generating activity). To put this in perspective, an air compressor, a typical loud and steady piece of construction equipment, generates about 77 dBA at a 50-foot distance. Then the actual receptor distance for the proposed project (400 feet) was and the spreadsheet results evaluated. As shown in the spreadsheet printouts in Appendix 3, there was only a 1dBA increase in the L_{eq}, and no increase in the L_{dn}, when the hypothetical construction noise source is considered in conjunction with the existing transportation noise sources.

b) Disruption of Utilities

The Build Alternative will be staged from Yard A to minimize any shut downs of tracks and power during construction. All commuter lines, bus, rail and ferry, will remain operative. A relieving platform will be constructed over the PATH tunnels to protect those structures from the increased loads resulting from the canal fill.

In order that the Jersey City, Hoboken and Path CSO discharges can continue until construction of the extended lines and treatment equipment are completed, canal filling will be phased. First, a sheet-pile barrier will be installed the length of the canal. Filling and the construction of the extension will occur on the south side of the sheet piles, allowing the CSO discharges to continue on the north. The CSOs then will be tied into the new extension and the north side of the canal will be filled.

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[3] Please see http://www.fta.dot.gov/library/planning/enviro/noise/ftanoise.html for information on this noise assessment tool.

c) *Water Quality and Runoff*

The Build Alternative potentially may impact water quality through erosion and sedimentation resulting from the exposure of site soils during excavation and from the transportation, stockpiling and placement of fill materials. Excavation in the canal entrance basin may mobilize oxygen-demanding sediments. Mitigation measures will include the following:

The Hudson County Extension of the Natural Resources Conservation Service (NRCS) will be notified prior to construction. A soil erosion and sediment control plan will be developed and approved by the NRCS for areas adjacent to the canal that will be disturbed and for staging areas where materials may be stockpiled.

Most of the fill materials will be transported by rail or barge to minimize trips and exposures. During canal filling operations, a boom-enclosed lock system will be used to contain suspended sediments. Modifications will be made to the existing boom so that the boom can be unhinged or depressed to allow barges to place dredged material in Long Slip Canal. The boom will be closed while sediments are being disturbed. A second bottom-weighted boom will be installed upstream of the first boom to provide an area for settling of suspended sediments from the dredged material off-loading. Alum or polymer will be added to the boom-enclosed "lock" to further enhance settling of the suspended sediments within the boom-enclosed area. In this way sediment will not flow into the canal entrance area. A package unit from Sweetwater Technologies, Minneapolis, MN may be used for chemical addition. Water quality at the lock system will be monitored continuously. Siltation curtains will be deployed during the re-contouring of the canal entrance basin. Potential impacts from this excavation will be minimized by the short duration of the excavation (1 to 2 days) and the proximity to the rapidly flushing main channel of the Hudson River. The work will be timed to avoid interfering with life cycles of key species.

d) *Traffic*

During construction, vehicular traffic and parking off-site will not be impacted. All transport of the construction materials for the estimated 82 weeks of project construction will take place either by air or through the use of barges or rail, as outlined in Table IV-9 above. Grade beams, box beams and the Hoboken CSO will be flown in and the remaining construction will occur by use of barge mounted cranes, dredges and drilling rigs. Daily crews of 15 to 20 workers on average are estimated during construction; those working land side will use on-site parking. Fill will be brought by barge or by rail. Diversions of area traffic due to the project are not anticipated.

e) *Air Quality and Dust Control*

Potential short-term air quality impacts of the Build Alternative were evaluated by estimating the emissions from the proposed construction activities. The envisioned potential sequence of construction and heavy duty equipment requirements were considered and emission estimates were made for 8 project phases. Detailed calculations are provided in the Appendix 2, including the basis, assumptions, references and emission factors. As summarized in the following table (Table IV-10), the estimated emissions that would be expected from the construction of the Build Alternative are less than the significance criteria for all criteria pollutants.

f) *Safety and Security*

All construction will occur within the fenced confines of the Hoboken Terminal in areas where the general public currently is not permitted. A health and safety plan will be developed and enforced by the general contractor. All workers will be required to adhere to the safe working practices of their trades.

g) Disruption of Business

Nearby businesses located on the north side of the terminal and to the south, at the Newport Center across 18th street. Since all construction activities and equipment will operate within the yard, construction

Table IV-10 Estimated Project Construction Emissions and Significance Determination (tons per year)

Emission Activity	NOx	VOC	SOx	CO	PM_{10}
Onsite Construction Equipment	11.0	0.87	0.72	2.4	0.78
Fill Material Transport Trucks	0.47	0.07	0.06	0.35	0.03
Fugitive Construction Dust	--	--	--	--	13.4
Project Annual Project Emission Rate	11.4	0.95	0.78	2.7	14
Significance Criteria	25	25	100	100	100
Would Project Impact Be Significant?	No	No	No	No	No

The activities and emission sources considered in estimating the emissions for the project construction included:

- Combustion exhaust from onsite heavy-duty construction equipment such as cranes, pile drivers, dredges and bulldozers.
- Vehicle emissions from fill material transport trucks.
- Fugitive dust emissions from heavy construction operations.

The type and number of construction equipment and the equivalent full load operating hours per project phase were estimated using preliminary project construction sequence and heavy duty equipment requirements information. Exhaust emissions were estimated using emission factors[4] for the pounds of exhaust pollutants per hour-power hour for diesel construction equipment.

Emissions from trucks needed to transport the final fill material were estimated assuming a round trip distance of 20 miles and a predicted frequency of four trucks per hour. Due to this low frequency and the relatively short duration for the canal filling phase of the proposed project, the level of service along the transportation route is not expected to change as a result of this project. This small level of additional truck traffic would not represent a significant impact on local traffic or regional mobility. It was assumed that clean fill, if selected as the canal fill material will be transported by rail to avoid impacts to air quality.

The fugitive dust emissions are estimated using the estimated acreage of disturbed land for each project phase and an emission factor of 1.2 tons particulate matter per month per acre of disturbed area.[5] It was

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[4] Compilation of Air Pollutant Emission Factors, Volume I, Fifth Edition, AP-42, Section 3.3 Gasoline And Diesel Industrial Engines, Table 3.3-1. Emission Factors for Uncontrolled Gasoline and Diesel Industrial Engines, EPA 10/96

[5] Compilation of Air Pollutant Emission Factors, Volume I, Fifth Edition, AP-42

assumed that approximately half of the particulate matter predicted by this emission factor would be PM_{10} dust particles. An emission control efficiency of 50% was assumed due to the naturally high moisture content of fill materials for this project and through application of standard construction site dust control measures such as the watering unpaved road services.

will not restrict access to nearby business or create inconveniences for patrons.

O. AESTHETICS

The present character of the area may be described as deteriorated, abandoned industrial blight. The area began to decline in the 1950's and was completely abandoned by the 1970's. Currently, the bulkhead is in disrepair and the pavement is broken-up and spalling. There are no significant natural communities currently existing on the site. The existing water quality precludes any viable marine life and the only terrestrial natural elements are undesirable invader species resulting from the lack of maintenance and possibly some rodent presence.

The current barren, monotonous, sterile, inhuman environment; will be replaced by a safe, accessible environment with variety within a unifying context. The proposed action will result in a water area that flushes, creating improved water quality. Odors, oil sheens, other undesirable visual characteristics of the existing canal waters will be eliminated. Attractive, inviting public access and amenities will be developed. The walkway will offer dramatic views of the terminal, the harbor, and New York City.

Landscaping of the buffers and walkway will essentially introduce vegetation to the site. The selected plantings will not only be hardy, pest resistant, drought resistant, salt tolerant, thornless, with non-aggressive root systems, but they will also provide color to the otherwise drab depressing area. Native species of high value as habitat and food will be selected to encourage birds, butterflies, squirrels, chipmunks, and other urban wildlife that will bring life and visual interest to an otherwise built environment.

All of the materials and finishes will be selected to contribute to the creation of a total, unified harmonious environment that will be compatible in terms of scale, massing, and architectural treatment with the existing development, especially the historic structures. The pre-dominant color that will be evident throughout most of the year will be a cheerful, spirit-lifting yellow. The pavement will have a non-slip surface with a human-scaled pattern. The light fixtures, while providing a safe, crime-reducing illumination, will also be human-scaled and allow for the seasonal hanging of flower baskets and festive banners. The proposed materials and finished will also be vandal-resistant and low-maintenance so that the aesthetic quality can be maintained.

P. COMMUNITY DISRUPTION

The southern portions of Hoboken terminal, the construction site, are surrounded by a four-lane road, shopping center, vacant land, a cement manufacturing plant and other industrial/warehousing uses. It is well-separated from the residential and commercial areas of Hoboken by the main train terminal and bus station.

Section 13.2.3 Miscellaneous Sources, Heavy Construction Operations, EPA 1/1995

No community disruption will result from the Build Alternative. The entire project occurs within the existing boundaries of the Hoboken terminal and does not introduce new activities to the site. The project will not generate vehicular or ship traffic.

No community disruption is anticipated to result from construction activities. Construction will operate eight to ten hours/day, five days/week and will adhere to Hoboken and Jersey City's no-construction hours. Hoboken's prohibitive construction hours-no construction/repair activities are during the hours of 6 PM to 7 AM, Monday through Saturday, and no construction allowed on Sunday. Jersey City's prohibitive construction hours - no construction/repair activities are during the hours of 6 PM to 7 AM, Monday through Friday; permission must be obtained from the City of Jersey City for weekend construction. Since active tracks are not affected by the project, there will be no disruption of commuter service. Construction noise levels will be similar to existing levels. Most construction will from barges so that roadway impacts will be minimized.

The proposed project will not only maintain community cohesion; it will increase participation among residents in activities along the waterfront. Important local or regional businesses or residential sectors will not be disrupted, displaced, or isolated as a result of the project. Any large-scale construction endeavor, especially in a densely populated urban area such as Hoboken and Jersey City, must fit into the community seamlessly. The proposed project, with its walkway, will be a link for the community to Hudson River and should have the feeling as though the walkway has always been present. The 30-foot wide waterfront walk will introduce public and fishing access to a highly developed portion of the waterfront where none currently exists. Improvements to water quality resulting from the project will enhance the recreational opportunities beyond what would be possible without the project. The walkway will connect the Erie Lackawanna Ferry Terminal on the north to the Newport Mall on the south. The walkway will be designed to allow emergency, but not general vehicular access. It is anticipated that a natural derivative of bringing a diverse community together, as the walkway is intended to do, will be an increase in community events, such as summer festivals, concerts, fairs and other positive community events.

As documented in a study on urban waterfront development by Breen and Rigby (1995), attractive waterfronts and access to a waterfront can bring many local benefits. Some of the benefits can be enumerated in a rigorous and quantitative fashion and others are less quantifiable although no less significant. Breen and Rigby (1995) cite a variety of benefits from improved waterfronts such as an increase in local image; an increase in jobs, income and tax revenue; social, recreational and aesthetic benefits; and environmental benefits. The walkway as proposed has a significant potential to improve the area, increase revenue, and lend to the two city's structures as a developed urban area.

Further community participation and cohesion should be obtained through the use of the newly renovated train terminal. The proposed project's construction of new acreage for the rail yard will increase NJ TRANSIT's operation efficiency. An efficiently functioning and easily accessible train operation will blend into the fabric of the community and will be compatible with circulation patterns in the neighborhood. This will have a positive impact on ridership, as well as a positive impact on the community at large.

Q. SAFETY AND SECURITY

The Build Alternative will be constructed entirely within the existing Hoboken terminal. The entire south and west side of the facility are fenced and lighted. Since this is a 24-hour operation NJ TRANSIT personnel and security are always present. Currently, the Long Slip area is not accessible to the general public.

The walkway will bring the public to these currently inaccessible areas. Physical and visual buffers such as fencing and dense vegetation will be installed to maintain public separation from potentially hazardous areas.

NJ TRANSIT intends to keep the walkway open at all times. At 30-feet wide, the walkway will have sufficient width to support emergency vehicles such as ambulance and police. Lighting will be designed in accordance with Hudson River Waterfront Walkway guidelines. Walkway Alternatives 2 and (constructed over fill) are advantageous from a public safety standpoint because they provide continuous sight lines, in contrast to the angular, broken sight lines of the no-fill alternative (Walkway Alternative 1).

R. SECONDARY DEVELOPMENT

The proposed project does not include residential nor commercial development and it is not expected that there be a potential for secondary developments such as changes in local land usage and property values. The primary goal of the proposed project is to enable NJ TRANSIT to meet current public transportation demands with operational and maintenance acreage. A further goal of the project is providing public access to the Hudson River waterfront by providing a waterfront walkway.

The Long Slip Canal Habitat Creation and walkway project will create 4.6 acres of new rail yard land to be used for yard maintenance and storage. The long-term affects of this additional land will benefit the future functionality of the rail yard. The project also will reduce the operating and maintenance expenses of the antiquated yard. Furthermore, the physical changes planned as part of the project and the economic affects resulting from expenditures for construction will complement existing redevelopment plans for the vicinity of the Hoboken Terminal.

Secondary impacts associated with the filling of the canal, creating a fish habitat, and constructing a walkway alongside the filled canal are consistent with CZM objectives for water quality leading to improved fisheries and ecosystem health. The walkway and wildlife will encourage foot traffic. There is the potential to stimulate additional redevelopment and renovation in the Hoboken/Jersey City waterfront as a result of the new access and recreational amenities are consistent with state and local master planning. Such beneficial growth is well within the carrying capacity of Hoboken and Jersey City municipal service infrastructure because of recent population losses (City of Hoboken, 1995).

The proposed project is consistent with officially adopted plans for Hoboken and Jersey City and secondary developments are not expected. For instance, the Hoboken Master Plan (*City of Hoboken Master Plan Reexamination Report* adopted February 7, 1995) and the Newport Redevelopment Plan (amended July 12, 1988 and approved by the City Council September 22, 1988) express particular goals such as maintaining the integrity of residential neighborhoods, controlling and restricting the circulation of vehicular traffic to preserve neighborhoods, increasing the use of mass transit and developing of waterfront amenities. The proposed project complements these land use goals. The proposed development, which will occur entirely within the existing rail yard boundaries, does not introduce non-conforming uses into the project area or the vicinity. In addition, the proposed project is located in the vicinity of several redevelopment areas in Hoboken and Jersey City. Redevelopment areas aim to revitalize neighborhoods by generating regional retail and recreation attractions and by taking advantage of mass transit access. The redevelopment plans include goals for residential and commercial growth. The proposed project complements these goals and objectives.

The proposed project will generate direct economic benefits (increased output, family earnings, and jobs) for the region. These benefits will result primarily from the construction expenditures associated with the project, and include the indirect effects of spending on construction. An estimated 500 jobs will be created during construction, with 6 jobs created for annual maintenance. The economic benefits created during the construction phase will occur for a relatively short time period (1-2 years) and it is unlikely that other large-scale projects will occur. Likewise, the local public facilities and services in the surrounding neighborhoods will be adequate for the project and any upgrades are unlikely.

The proposed project's amenities provide some significant benefits. For example, the Newport Redevelopment area contains fire and police facilities. Extension of the Hudson Waterfront Walkway will connect waterfront amenities currently separated geographically, and add to the total amount of recreational area available in the vicinity of the project. Recreational areas include the Newport City walkway to Liberty State Park, NJ TRANSIT's renovation of the Hoboken Terminal with its plans for new retail development in existing historic, but abandoned areas, and the proposed NY/NJ Port Authority redevelopment in the vicinity of River Road. Newport will be linked to the train terminal via the walkway. In addition, the walkway will allow for public access to the riverfront, where visitors can fish, see a pleasant and clean habitat, and enjoy the view of Manhattan.

S. Consistency With Land-Use Plans

The Build Alternative is consistent with the most recent revisions of the Hoboken Master Plan (*City of Hoboken Master Plan Reexamination Report* adopted February 7, 1995), and with the Newport Redevelopment Plan (amended July 12, 1988 and approved by the City Council September 22, 1988). The proposed development, which will occur entirely within the existing rail yard boundaries, does not introduce non-conforming uses into the study area. Portions of the proposed development, such as the habitat creation, significantly complement existing land use plans.

The City of Hoboken Master Plan includes the goals of preserving the integrity of residential neighborhoods, controlling and restricting the circulation of vehicular traffic to preserve neighborhoods, and developing the waterfront. The proposed project does not add new vehicle circulation routes, and the availability of mass transit will assist in preserving neighborhoods. Because the proposed project includes a significant component of waterfront habitat restoration and completion of the waterfront walkway, it will contribute to the City of Hoboken's planning goals.

The area on the southern end of the project boundary--the Newport Development--is a part of Jersey City. As a redevelopment area, its master plan includes the goals of greater use of mass transit and development of waterfront amenities. The proposed project complements these goals. Their achievement further complements the overall land use goals for Newport, which are to create an area of mixed residential and commercial use.

The project directly addresses applicable goals and strategies of the New Jersey State Development and Redevelopment Plan (NJSPC, 1992). Filling Long Slip Canal as proposed facilitates beneficial economic growth and the revitalization of the state's urban centers and areas in several ways. First, the project provides cost-effective expansion of the public transportation infrastructure that increases operational efficiency while utilizing existing facilities. The project revitalizes a currently blighted waterfront by developing several acres of new public access and educational space.

The project also is fully consistent with federal and New Jersey environmental plans. The Comprehensive Conservation and Management Plan (CCMP) (NY-NJ Harbor Estuary Program, 1996) sets forth a series of goals and objectives aimed at improving water quality and restoring abundance, diversity and quality of estuary habitats, reducing human impacts, managing dredged materials, and improving public access and education. All the goals and a total of 23 of the objectives are supported by the proposed project. Table IV-11 identifies the specific objectives supported by each component of the project. Table IV-12 describes consistency with the Hudson River/New York Bight Ecosystem Plan (USFWS, 1996).

The project supports the objectives of the NOAA National Habitat Program by improving water quality and promoting diversity.

Dredging's vital importance to the regional to the regional economy, predicated by the recognition of the equal importance of the preservation and restoration of the harbor's natural resources are the fundamental goals of management strategies such as the Joint Dredging Plan for the Port of New York and New Jersey (Whitman and Pataki, 1996), the Dredged Material Management Plan for the Port of New York and New Jersey (Corps of Engineers, 1996), and the CCMP. These plans encourage the beneficial use of dredged materials as proposed by this project.

The Dredged Material Management Plan for the Port of New York and New Jersey (Corps of Engineers, 1996) specifically seeks to maintain the port and restore the estuary, reduce the magnitude of contaminated sediments, beneficially use as much dredged material as possible, and to dispose of unused material. That plan identifies the following as appropriate beneficial uses of dredged material:

- restoration of aquatic habitats;
- recontouring;
- construction fill; and,
- capping material.

The Long Slip Habitat Creation project promotes these goals and beneficial uses. Dredged material could be used as construction fill and as capping material in the canal. Both fills and their end uses support the restoration of the estuary through water quality benefits. By promoting public transportation, the fills improve air quality, thereby reducing atmospheric sources of pollutants to the estuary. Both fills facilitate the recontouring of the bottom and the shoreline that is a key component of the Habitat Creation mitigation alternative. Finally, through the improvements to the CSOs, the improved hydraulics, and the capture and treatment of non-point source pollution, the project supports the reduction of sediment inflows and pollutant discharges called for by the plan to reduce future dredging needs and disposal problems.

T. ENVIRONMENTAL JUSTICE

The Long-Slip Canal Habitat Creation Project, or Build Alternative, is a key element of NJ TRANSIT's Hoboken Terminal Expansion and Rehabilitation Project for the terminal and railyard located in Hoboken/Jersey City, NJ. The existence of low-income and minority populations in the surrounding community necessitates heightened awareness of the health and environmental impacts of the project. Executive Order 12898, signed by President Clinton on February 2, 1994, was created in order to promote nondiscrimination in programs or policies that affect the health and environment of low-income and minority communities. The Executive Order stipulates that:

- To the greatest extent practicable and permitted by law…, each Federal agency shall make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations…[Section 1-101]

Table IV-11 Summary of Compliance with New Jersey Comprehensive Conservation and Management Plan Objectives

CCMP Objective	Title	Project Component										
		Expanded Rail Yard	Confined Disposal Facility	Removal of SOD*	Improved Circulation	CSO Extension	CSO Modification	Stormwater Mangement	Walkway	Public Access Area	Rubble Berm Face	Landscaping
H-1	Control point and non-point pollution loads					X	X	X				
H-2	Manage coastal development	X										
H-4	Maintain healthy estuarine conditions by managing freshwater inputs					X		X	X	X		
H-5	Minimize human disturbance of natural habitats	X	X	X	X	X	X	X			X	X
H-6	Preserve and improve fish & wildlife population and diversity		X	X	X	X	X	X			X	X
H-7	Increase public access consistent with other ecosystem objectives								X	X		
H-8	Increase public education								X	X		
H-9	Initiate special studies on habitat issues			X	X	X		X				
H-11	Develop and implement plans to restore significant coastal habitats and impacted resources		X	X	X	X	X	X			X	X
T-3	Minimize the discharges of toxic chemicals from CSOs, storm water and non-point sources					X	X	X				
T-4	Reduce air emissions of chemicals of concern	X		X								
T-9	Identify and remediate selected contaminated sediments		X	X					X	X		
D-6	Improve dredging, transport and disposal options		X									
P-1	Reduce loadings of pathogens from CSOs, stormwater discharges and non-point sources					X	X	X				
P-2	Reduce or eliminate the discharge of raw or inadequately treated sewage						X					

CCMP Objective	Title	Project Component										
		Expanded Rail Yard	**Confined Disposal Facility**	**Removal of SOD***	**Improved Circulation**	**CSO Extension**	**CSO Modification**	**Stormwater Mangement**	**Walkway**	**Public Access Area**	**Rubble Berm Face**	**Landscaping**
F-6	Reduce loadings from CSOs, storm water discharges, and other non-point sources			X	X	X	X	X				
N-4	Develop and implement additional actions necessary to eliminate adverse effects of eutrophication, including hypoxia on marine life		X	X	X	X	X	X				
N-5	Conduct additional studies to understand the causes of hypoxia, algae blooms and other eutrophication effects			X	X							
CSO-2	Implement additional CSO controls to meet water quality standards and restore beneficial uses				X	X						
SW-1	Implement measures to control municipal and industrial storm water discharges			X	X	X						
E-2	Build community awareness, appreciation, and understanding of the ecosystem and its importance ...								X	X		
E-6	Enhance educational opportunities at all educational levels								X	X		
C-2	Seek additional funds for project implementation and program enhancements	X	X			X	X					
Totals: (23 plan objectives are addressed)		**4**	**7**	**10**	**9**	**13**	**10**	**10**	**6**	**6**	**3**	**3**

* SOD = Sediment Oxygen Demand

Table IV-12 Summary of Support to USFWS Hudson River/New York Bight Ecosystem Plan Resource Priorities (USFWS, 1996)

Plan Objective	Title	Project Component: Expanded Rail Yard	Confined Disposal Facility	Removal of SOD*	Improved Circulation	CSO Extension	CSO Modification	Stormwater Mangement	Walkway	Public Access Area	Rubble Berm Face	Landscaping
HR-3	Maintain and restore Hudson River tidal wetlands and deepwater habitats, and freshwater wetlands throughout the ecosystem, which support waterfowl, anadramous fish, and regionally rare plants and animals.		X	X	X	X	X	X				
HR-4	Increase populations of colonial nesting waterbirds, shorebirds, waterfowl, and interjurisdictional fishes requiring shallow water, salt marshes, adjacent uplands, and coastal lagoons and rivers.			X	X	X	X	X			X	
HR-5	Protect, enhance, and restore spawning and nursery habitats and provide passage for migratory fishes, with emphasis on the upper Hudson River.			X	X	X	X	X			X	
Total: 3 of 6 plan Resource Priorities are addressed												

SOD = Sediment Oxygen Demand

1. Population Density and Demographics

Information on population density and demographics for the immediate area and for the service area are both relevant to an understanding of this project (see Table V-7). In the immediate vicinity of the project, population density is characteristic of a developed urban area. As indicated in Table V-7, population densities range from 689 persons per square mile in Ocean County, NJ to 6,132 in Essex County, NJ and 32,199 in Kings County, NY.

Table IV-7 Population, Population Density, and Population Changes in Counties Served by the Hoboken Terminal

Jurisdiction	Population			Percent Change 1980-1992	Population Density Per square mile
	1980	1990	1992		
Bergen	845,385	825380	834,983	-1.2	3,568
Essex	851,304	778,206	773,420	-9.1	6,138
Hudson	556,972	553,099	554,950	-0.4	11,807
Hunterdon	87,361	107,776	111,913	28.1	260
Mercer	307,863	325,824	327,694	6.4	1,449
Middlesex	595,893	671,780	684,456	14.9	2,200
Monmouth	503,173	553,124	565,928	12.5	1,199
Morris	407,630	421,353	428,156	5	912
Ocean	346,038	433,203	438,315	26.7	689
Passaic	447,585	453,068	456,172	1.9	2,465
Sussex	116,119	130,943	134,773	16.1	258
Union	504,094	493,819	493,340	-2.1	4,789
Warren	84,429	91,607	93,611	10.9	261
NEW JERSEY	**5,655,826**	**5,841,172**	**5,899,703**	**6.2**	**1,054**
Kings	2,231,028	2,300,664	2,286,167	2.5	32,199
Rockland	259,530	265,475	270,854	4.4	1,556
NEW YORK	**2,490,558**	**2,566,139**	**2,557,021**	**3.1**	**383**
Total	**8,146,384**	**8,407,311**	**8,456,724**	**3.8**	**N/A**

In general, the data in Table V-7 document two related growth patterns in New Jersey/New York and in other urban areas in the Eastern United States. The total population of New Jersey continues to grow, but the geographic distribution of the population is changing. Highly developed urban areas show population decreases (Essex County's population decreased by over 9 percent between 1980 and 1992), while fringe suburban areas show population increases. Some of these are dramatic, considered in percentage terms. For example, Ocean Count, NJ and Hunterdon County, NJ showed population increases of over 25 percent between 1980 and 1992.

Hoboken and Jersey City are the two communities that surround the project area. It is a densely developed and densely populated area. According to census data, Hudson County, which encompasses the Hoboken railyard and the surrounding neighborhoods, has a minority population of 52.6% (NJ Transit, 1996). The EPA guidelines state that if a population is over fifty percent minority than environmental justice concerns must be evaluated (USEPA, 1998). Another factor to consider in environmental justice analysis is income level. The median income level for households in Hudson County, according to census data, is $30,917. The Department of Housing and Urban Development defines a low-income household as a household where income is 80% or less of county median. (USEPA, 1998.) Although there is not exact data on the number of households that are low-income, there is believed to be a substantial amount in the communities of Jersey City and Hoboken.

The communities of Hoboken and Jersey City have developed around and have depended upon the operation of this railyard since the mid-1800's. Initially, the railyard served industrial purposes and then made a transition to commuter rail service in 1907. Presently the people of the surrounding communities are adapted to its existence as a commuter terminal and are most likely reliant on it for various purposes. Neither the No-Build nor Build Alternative will change the Hoboken Terminal's present role in the community.

2. IMPACTS OF THE PROJECT AND ALTERNATIVES

The No-Build Alternative would maintain the status quo of the Long Slip. The evaluation of such an alternative illustrates the existing and anticipated problems that require attention and have prompted the multi-million dollar yard and terminal renovation program. Succinctly, the major problems entail a shortage of train handling and storage space, poor juxtaposition of facilities, and the consequent inability to physically and financially operate trains. Intrinsic yard inefficiencies together with increased train traffic as system expansions now under construction come on line may increase noise and air pollution and result in less reliable service for commuters. Furthermore, the No-Build Alternative will not improve water quality, or provide educational and recreational benefits.

The Build Alternative will facilitate efficient and cost-effective operation and maintenance of current rail traffic, as well as the expected increases in rail ridership of coming years. The present noise and air pollution levels are expected to decrease once a more efficient system is implemented due to improved operational efficiency. All construction will be within the existing bounds of the present railyard; therefore surrounding neighborhoods will not be relocated or disrupted. Other benefits of the Build Alternative include improved water quality (CSO discharge will be redirected and improved, and a new aquatic habitat created), and the increased public access and recreational space offered by the new 1,000 foot long Hudson River Waterfront Walkway segment. The walkway creates numerous benefits such as recreational opportunities (exercising, fishing, socializing or relaxing), access to historic sites and retail shopping, a reversal of the current blighted appearance of the waterfront.

By connecting surrounding neighborhoods it will act as a catalyst to strengthen community ties. The Build Alternative strongly promotes the goals of the current State development and redevelopment plan (NJSPC, 1992) to revitalize neighborhoods by generating recreation attractions and by taking advantage of mass transit access. The project will generate direct economic benefits (increased output, family earnings, and jobs) for the region, contributing to overall neighborhood and family stability. The Build Alternative does not disproportionately affect the minority and low-income neighborhoods of Hoboken and Jersey City, rather it benefits their health and environment.

V. AGENCY COORDINATION AND PUBLIC OUTREACH

NJ TRANSIT has worked closely with stakeholders throughout the conceptual, planning and permitting stages of this project with the purpose of identifying, addressing and incorporating comments and concerns as early as possible. Public outreach consisted of meetings and other communications with regulating agencies, abutters, environmental advocates, and other stakeholders. Several presentations were made to interest groups such as the Port Authority of New York/New Jersey, the New York Maritime Association as well as to technical conferences. This section summarizes these efforts

A. PERMITS RECEIVED

NJDEP determined that the application was administratively complete on September 3, 1999 and issued a Waterfront Development Permit on December 3, 1999 that approved the proposed project. This approval includes a Water Quality Certification under Section 401 of the Clean Water Act and a determination of Coastal Zone Management Consistency. The Corps of Engineers issued a Department of the Army permit on April 20, 2000. Copies of these permits are included in Appendix 7.

B. ADMINISTRATIVE HISTORY

Two pre-application meetings of an exploratory nature were held with federal and New Jersey environmental agencies to determine the regulatory feasibility of decking or filling the canal. The first held on June 2, 1993, was on-site and attended by the Corps of Engineers and the US Coast Guard. The second was held in Trenton on June 7, 1993 and attended by several NJDEP sections, including Division of Fish, Game and Wildlife, Land Use Regulation, Office of Program Coordination, and Permit Identification and Assistance. For both meetings, the purpose was to identify regulatory issues and constraints pertaining to the utilization of the canal. Comments from the agencies led to the initiation of monitoring and sampling programs and an understanding of the likely mitigation requirements that enabled preliminary estimations of feasibility and costs.

A second pre-application meeting was held on June 10, 1996 at the Corps of Engineers' New York District offices. The US Fish and Wildlife Service, the Environmental Protection Agency, and the NJDEP Land Use Regulation Program attended the meeting. By this meeting considerable baseline data had been collected and analyzed, allowing the formulation and presentation of the project concept and program essentially as proposed here. The agencies' responses were supportive of the project provided statutory tests could be met.

By summer 1997, the project had matured sufficiently to warrant a final round of pre-application meetings. A draft application narrative was circulated in advance of the meetings. The purpose was two-fold: first to update the agencies to the current project program, and second, to coordinate the separate utility filing for HBLRT. The results of these meetings are summarized below. Copies of the meeting minutes and the attendance lists are included in Appendix 7.

- **July 8, 1997 Meeting with the Corps of Engineers** - James Cannon expressed support for the project, but suggested meetings with the other reviewing agencies. He indicated the need for Jersey City to commit to the CSO improvement plan. He recommended more comprehensive coordination from the HBLRT to resolve confusion over possible cumulative impacts and the overlap between the two projects.

- **July 17, 1997 Meeting with NJDEP Land Use Regulation Program, US. Fish and Wildlife Service and the HBLRT engineering consultants** - The agencies, agreeing that there was compelling justification and no prudent alternatives, did not object to filling the canal. The USFWS supported a Finding of No Significant Impact (FONSI) and indicated that extension of the Jersey City CSO and the improvements to remove floatables and dry weather flows were sufficient mitigation. However, the permit application must include a written agreement with the Jersey City Sewer Authority regarding these improvements.

- **August 7, 1997 Meeting with the Environmental Protection Agency and National Marine Fisheries Service** - Both agencies stated no objections to filling the canal and for a FONSI. The agencies provided guidance of the mitigation plan elements that could be counted as mitigation acreage. Primarily, these consisted of the measures proposed to improve water quality.

- **August 11, 1997 Meeting with the Baykeeper and the Ocean Action Coalition** - The groups questioned whether the mitigation plan to create habitat was sufficient since Long Slip Canal provides a service to the river by trapping sediment and indicted that the proponent should purchase off-site wetlands acreage at a 3:1 ratio.

- **August 28, 1997 Meeting with the Corps of Engineers and the HBLRT team** - The projects will file individual applications as separate utilities. Each will acknowledge the other project and the permit contents will be consistent.

- **September 29, 1997 Meeting with the Jersey City Sewer Authority -** This meeting was held to present alternative sites for settling tank and net and the CSO extension route. The sewer authority agreed that these could be removed from NJ TRANSIT property and that other locations would make maintenance more convenient.

- **October 31, 1997 Meeting with the Jersey City Sewer Authority** – The Jersey City Sewer Authority reviewed the CSO improvement plans and committed to provide a written agreement for inclusion in the permit application.

An application to the Corps of Engineers, for a Department of the Army Permit under Section 404 of the Clean Water Act (33 USC 1344) and Section 10 of the Rivers and Harbors Act of 1899 (33 USC 403) filed on December 19, 1998 is currently under review. A Public Notice Public Notice Number 98-02350-J2) was issued by the Corps on September 28, 1998. The 30-day comment period was extended to November 12, 1998 at the request of NMFS. Comments received from Public Notice review and the proponent's responses are included under separate cover.

An application to the New Jersey Department of Environmental Protection (NJDEP) Land Use Regulation Program for a Waterfront Development Permit (under E.O. 215), Coastal Zone Management consistency, and a Water Quality Certification under the New Jersey Coastal Permit Program Rules (N.J.A.C. 7:7), filed at the same time, also is under review. The following meetings were held after those filings:

- **January 16, 1998 Meeting with Hudson County and Jersey City Engineering Department -**To advise of project status.

- **January 20, 1998 Meeting with Jersey City Municipal Environmental Council -** To advise of project status.

- **January 30, 1998 Meeting with Fund for a Better Waterfront** (Hoboken stakeholder) - To advise of project status.

- **April 9, 1998 Meeting with NJDEP** - The NJDEP reviewed water quality modeling

- **April 14, 1998 Meeting NJDEP** -Review of mitigation plan.

- **April 15, 1998 Meeting with the NJDEP Land Use Regulation Program and the Department of Parks and Forestry** – Both agencies agreed that Liberty State Park could be used to site compensatory wetlands as an alternative mitigation measure.

- **April 16, 1998 Coordination with US Coast Guard -** regarding potential navigation issues; none were identified

- **April 21, 1998 Meeting with North Hudson Utility Authority -** Coordination regarding sewer and outfall design.

- **April 27, 1998 Meeting with North Hudson Sewage Authority -** Coordination regarding sewer and outfall design.

- **October 7, 1998 Meeting with National Marine Fisheries Service -** The meeting was held to advise NMFS of HBLRT impacts and project developments.

- **December 11, 1998 Meeting with the Corps of Engineers, the USFWS, and NMFS -** The meeting was held to review and address comments on the public notice, to update the agencies on design changes and to reach agreement on an acceptable development program and mitigation plan. The resource agencies agreed that additional fill in the entrance basin could not be justified, that the excavation was beneficial to water quality and that it and the other water quality measures were acceptable mitigation if accompanied by token wetlands replication.

- **December 17, 1998 Meeting with NJDEP and FTA.** This meeting also was held to review and address comments on the public notice, to update the agencies on design changes and to reach agreement on an acceptable development program and mitigation plan. NJDEP also agreed that additional fill in the entrance basin could not be justified, that the excavation was beneficial to water quality and that it and the other water quality measures were acceptable mitigation if accompanied by token wetlands replication.

- **March 4, 1999 Meeting with the Baykeeper and Rutgers Environmental Law Clinic.** This meeting was held to address comments on the Public Notice. RELC requested additional analysis of project alternatives. NJ TRANSIT complied and the results are contained under separate cover in the comment/response document.

- **June 29, 1999 Meeting with NJDEP**. A site visit to the proposed wetlands mitigation site at the Caven Point peninsula was held to obtain NJDEP concurrence on the acceptability of the mitigation site and preliminary plan. The second objective was to identify remaining agency concerns and information needs. NJDEP found the site suitable and supported the position that wetlands habitat has greater value that than the existing disturbed uplands and contaminated areas. The mitigation should mix uplands and wetlands while preserving prime uplands habitat areas.

- **February 17, 2000 Meeting with MIMAC**. NJ Transit met with MIMAC to request the purchase of acreage at the Marsh Resources, Inc. mitigation bank in the Hackensack Meadowlands at a ratio of 1.1:1 to provide the compensatory wetlands required by the NJDEP permit. The request was approved but a 2:1 ratio was required.

- **April 28, 2000 Meeting with NJDEP.** NJ Transit, including the Hudson Bergen Light Rail Transit (HBLRT) group, met with NJDEP to coordinate on the Hudson Waterfront Walkway design in reference to Administration Condition Number 9 of the Waterfront Development Permit. While the yard conditions and the HBLRT Terminal impose many constraints, the discussions identified several opportunities to expand and improve public access that will be developed in later submittals to NJDEP.

The Draft Environmental Assessment and Section 4(f) Evaluation was filed with the FTA on March 28, 2000. Copies were distributed to the municipal planning departments of Jersey City and Hoboken and to the Jersey City Main Library, Jersey City Five Corners Library and the Hoboken Public Library. Notice of Availability was published in the following newspapers:

Jersey Journal	March 31, 2000
New Star Ledger	April 18, 2000
La Voz	April 6, 2000
Bergen Record	April 17, 2000

Copies of these notices are included in Appendix 7. No comments were received by the FTA or NJ Transit in response to these notices. The FTA issued its' Finding of No Significant Impact on June 22, 2000.

C. AGENCY CONTACTS

Agencies and persons contacted include:

<u>**U.S. Army Corps of Engineers**</u>
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Andy Willner - Baykeeper
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William Wisseman, Newport Center
Ron Hine, Fund for a Better Waterfront
Ann, Alexander, Rutgers Environmental Law Clinic

D. REFERENCES CITED

Able, K. W., A. L. Studholme and J. P. Manderson, 1995. *Habitat Quality in the New York/New Jersey Harbor Estuary: An Evaluation of Pier Effects on Fishes*. Final Report to the Hudson River Foundation. 84p.

Amercom Corporation, 1994. *Inspection and Stability Analysis for the Long Slip Canal , Jersey City & Hoboken, New Jersey*. July, 1994.

Amy S. Greene Environmental Consultants, Inc. (ASGECI). 1996. *Interim Report Upon the Combined Sewer Overflow Planning Study for Planning Area III*; Volume II, Environmental Inventory and Impact Assessments. Prepared for Killam Associates.

Andrews, W. 1984. *Inventory of the Fishery Resources of the Hudson River*. Final Report to the NJ DEP, Division of Fish, Game and Wildlife, Marine Fisheries Administration, Nacote Creek Research Station.

Andrews, William, 1997. NJDEP Fisheries Personal Communication April 7, 1997.

Auster, P. J., 1989. Tautog and Cunner. *Species Profiles: Life Histories and Environmental Requirements of Coastal Fishes and Invertebrates (North and Mid-Atlantic)*. Biological Report 82(11.105) U.S. Dept. of Interior, Fish & Wildlife Service 13

BEM Systems, Inc., 1996. *New Jersey Transit Hudson-Bergen Light Rail Transit System Remedial Investigation/Remedial Alternatives Analysis Group 6 Newport Extension-Hoboken Terminal* Volume I (Draft). BEM Systems, Inc., Florham Park, NJ.

Berg, D.R., G. Ferrier, and J. Paugh, 1998. *The U.S. Environmental Industry, Meeting the Challenge: U.S. Industry Faces the 21^{sst} Century*: U.S. Department of Commerce Office of Technology Policy. October, 1998.

Breen, A., and Rigby, D., 1995, *Waterfronts: Cities Reclaim Their Edge*.

Cantelmo, F. R. and C. H. Wahtola, Jr., 1992. Aquatic habitat impacts of pile-supported and other structures in the lower Hudson River. pp. 59-75 in: W. Wise, D. J. Suszkowski and J. R.

Waldman (eds.). *Proceedings: Conference on the impacts of New York Harbor development on aquatic resources*. Hudson River Foundation, N.Y.

CH2M Hill, 1997. Written communication to N. Valente, NJ TRANSIT conveying results of flow measurements from the Hoboken Park Avenue sewer.

City of Hoboken, 1995. *South Waterfront Development, Hoboken, NJ NJDEP Waterfront Development Permit Application and Water Quality Certification*. Prepared by Paulos, Sokolowski, and Sartor, Inc., Warren, NJ. October 6, 1995.

Clark, J.R., 1995. *Coastal Zone Management Handbook*. Lewis Publishers, Boca Raton. 694p.

Coutant, C. C. and D. L. Benson, 1990. *Summer habitat suitability for striped bass in Chesapeake Bay: Reflections on a population decline*. Trans. Amer. Fish. Soc. 119(4):757-778.

Dames & Moore, 1997. *Application of a Three-Dimensional Numerical Model to Evaluate Water Quality Improvements in the Long Slip Canal Entrance Basin, Phase I Report*. Dames & Moore, New York, NY. 58p.

Dames & Moore, 1998. *Application of a Three-Dimensional Numerical Model to Evaluate Water Quality Improvements in the Long Slip Canal Entrance Basin, Phase II Report -Dissolved Oxygen Prediction*. Dames & Moore, New York, NY. 31p.

Dames & Moore, 1999. *Application of a Three-Dimensional Numerical Model to Evaluate Water Quality Improvements in the Long Slip Canal Entrance Basin, , Phase III Report - Dissolved Oxygen Predictions of Updated Development Program and the Hudson Bergen Light Rail Transit Station*. Dames & Moore, New York, NY. 18p.

Dew, C. B. and J. H. Hecht, 1994. Hatching, estuarine transport, and distribution of larval and early juvenile Atlantic tomcod, *Microgadus tomcod*, in the Hudson River. *Estuaries* 17(2): 472-488.

Dolan Research, Inc., 1997. *Phase 1A Archaeological Survey of the Long Ship Canal Site*. Dolan Research, Inc., Philadelphia, PA. 7p.

Dravo Van Houton, 1986. *Parcel No. 1 Bulkhead Stability Analysis and Environmental Findings at Newport City, Jersey City, NJ*.

Dutko, R. 1997. Personal Communication. NJ Natural Heritage Program. Trenton, NJ.

Federal Emergency Management Agency. Flood Insurance Rate Maps. City of Hoboken (November 17, 1982) and City of Jersey City (March 1, 1984), Hudson County, New Jersey.

Federal Emergency Management Agency. *Flood Insurance Study. City of Hoboken* (May 17, 1982) and *City of Jersey City* (September 1, 1983), Hudson County, New Jersey.

Federal Interagency Committee for Wetland Delineation (FICWD). 1989. *Federal Manual for Identifying and Delineating Jurisdictional Wetlands*. US Army Corps of Engineers, US Environmental Protection Agency, US Fish and Wildlife Service, and USDA Soil Conservation Service, Washington, D.C. Cooperative technical publication.

Gardinier, M.N. and T.B. Hoff, 1982. Diet of striped bass in the Hudson Estuary, *NY Fish Game J.* 29(2):152-165.

Geismar & Calamari, 1986. *Newport City at Jersey City, New Jersey: Survey of Existing Waterfront Structures with Redevelopment Recommendations.*

Grabe, S. A., 1978. Food and feeding habits of juvenile Atlantic tomcod, *Microgadus tomcod*, from Haverstraw Bay, Hudson River, New York. U.S. Natl. Mar. Fish. Serv. Fish. Bull. 76:89-94.

Grabe, S. A., 1980. Food of age 1 and 2 Atlantic tomcod, Microgadus tomcod, from Haverstraw Bay, Hudson River, New York. *U.S. Natl. Mar. Fish. Serv. Fish. Bull.* 77:1003-1006.

Guida, V. G., D. Zeroka and A. Choudhury. 1995. *Biological Baseline Study of Long Slip Canal*. Final Report to F. R. Harris, Inc., project no. 10-2758-03. Environmental Studies Center, Lehigh University Bethlehem, PA. 33p.

Guida, V.G., 1997. *Long Slip Canal Habitat Restoration Project Hydrographic Data Report and Implications for Projected Habitat Restoration.* Final Report to NJ TRANSIT, February, 1997. Environmental Studies Center, Lehigh University. Bethlehem, PA. 14p.

Hamrick, J.M., 1992a. *A Three-Dimensional Environmental Fluid Dynamics Computer Code: Theoretical and Computational Aspects*. The College of William and Mary, Virginia Institute of Marine Science, Special Report 317. 63p.

Hamrick, J.M., 1992b. Estuarine environmental impact assessment using a three-dimensional circulation and transport model In: Spaulding, M.L., *et al.*., (eds) *Estuarine and Coastal Modeling, Proceedings of the Third International Conference*. Am. Soc. of Civil Eng., NY, pp 591-608.

Havens and Emerson, Inc. 1979. *201 Wastewater Facilities Plan, Planning Area I; Volume One, Facility Report*. Prepared for the Hudson County Utilities Authority.

ICF Kaiser Engineers, 1990. *Hoboken Yarding and Development Concept Study*. prepared for NJ TRANSIT.

Jersey City Planning Board, 1992. *Master Plan Re-examination Report, Jersey City, NJ*. City of Jersey City Department of Housing and Economic Development, Division of City Planning, May, 1992.

Jersey City Sewerage Authority, 1995. *Revised Combined Sewer Overflow Abatement Study* Volume 1 of 2. Prepared by Malcolm Pirnie.

Jersey City Sewerage Authority, 1996. *Combined Sewer Overflow Discharge Characterization Study:* Part B - Service Area Drainage and Land Use Report. Prepared by Malcolm Pirnie.

Kaufman, K. 1996. *Lives of North American Birds*. Houghton Mifflin Company. New York, NY.

Kiernan, John, 1997. CH2M Hill civil engineer, personal communication, April 10, 1997.

Lawler, Matusky & Skelly Engineers, LLP. 1996. *Hoboken Rail Yard Long Slip Canal Habitat Creation Project Water Quality and Bathymetric Surveys*. Report to New Jersey Transit. Project # 694-006 under subcontract to Dames & Moore. Pearl River, NY.

Long, E. R., D. A. Wolfe, K. J. Scott, G. B. Thursby, E. A. Stern, C. Peven and T. Schwartz. 1995. *Magnitude and Extent of Sediment Toxicity in the Hudson-Raritan Estuary*. NOAA Tech. Memorandum NOS ORCA 88. NOAA Coastal Ocean Office, Silver Spring, MD.

Marchwinski, T., 1995. (Business planner, NJ TRANSIT) Written communication regarding ridership, air quality and other benefits of the Secaucus Transfer project.

Markhurd. 1986. *NJDEP Freshwater Wetlands Map*. Jersey City, NE quarterquad.

Mid-Atlantic Fisheries Management Council, *et al*., 1998. Draft Environmental Impact Statement for Amendment 1 to the Fishery Management Plan for the Atlantic Bluefish Fishery (FMP). July 7, 1988 Hearing Draft.

Mid-Atlantic Fisheries Management Council, *et al*., 1998. Draft Environmental Impact Statement for Amendment 8 to the Fishery Management Plan for the Atlantic Mackerel, Squid and Butterfish Fisheries (FMP). August 20, 1998 Hearing Draft.

Mid-Atlantic Fisheries Management Council, *et al*., 1998. Draft Environmental Impact Statement for Amendment 12 to the Fishery Management Plan for the Summer Flounder, Scup and Black Sea Bass Fisheries (FMP). August 18, 1998 Hearing Draft.

Mid-Atlantic Fisheries Management Council, *et al*., 1998. Draft Environmental Impact Statement for Amendment 12 to the Fishery Management Plan for the Atlantic Surfclam and Quahog Fisheries (FMP). August 19, 1998 Hearing Draft.

Mueser Rutledge, 1996. *Hoboken Terminal Geotechnical Investigation, Hoboken, NJ*; prepared for NJ TRANSIT, November 7, 1996.

Newcomb, L. 1977. *Newcomb's Wildflower Guide*. Little, Brown and Company. Boston, MA.

New Jersey Marine Science Consortium. 1987. *The Hudson-Raritan: State of the Estuary, Summary*.

NJDEP, 1984. *Hudson Waterfront Walkway Plan and Design Guidelines*; prepared by Wallace, Roberts & Todd, Louis Berger & Associates, Inc., and Ralph B. Hirsch March, 1984. NJDEP Divsion of Coastal Resources. 136p.

NJDEP, 1994, *Surface Water Quality Standards*. N.J.A.C. 7:9B Office of Land and Water Planning. Trenton, New Jersey.

NJDEP, 1995. *Air Quality Report, Ambient Air Monitoring Data - Annual*. Bureau of Air Monitoring, 64 p.

NJDEP, 1996. *The Management and Regulation of Dredging Activities and Dredged Material in New Jersey's Tidal Waters*. NJDEP Dredging Task Force.

NJDEP, 1997. *The Management and Regulation of Dredging Activities and Dredged Material in New Jersey's Tidal Waters*. Draft, March 1996. 61p.

Newport Associates Development Company, 1988. *Newport Southeast Quadrant Project, City of Jersey City, NJ- Waterfront Development Permit Application*. Newport Associates Development Company, Jersey City, NJ.

NJ TRANSIT, 1981. *New Jersey Rail Equipment Maintenance Facilities Study,* Final report Project No. IT-09-0058, TS F-212: prepared by Seelye, Stevenson Value & Knecht,Inc., New York, NY.

NJ TRANSIT, 1992. *NJ TRANSIT Yard Siting Study, Evaluation of Alternate Sites*: prepared by Parsons Brinckerhoff, Quade & Douglas, Inc., New York, NY.

NJ TRANSIT, 1994. *Long Slip Canal Engineering Study*. Prepared by F. R. Harris, Inc., Iselin, NJ.

NJ TRANSIT, 1995a. <u>*Final Technical Memorandum for Long Slip Canal Sediment and Surface Water Sampling*</u>. Prepared by F. R. Harris, Inc., Iselin, NJ.

NJ TRANSIT, 1995b. *Long Slip Canal Environmental and Engineering Study*: *Task 2 - Environmental Feasibility*. Prepared by F. R. Harris, Inc., Iselin, NJ.

NJ TRANSIT, 1995c. *Long Slip Canal Sediment and Surface Water Sampling*. F. R. Harris, Inc. Draft Final Technical Memorandum to New Jersey Transit. NJT No. 92-CG-0024B-23.R2., Iselin, NJ.

NJ TRANSIT, 1995d. *NJ TRANSIT Corporation Train Storage Yard Improvements Project, Hoboken Yard Final Concept Design Report*: prepared by Parsons Brinckerhoff, Quade & Douglas, Inc. New York, NY.

NJ TRANSIT, 1996. *Hudson-Bergen Light Rail Transit System, Hudson and Bergen Counties, NJ, Final Environmental Impact Statement /Section 4(f) Statement:* prepared by US Department of Transportation Federal Transit Administration and NJ TRANSIT, August, 1996, 2 vol.

NJ TRANSIT, 1996b. *Hoboken Terminal and Yard Preservation Plan, Final Draft*. Prepared by Beyer, Blinder, Belle, New York, NY. December 11, 1996.

NJ TRANSIT, 1997. *General Design Consultant Services for the Rehabilitation and Redevelopment of the Hoboken Terminal and Yard Complex NJT Contract No. 94CA035, Task 2700 - Rail Operations Study Final Task Report:* prepared by Rail Transportation Systems, Inc., New York, NY.

Olla, B. L., A. J. Bejda and A. D. Martin, 1979. Seasonal dispersal and habitat selection of cunner, *Tautoglabrus adspersus* and young tautog, *Tautoga onitis*, in Fire Island Inlet, Long Island, New York. *U.S. Natl. Mar. Fish. Serv. Fish. Bull.* <u>77</u>:255-261.

Port Authority of New York and New Jersey, 1994. *Evaluation of PATH Discharges at 15th Street, Exchange Place and Caisson 2*: prepared by Killam Associates, Millburn, NJ.

Seed, R., 1976. Ecology. Ch. 2, pp. 13-65 in: B. L. Bayne (ed.), *Marine Mussels: Their Ecology and Physiology*. Cambridge Univ. Press, London

Trust for Public Lands, 1996. *Hudson River Walkway Gap Site Implementation Study, Hudson County, NJ Alternatives Analysis*. Prepared by Strauss Associates for NJDEP.

Urban Mass Transportation Administration, 1979. *Guidelines for Preparing Environmental Assessments*: UTMA Circular UMTA C 5620.1, October 16, 1979. 51p.

U.S. Army Corps of Engineers, 1987. *Confined Disposal of Dredged Material - Engineer Manual*. EM 1110-2-5027.

U.S. Army Corps of Engineers, 1996, *Dredge Material Management Plan for the Port of New York and New Jersey,* Interim report September 1996. COE, New York District, NY, NY

U.S. Department of Agriculture. 1992. *Draft Soil Survey of Hudson-Essex-Passaic Counties*. 430-VI-NSH. Soil Conservation Service, Verona, New Jersey.

U.S. Department of Commerce, 1994. *1994 City County Data Book*. Washington, D.C. U.S. Department of Commerce.

U.S. Department of the Interior. 1979. *Classification of Wetlands and Deepwater Habitats of the United States*. USFWS, Washington, DC.

U.S. Fish and Wildlife Service. 1979. *National Wetlands Inventory Mapping; Jersey City, NJ-NY Quadrangle.* US Department of the Interior.

U.S. Fish and Wildlife Service, 1995. *Regionally Significant Habitats and Habitat Complexes of the New York Bight Watershed.* Final report (draft), November, 1995. USFWS, Southern New England -NY Bight Coastal Ecosystems Program, Charlestown, RI.

U.S. Fish and Wildlife Service, 1996. *Hudson River/New York Bight Ecosystem Plan for the Fiscal Years 1997-1999*. U.S. Fish and Wildlife Service Region 5. October 1, 1996.

Whitman, C.T. and G.E. Pataki, 1996. *Joint Dredging Plan For The Port Of New York And New Jersey, October 7, 1996*. 16p.

LONG SLIP CANAL HABITAT CREATION PROJECT

Part of the
HOBOKEN RAILYARD
REHABILITATION PROJECT
Hoboken/Jersey City, New Jersey

FINAL ENVIRONMENTAL ASSESSMENT and SECTION 4(f) EVALUATION

Prepared for:
Federal Transit Administration
June 19, 2000

VOLUME II TECHNICAL APPENDICES

DAMES & MOORE
A DAMES & MOORE GROUP COMPANY
1515 Broadway, 35th Floor
New York, NY 10036

NJ TRANSIT
One Penn Plaza East
Newark , NJ 07105

List Of Appendices

APPENDIX 1

ADMINISTRATIVE DOCUMENTS

CONTENTS:

RIPARIAN GRANT
NJDEP TIDELANDS REVIEW
OWNERSHIP OF PARCELS
PRE-APPLICATION MEETING NOTES
LETTER OF AGREEMENT REGARDING CSO

State of New Jersey
Department of Environmental Protection

Christine Todd Whitman
Governor

Robert C. Shinn, Jr.
Commissioner

Bur. of Tidelands Management
CN-401, Trenton, NJ 08625
609-292-2573

6/25/96

Joseph Porrovecchio
Dames & Moore
One Blue Hill Plaza - Suite 530
Pearl River, NY 10965

RE: "Long Slip Canal" (part of Lot 7, Block 19), Jersey City, Hudson Co., NJ

FILE: 0905-96

Dear Mr. Porrovecchio,

In reply to your 6/21/96 faxed inquiry, any tidelands ownership interest the State may have had in the above referenced canal seems to have been conveyed by a riparian grant dated April 14, 1888 to the Morris and Essex Rail Road Company. We are assuming that the grant was valid and that all its terms and conditions have been fulfilled. You might consider showing the exact limits of that grant on plans you prepare for the overall project site.

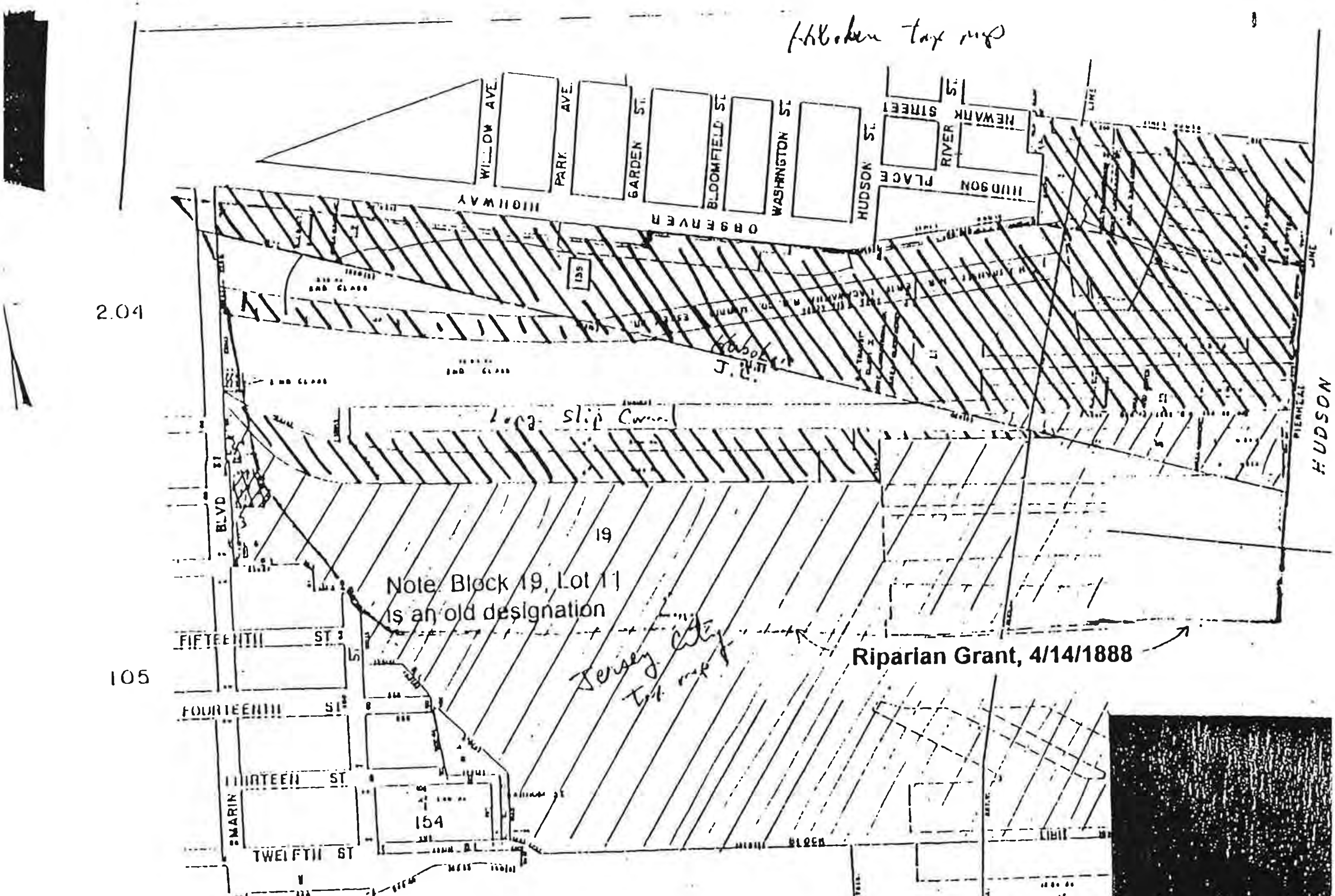
This position is not really 'official' or legally binding on the State. The only official determination that the State has no tidelands title interest in any property is made upon delivery of a fully signed "Statement of No Interest."

If necessary, a copy of the prior grant may be obtained from this office. Such a request should include a check for $10.00 (payable to the Treasurer, State of N.J.) and reference our Liber 3, page 158.

Yours truly,

[illegible]
Manager, Bureau of
Tidelands Management

JAC/DAH/eh



MAP D

Source: Hoboken and Jersey City Block & Lot tax maps

THE JERSEY CITY SEWERAGE AUTHORITY
555 ROUTE #440 · JERSEY CITY, NEW JERSEY 07305
TEL: (201) 432-1150 · FAX: (201) 432-1576

November 17, 1997

Mr. Steven Jurow
NEW JERSEY TRANSIT
One Penn Plaza East
Newark, New Jersey 07105

RE: LONG SLIP CANAL

Dear Mr. Jurow:

The Jersey City Sewerage Authority's (JCSA) Eighteenth Street regulator presently discharges its Combined Sewer Overflow (CSO) into the Long Slip Canal.

New Jersey Transit (NJT) plans to fill the Long Slip Canal as part of the Hoboken Rail Yard Rehabilitation Project. To effectuate this filling of the Long Slip, NJT proposes to relocate the CSO outfall and extend said outfall to, at a minimum, the bulkhead line. The final alignment of the outfall extension must still be determined with input from all affected parties, including the City of Jersey City. As part of this extension, NJT plans to install netting facilities and sedimentation basins to insure that the CSO discharge meets or exceeds the USEPA nine minimum control requirements.

NJT will be responsible for the design of these outfall improvements, either through their own engineers or through agreement with the JCSA, and for construction of the improvements as part of the HBLRTS project.

Upon completion of the construction of these improvements, in accordance with a properly completed design and in accordance with all local, state and federal laws and regulations, it is proposed that the JCSA, through agreement with NJT, will accept ownership of the improvements and perform all operations and maintenance of said improvements.

The JCSA believes that this proposal, as herein described, is an acceptable way to accomplish the goals of both agencies and we endorse your efforts to improve water quality. An agreement, however must be approved by resolution of the JCSA Board of Commissioners.

Very truly yours,

William A. Macchi
Executive Director

JFB/ljl

cc: Honorable Board of Commissioners
Joseph F. Beckmeyer, P.E., Chief Engineer
Brian C. Doherty, Esq, General Counsel
Mark Del Bove, Malcolm Pirnie

The State of New Jersey to all to whom these Presents may come or concern, Greeting:

Whereas [illegible] of the State of New Jersey approved [illegible] entitled An Act relative to the Riparian Commissioners [illegible] among other things enacted that said Commissioners [illegible] with the concurrence of the Governor [illegible] in all cases of applications for grants or leases of land which were not then or thereafter [illegible] the land of the applicant or at the time of the [illegible] grant [illegible] and in case of applications for grants or leases for all or any of the lands [illegible] the first [illegible] riparian [illegible] grant or lease [illegible] grant afterwards [illegible] at any time [illegible]

[illegible]

[illegible]

[illegible]

6

[illegible] under tide water [illegible]
lie between the original line of high water mark [illegible]
[illegible]
[illegible] for which [illegible]
[illegible]
[illegible]
[illegible]
the sum of [illegible] thousand [illegible] hundred [illegible]
[illegible]
[illegible]
[illegible]

And Whereas the amount of such [illegible]
[illegible]

And Whereas the [illegible]
[illegible]

[illegible]

172

and after an application for such grant in writing [illegible] and agreeing to pay to the said State the sum of [illegible] thousand [illegible] dollars [illegible]
Therefore the said State of New Jersey by the present Commissioners appointed in the said Act, to wit [illegible] Randolph, [illegible] Ross, Richard [illegible] and [illegible] B. [illegible] the Governor of said State, [illegible] consideration of the premises and of the sum of [illegible] thousand [illegible] hundred dollars duly paid by the Morris and Essex Rail Road Company to the said State, the receipt whereof is hereby acknowledged, doth hereby grant [illegible] unto the said the Morris and Essex Rail Road Company and to their successors and assigns forever, all that tract of land situate and bounded as follows: Beginning at the centre of [illegible] Street [illegible] at the original line of high water mark thence [illegible] along the said line of high water mark [illegible] [illegible] line of [illegible] [illegible] northerly tract of land [illegible] [illegible] Street [illegible] [illegible] Rail Road Company [illegible]

[illegible]

With the right, liberty, privilege and franchise to exclude the tide water from so much of the lands above described as lies easterly of the original line of high water [illegible] or heretofore under tide water by filling in or otherwise improving the same and to appropriate the lands above described to their exclusive private use.

And Also all and singular the land under water and the docks and other structures now existing between the above mentioned exterior line for solid filling and the exterior line for piers as fixed by the said Commissioners [illegible] and bounded as follows:

Beginning on the exterior line for solid filling at the beginning point of the last course in the tract first described and [illegible] and running thence south seventy one degrees and twenty four minutes east, five hundred and forty feet to the exterior line for piers as fixed by the aforementioned Commissioners; thence along said exterior line for piers north twenty two degrees and thirty four minutes east fifteen hundred and sixteen feet; thence north seventy degrees and twenty four minutes west four hundred and fifty feet to the exterior line for solid filling; thence along the exterior line for solid filling south twenty four degrees and fifty [illegible] minutes west fifteen hundred and [illegible] eight feet to the place of beginning.

With the right, liberty, privilege and franchise [illegible]

[illegible]

And also Provided, That if the exterior line for solid filling and the exterior line for piers or [illegible] of said lands now established or lines that may hereafter [be] established by the Riparian Commissioners of the State of New Jersey shall be hereafter changed by the action of the authorities of the United States Government and the grantee herein suffers damages that the claim or claims therefor must be made against the authorities of the United States Government and not against the State of New Jersey.

And the said State also covenants to and with the said The Morris and Essex Rail Road Company their successors and assigns that the said State will not grant or give any license, power or authority to any other person or corporation affecting lands under water in front of the said lands hereby granted, but this covenant shall not preclude the State from leasing or disposing of its lands under water which lie in front of the exterior line or lines hereinbefore described, should said State hereafter enact any law or laws for leasing or disposing of its lands under water for the [illegible] of [illegible] provided that in such case [illegible] space of suitable width for free and uninterrupted passage and access to and from the lands hereinbefore described shall at all times be left [illegible] free and uninterrupted between the line of solid filling [or] between the exterior line for piers [illegible]

[illegible]

And [illegible]

[illegible]

in the year one thousand eight hundred and eighty eight

Robt. S. Green

Pennington F. Randolph

Miles Ross

Richard N. Herring

Richard B. Reading

Witness R. C. Brock

The Great Seal of the State of New Jersey MDCCLXXVI

Attest Henry C. Kelsey Secretary of State

State of New Jersey }
County of Hudson } ss.

Be it remembered that on the ~~eighteenth~~ third day of ~~April~~ May eighteen hundred and eighty eight before me the subscriber a Master in Chancery of New Jersey personally appeared Robert C. Brock of full age who being by me duly sworn on his oath saith that the said Pennington F. Randolph, Miles Ross, Richard N. Herring and Richard B. Reading the within named Commissioners signed sealed and delivered the within deed as their voluntary act and that he the said Robert C. Brock thereupon subscribed his name as an attesting witness thereto. R. C. Brock

Sworn and subscribed before me the third day of May eighteen hundred and eighty eight

[illegible]

Master as aforesaid

Long Slip Canal Habitat Creation Project-Title and Easement Search

Objective

The title and easement investigation was conducted to determine current ownership and easements adjacent the Long Slip Canal. This activity was performed as a part of the Long Slip Canal Habitat Creation Project. Knowledge of easements and title is necessary prior to facilitation of the project. All of the documents reviewed are available to the public.

References

Title & Easement documents 758-640-D CE and CE758-640(B) provided by NJ Transit;
Tidelands Management findings from the NJDEP;
Tax block and lot maps for the cities of Hoboken and Jersey City;
Well search within ½ mile radius of the Long Slip Canal, at Water Allocation, NJDEP.
Newport Redevelopment Plan, September 22, 1988

Observations

The references were throughly reviewed. Many of the materials were dated from the turn-of-the-century and were related to the early ownership of the property by the Morris & Essex Railroad Company. Documentation relating to the riparian grant by the State of New Jersey to Morris & Essex and tunnel rights-of-way of the Hoboken and Manhattan Railroad Company were reviewed. The document that conveys right-of-way to Jersey City to construct and maintain a sewer line that outfalls to the Long Slip Canal was reviewed. License agreements were reviewed for electric and gas lines by Public Service Electric and Gas and telephone lines by New Jersey Bell Telephone, although maps that were referred to in the documents were not provided. The Town Halls of Hoboken and Jersey city were visited and current ownership of properties adjacent the Long Slip Canal was obtained by reviewing the tax assessor records; the parcel of property adjacent to NJ Transit property to the south of the Long Slip Canal was confirmed to be owned by Newport Centre. A phone call was made to the permit department at the NJDEP to ascertain whether any waterfront development or Coastal Area Facility Review Act permits were requested for Block 19, Lot 11 or for Newport and none were A well search was conducted within a ½ mile radius of the project area. This effort was part of the geological investigation stage of the project but important ownership information for properties in question was obtained; well permits requested in Block 19, Lot 11 were all from NJ Transit and the well permits requested by the Newport owners were south of Block 19, Lot 11. A review of the Newport Redevelopment Plan shows the areas that will be acquired to include all of the Long Slip Canal and property adjacent the Canal to the south; the property adjacent the Canal to the north will not be acquired.

Findings

The enclosed five page table lists the reviewed Long Slip Canal documents and other reviewed materials.

List of Maps

Map A--Subsurface rights for tunnels in Jersey City and Hoboken; Source: Map 2051, undated

Map B1--Sewer line drawing near Cole and 18th streets in Jersey City; Source:

Deed Book 3139, pg. 593

Map B1--Sewer line drawing for west end of Long Slip Canal; Source: as above

Map C1--Original line of high water from Riparian Grant map, 4/4/1888, in Hoboken; Source: Deed Book 456, pg. 615

Map C2--Original line of high water from Riparian Grant map in Jersey City; Source: as above

Map D--Current property ownership status adjacent Long Slip Canal; Source: Combined Hoboken and Jersey City tax assessor block and lot maps

Conclusions

From the available data, the landside property adjacent the Long Slip Canal is owned by NJ Transit (see Map D.) Waterside property adjacent the eastside opening of Long Slip Canal is owned by Harborside Development and Newport Centre. There are no apparent covenants that need to be researched by an attorney.

Recommendations

- The most recent title documents provided by NJ Transit is dated 1984. There has been an apparent change in title for a portion of the railroad company's property, the area shown on Map D as Block 19 Lot 11. NJ Transit should verify that there are no additional deed records.
- The maps referred to in various Deed Book documents were not supplied. This omission is noted throughout the table. These maps may be useful for a utility search.
- Page 2 is missing from Deed Book 3435, pg. 455, and refers to a sketch map. The sketch map was provided but the description may be on the missing page 2.
- Maps B1 and B2 showing sewer lines are essentially illegible. A cleaner copy of these maps, which is from Deed Book 3139, pg. 593, might be helpful.
- A portion of southeast side of NJ Transit's property has a batch plant in operation. From our review of the available ownership information, this facility is operating without consent of NJ Transit. NJ Transit should seek counsel and execute definite control and ownership of the property (i.e, fence off area and publish notification in the legal section of a local newspaper.)

Reviewed Long Slip Canal Documents

Document	Date	Parties involved	Information supplied
Deed Book 163, pg. 201	Nov. 1, 1867	Hoboken Land & Imp. vs. The Morris & Essex RR Co.	Land use allowed to Morris & Essex from the south side of Ferry St. (Observer Hwy) to where the east side of Hudson St intersect. Then east to the "exterior line of solid filling" and north along that line to the intersection with another line (?) to the southwest corner of the present most southerly Ferry bridge.
Deed Book 859, pg. 67	Aug. 13, 1902	New York/New Jersey RR Co. vs. Morris & Essex RR Co.	Tunnel line agreement. NY/NJ RR Co now owns and can construct, operate and maintain tunnels and railroads within certain strips or parcels of land below ground. The right-of-way is 50 feet wide and 30 feet high. The tunnel will connect at 14th St., Jersey City, and proceed east to the NY/NJ state boundary (middle of Hudson R.)
Map 2051	undated		Shows subsurface rights for tunnels in Hoboken and Jersey City and describes agreements and easements at the Hoboken terminal (Map A.) Larger maps shows where tunnel crosses Ferry St. (Observer Hwy) and the Long Slip Canal. The tunnel is approximately located on Map E.
Deed Book 859, pg. 512	Dec. 19, 1905	Morris & Essex RR Co. vs. Hoboken & Manhatten RR Co.	This document decribes easements for the Hoboken & Manhatten RR Co. for tunnels. Maps are referred to but not provided. Written description: beginning at a point 15 feet below and under a point where the middle of 15th St. intersects Provost St. and continuing on a uniform deepening grade 1661 feet to a point 31 feet under a point 185 feet west of the bulkhead line, then with the same descending grade, curving to the left with a radius of 1,146.28 feet to a point 35 feet below present surface (?) The tunnel company agrees to keep the tunnels deep enough to not interfer with the existing slip and a proposed slip.

Document	Date	Parties involved	Information supplied
Deed Book 3139, pg. 593	April 19, 1972	Erie Lackawanna Railway Co. vs. City of Jersey City	Payment to Erie Lackawanna of $72,335 that conveys to Jersey City the right-of-way to construct, operate and maintain a 120 inch sewer line and a 36 inch RCP branch interceptor line. (see Map B1 and B2.) The area in question is at the intersection of 18th St. and Cole St. and near Hoboken Ave. and then proceeding east to the Long Slip Canal. The maps are difficult to read. Sec. 7 saves harmless Erie Lackawanna from any claims of pollution in the Long Slip as a result of the sewer project. Sec. 8 is an agreement by Jersey City to remove solids/debris from the Long Slip. Sec. 9 Jersey City agrees to move the sewer lines in the event of Erie Lackawanna filling in all or a portion of the Long Slip at Jersey City's expense. The extension will be the end of the filled area or to the bulkhead line, whichever is shortest. Sec. 11 no connection can be made to the 120 inch sewer line and the size will not be increased.
Deed Book 3435, pg. 455	Nov. 14, 1984	Consolidated Rail Corp. vs. The State of New Jersey	Regional Rail Reorganization Act of 1973. Discusses "easement items" in Exhibit A (not provided) such as lines, poles, pipes, appliances, equipment, structures, facilities and appurtences conveyed to New Jersey. Mineral rights do not convey. Page 2 was missing from this document.
Deed Book 296, pg. 646 Deed Book 456, pg. 615 Deed Book 405, pg. 341 Deed Book 488, pg. 70	Feb., 1876 Apr. 14, 1888 June 3, 1885 Aug. 14, 1889		Terms and conditions of Riparian Grants. All documents are hand written and illegible. There are maps showing the original line of high water (maps C1 and C2), which appear to coorespond with 18th to 12th streets to the west of Block 19 on the Jersey City tax map (Map C2) and is well in from the exterior line for solid filling and the exterior line for piers.
Liber G, pg. 168	Apr. 14, 1888	State of New Jersey vs. Morris & Essex RR Co.	Property in question was granted a riparian grant to Morris & Essex for $76,900. Shown outlined on Map D in orange.

Document	Date	Parties involved	Information supplied
Deed Book 3446, pg. 246	Dec. 29, 1983	Consolidated Rail Corp. vs. Public Service Electric & Gas Co.	PSE & G pays lump sum of $1,528,627.60 for easement access to lands over, across, along and under Consolidated's property. Maps or a description of the location of facilities were not provided.
Deed Book 3446, pg. 320	Jan. 1, 1959	Consolidated Rail Corp. vs. Public Service Electric & Gas Co.	License Agreement. PSE&G desires the license and privilege of installing and maintaining under conduit crossing for high power electric lines under and across the lands/tracks. Specs. not provided.
Deed Book 3446, pg. 322	Jan. 1, 1959	Consolidated Rail Corp. vs. Public Service Electric & Gas Co.	Same as above but it must be different specs, which were not provided.
Deed Book 3446, pg. 330	June 15, 1969	Consolidated Rail Corp. vs. Public Service Electric & Gas Co.	License Agreement. PSE&G desires the license and privilege of installing and maintaining under conduit along the lands for high power electric lines. Specs. not provided.
Deed Book 3446, pg. 355	Aug., 1941 (?)	Consolidated Rail Corp. vs. Public Service Electric & Gas Co.	Agreement. Power line construction, guys attached to the northerly girder of the RR Co's northery bridge over Henderson St., north of 18th St. No map.
Deed Book 3446, pg. 356	Dec. 14, 1949	Consolidated Rail Corp. vs. Public Service Electric & Gas Co.	Agreement. Licensee desires to construct, maintain, and operate one pole and one anchor guy upon and over the property of the RR Co. adjoining Observer Hwy, opposite Park Ave.
Deed Book 3446, pg. 359	Mar. 19, 1958	Consolidated Rail Corp. vs. Public Service Electric & Gas Co.	Agreement. No attached drawing.
Deed Book 3446, pg. 361	illegible	Consolidated Rail Corp. vs. Public Service Electric & Gas Co.	All illegible.
Deed Book 3446, pg. 370	Feb. 5, 1946	Consolidated Rail Corp. vs. Public Service Electric & Gas Co.	License Agreement. Licensee desires the license and privilege of using and maintaining a gas main on the lands and under the tracks and right-of-way of the RR Co. in Jersey City. Specs. not provided.

Document	Date	Parties involved	Information supplied
Deed Book 3457, pg. 356	June 4, 1985	Consolidated Rail Corp. vs. New Jersey Bell Telephone Co.	NJ Bell pays lump sum of $44,766.52 for easement access to lands over, across, along and under Consolidated's property. Maps or a description of the location of facilities were not provided.
Deed Book 3457, pg. 369	May 4, 1979	Consolidated Rail Corp. vs. New Jersey Bell Telephone Co.	Agreement. ...the Licensee desires to construct, maintain, repair, alter, renew, relocate, and ultimately remove one (1) 100 pair telephone cable over and across the land, roadway and tracks of the RR Co. opposite Valuation Station 401+19± located 1675 feet east of mile post 8, at a point 0.15 of a mile east of the Station of Babbitt, Hudson County, NJ.
Deed Book 3457, pg 375	Dec 15, 1965	Consolidated Rail Corp. vs. New Jersey Bell Telephone Co.	License Agreement. Specs. not provided.
Newport Redevelopment Plan	Sept 22, 1988	Newport/Harbourside Developers Amended by Jersey City Planning Board and City Council	This is a document obtained from Jersey City Planning department showing plans for development of the northeast portion of Jersey City by Newport. Wording in the document is that they intend to acquire properties from the intersection of 6th St. and Luis Munoz Marin Blvd, then going east along the centerline of 6th St. to a point at the intersetion with the U.S. Pierhead Line, then north to the intersection with the Jersey City/Hoboken city line, then west along that line to the intersection point with Luis Munoz Marin Blvd., and then south to the beginning point at 6th St. This description includes all of the Long Slip Canal and it's surrounding property. There is a description of a waterfront walkway intended connect Long Slip Canal to 6th St.

Other Reviewed Materials for the Long Slip Canal

Information	Date	Notes
Tax Map Jersey City	Aug 20, 1996	Block 19, Lots 5, 6, and 9 are owned by NJ Transit. Property Directly adjacent Long Slip Canal to the south is all NJ Transit's property, according to the tax assessor's office. See Map D.
Tax Map Hoboken	Aug 20, 1996	Block 139, Lots 1.1, 1.2, 1.3, 2, 3 and 4 are owned by NJ Transit. These properties are adjacent Long Slip Canal to the north. See Map D.
Permits	Aug 22, 1996	Called NJDEP to check on Waterfront Development Permit and Coastal Area Facility Review Act (CAFRA) permit for Block 19, Lot 11 This is the property that is adjacent NJ Transit property to the south in Jersey City. There were no permits for that Block and Lot, nor were there any listed under the name "Newport" for the Newport Mall Phone number 609-292-0060.
Well search results	Sept 3 and 13 1996	There were 203 well records within a 1/2 mile radius of the Long Slip Canal obtained from the NJDEP. Of interest for proximity to the Long Slip or for depth of sediment information were 63 wells for which well permit records were obtained. Most are shown on Map E. Geologic information contained in borings is consistent with the geologic bedrock map of New Jersey. Of note: borings for the Newport Mall and owners, Melvin Simon or SNP of Indianpolis IN, were all well south of Block 19, Lot 11.

Explanation for Map D

Block & Lot	Map color	Owner Identified at Tax Assessor's Office(s)*	City
Block 139, Lots 1.1, 1.2, 1.3 2, 3, 4	Green	NJ Transit	Hoboken
Block 139, Lot 5	Red	Harborside Development Co.	Hoboken
Block 19, 5A, 6A, 9A	Green	State of New Jersey DOT	Jersey City
Block 19, Lot 12A	Blue	Consolidated Railroad Corp.	Jersey City
Block 19, 11A (old)	Red	Newport Centre	Jersey City

* Data obtained August 20, 1996.

Area labeled "2nd Class" in Jersey City is part of NJ Transit.

Orange line identifies boundary of riparian grant of April 4, 1888, to Morris & Essex RR Co.

APPENDIX 2

AIR QUALITY

CONTENTS:

IMPACT CALCULATIONS

Table 1
Long Slip Canal Habitat Creation Project
Air Impact Assessment - Onsite Construction Activities

Basis of Air Emission Estimation

Estimated Construction Schedule

	1. Site Prep & Build "Bridges" over PATH	2. Dredge Canal for Hoboken Sewer Stuctures	3. Build Hoboken Sewer Structures in Canal	4. Construct coffer-dam & screening chamber	5. Dredge circula-tion basin and fill canal with scows	6. Construct sheet pile curtain wall to close off canal	7. Fill Canal with off site fill materials	8. Surface grading, Build walkway, Stabilize site
Estimated Weeks of Construction Activity Phase	12	2	20	8	8	8	14	10

Project phases will overlap and total project is estimated to take place over a total 19 month period.

Estimated Number of Operating Weeks For Each Type of Construction Equipment Per Phase

									Hp/Equip.	Utilized Hrs/Day
Heavy Duty Crane	10		26				28		194	8
Drilling Rig	3		10						400	8
Small Tug to move Barges					8			8	2000	8
Barge mounted pile driver or dredge	2	2	0	3	4	8			250	8
Pumps for de-watering	4			2					150	24
Pumps for sludge transfer					2				350	8
Fork Lift	12	1	20	8	8	8	1	10	83	8
Wheeled Loader	1							2	150	8
Compactor								2	150	8
Tampers							4	2	5	8
Backhoe Loader	1							2	79	8
Crawler Dozer	1		0					2	100	8
Concrete Pavers								2	130	8

Note Bolded values are calculated in Detail Table 1B, non-bolded values are engineering estimates.

Table 1

Long Slip Canal Habitat Creation Project
Air Impact Assessment - Onsite Construction Activities

Horsepower-hour Calculations

Estimated Construction Schedule

	1. Site Prep & Build "Bridges" over PATH	2. Dredge Canal for Hoboken Sewer Stuctures	3. Build Hoboken Sewer Structures in Canal	4. Construct coffer-dam & screening chamber	5. Dredge circula-tion basin and fill canal with scows	6. Construct sheet pile curtain wall to close off canal	7. Fill Canal with off site fill materials	8. Surface grading, Build walkway, Stabilize site
Estimated Months of Construction Phase	12	2	20	8	8	8	14	10

Assumed 22/days per month

Estimated Number of Horsepower-Hours per Type of Construction Equipment Per Phase

	1	2	3	4	5	6	7	8	Hp/Equip	Equivalent hrs/day at full load	Load Factor
Heavy Duty Crane	38800	0	100880	0	0	0	108640	0	194	4	0 5
Drilling Rig	24000	0	80000	0	0	0	0	0	400	4	0 5
Small Tug to move Barges	0	0	0	0	192000	0	0	192000	2000	2 4	0 3
Pile Driver	10000	10000	0	15000	20000	40000	0	0	250	4	0 5
Pumps for de-watering	72000	0	0	36000	0	0	0	0	150	24	1
Pumps for sludge transfer	0	0	0	0	28000	0	0	0	350	8	1
Fork Lift	19920	1660	33200	13280	13280	13280	1660	16600	83	4	0.5
Wheeled Loader	3000	0	0	0	0	0	0	6000	150	4	0.5
Compactor	0	0	0	0	0	0	0	6000	150	4	0 5
Tampers	0	0	0	0	0	0	800	400	5	8	1
Backhoe Loader	1580	0	0	0	0	0	0	3160	79	4	0 5
Crawler Dozer	2000	0	0	0	0	0	0	4000	100	4	0 5
Concrete Pavers	0	0	0	0	0	0	0	7800	130	6	0.75
Total Horsepower-Hrs Per Phase	171,300	11,660	214,080	64,280	253,280	53,280	111,100	235,960			

Table 1

Long Slip Canal Habitat Creation Project
Air Impact Assessment - Onsite Construction Activities

Air Emission Estimation

	1 Site Prep & Build "Bridges" over PATH	2. Dredge Canal for Hoboken Sewer Stuctures	3. Build Hoboken Sewer Structures in Canal	4. Construct coffer-dam & screening chamber	5. Dredge circula-tion basin and fill canal with scows	6. Construct sheet pile curtain wall to close off canal	7. Fill Canal with off site fill materials	8. Surface grading, Build walkway, Stabilize site
Total Horsepower-Hrs Per Phase	171,300	11,660	214,080	64,280	253,280	53,280	111,100	235,960
Weeks Duration per Phase	12	2	20	8	8	8	14	10
Horspower-Hrs per Day (5 day/wk)	2,855	1,166	2,141	1,607	**6,332**	1,332	1,587	4,719

Emission Rate Estimates in Pounds of Pollutants per Phase

Pollutant	1	2	3	4	5	6	7	8	Emission Factors (lb/hp-hr)
Nitrogen Oxides - NO_x	5,310	361	6,636	1,993	7,852	1,652	3,444	7,315	3.10E-02
Carbon Monoxide - CO	1,144	78	1,430	429	1,692	356	742	1,576	6.68E-03
Sulfur Oxides - SO_x	351	24	439	132	519	109	228	484	2.05E-03
Particulate Matter - PM_{10}	377	26	471	141	557	117	244	519	2.20E-03
Volatile Organic Compounds - VOC	423	29	529	159	626	132	274	583	2.47E-03

Total Project Emission Estimate for On-Site Construction Equipment

Pollutant	lbs	tons
Nitrogen Oxides - NO_x	**34,563**	**17.3**
Carbon Monoxide - CO	**7,448**	**3.7**
Sulfur Oxides - SO_x	**2,286**	**1.1**
Particulate Matter - PM_{10}	**2,453**	**1.2**
Volatile Organic Compounds - VOC	**2,754**	**1.4**

Maximum Daily Emissions Estimate

Pollutant	lb/day
Nitrogen Oxides - NO_x	**196**
Carbon Monoxide - CO	**42**
Sulfur Oxides - SO_x	**13**
Particulate Matter - PM_{10}	**14**
Volatile Organic Compounds - VOC	**16**

Table 1B

Long Slip Canal Habitat Creation Project

Air Impact Assessment - Construction Task/Phase Schedule & Equipment Details

							Estimated Equipment Operating Weeks					
No.	Construction Activity Description	Projected Schedule	Task Specific Heavy Equipment	Task Duration	Net Duration (1)	Project Phase	Crane	Dozer	Dredge	Pile Driver	Tug	Drilling Rig
1	Commence mobilization upon noticing the Hudson Essex Passaic Soil Conservation of the intent to commence construction	Week 1-2	None	2	2	1						
2	Construct security fencing and signage about the periphery of the work area and maintain appropriate security practices for the socio/geophysical environment	Week 2-3	None	1	3	1						
3	Construct sediment filter fences and hay bale berms at all locations within the work area where sediments may be transported offsite	Week 2-3	None	1	3	1						
4	Construct flotation boomed sedimentation curtains at the entry and midpoints of the canal	Week 3-4	Barge mounted crane, dozer	1	4	1	1	1				
5	Dredge canal area over PATH tunnels and deposit materials in canal on its southerly side near the sedimentation curtain at the canal's entrance.	Week5-6	Barge mounted hydraulic dredge	2	6	1			2			
6	Construct caissons for PATH tunnel relieving platform.	Weeks 6-9	Barge mounted crane and drilling rig	3	9	1	3					3
7	Fly in grade beams and anchor to PATH tunnel relieving platform caissons	Weeks 9-10	Two barge mounted cranes	1	10	1	2					
8	Fly in box beams and anchor to PATH tunnel relieving platform grade beams.	Weeks 10-12	Two barge mounted cranes	2	12	1	4					
	Project Phase 1 Weeks of Activity Subtotal				**12**		**10**	**1**	**2**	**0**	**0**	**3**

Table 1B
Long Slip Canal Habitat Creation Project
Air Impact Assessment - Construction Task/Phase Schedule & Equipment Details

							Estimated Equipment Operating Weeks					
No.	Construction Activity Description	Projected Schedule	Task Specific Heavy Equipment	Task Duration	Net Duration (1)	Project Phase	Crane	Dozer	Dredge	Pile Driver	Tug	Drilling Rig
9	Dredge canal in area of proposed Hoboken Sedimentation/Screening Chamber and deposit materials in canal on its southerly side near the sedimentation curtain at the canal's entrance	Weeks 12-14	Barge mounted hydraulic dredge	2	14	2			2			
	Project Phase 2 Weeks of Activity Subtotal				**2**		**0**	**0**	**2**	**0**	**0**	**0**
10	Construct caissons for the Hoboken Sedimentation/Screening Chamber	Week 15-16	Barge mounted crane and drilling rig	1	16	3	1					1
11	Install heads onto the caissons for the Hoboken Sedimentation and Screening chamber	Week 16-17	Barge mounted crane and drilling rig	1	17	3	1					1
12	Construct caissons for the Hoboken CSO	Week 20-28	Barge mounted crane and drilling rig	8	28	3	8					8
13	Install heads onto the caissons for the Hoboken CSO.	Week 28-32	Two barge mounted cranes	4	32	3	8					
14	Fly in the Hoboken CSO and install onto the caisson heads.	Week 30-34	Two Barge mounted cranes	4	34	3	8					
	Project Phase 3 Weeks of Activity Subtotal				**20**		**26**	**0**	**0**	**0**	**0**	**10**
15	Construct cofferdam and install the Hoboken Junction chamber.	Week 32-34	Barge mounted pile driver	2	34	4				2		
16	Construct the Jersey City Sedimentation/Screening chamber.	Week 34-42	Pile driver (1 week)	8	42	4				1		
	Project Phase 4 Weeks of Activity Subtotal				**8**		**0**	**0**	**0**	**3**	**0**	**0**

Table 1B

Long Slip Canal Habitat Creation Project

Air Impact Assessment - Construction Task/Phase Schedule & Equipment Details

No.	Construction Activity Description	Projected Schedule	Task Specific Heavy Equipment	Task Duration	Net Duration (1)	Project Phase	Estimated Equipment Operating Weeks					
							Crane	Dozer	Dredge	Pile Driver	Tug	Drilling Rig
17	Dredge circulation basin.	Week 38-42	Barge mounted hydraulic dredge	4	42	5			4			
18	Fill canal via scows with the appropriate mix of angular and fine materials to within draft depth	Week 42-50	Two 150 yard scows	8	50	5					8	
	Project Phase 5 Weeks of Activity Subtotal				**8**		**0**	**0**	**4**	**0**	**8**	**0**
19	Construct sheet pile curtain wall at the canal entrance	Week 50-58	Barge mounted pile driver	8	58	6				8		
	Project Phase 6 Weeks of Activity Subtotal				**8**		**0**	**0**	**0**	**8**	**0**	**0**
20	Fill canal to within 2 feet of final grade via 10 yard tandems bringing suitable fill materials to the site.	Week 58-72	Ten 10 yard tandems and two 3 yard clamshells	14	72	7	28					
	Project Phase 7 Weeks of Activity Subtotal				**14**		**28**	**0**	**0**	**0**	**0**	**0**
21	Construct waterfront walkway.	Week 72-80	Barge (for cable concrete installation)	8	80	8					8	
22	Permanently stabilize site.	Week 80-82	None	2	82	8						
	Project Phase 8 Weeks of Activity Subtotal				**10**		**0**	**0**	**0**	**0**	**8**	**0**

Note 1: Net Duration includes estimated overlaps and periods of non-activitiy.

Table 2
Long Slip Canal Habitat Creation Project
Air Impact Assessment - Material Transport

Basis of Air Emission Estimation

Source:	Trucks to Transport Fill material	
Vehicle Class:	Heavy Duty Truck	
Operating Hours:	9 am to 3 pm	6 hrs/day
Frequency	4 trucks per hour	
One way Distance	10 miles	
Trips per Day	24	
Vehicle Miles Traveled per Day	480 VMT/day	

<u>Total Project Transport Requirements</u>

Total Activity Duration	14 weeks
Total Two Way Trips	1680
Total Vehicle Miles Traveled	33600

Emission Rate Estimates in Pounds of Pollutants per Day

	Emission factors		Emissions
	gr/mile	lb/mile	lb/day
NO_x	20.20	0.044	21.4
CO	14 89	0 033	15 7
SO_x		0 006	2 7
PM_{10}		0 003	1 4
VOC	3 19	0 007	3 4

<u>Project Truck Transport Emissions</u>

	tons
NO_x	0.75
CO	0 55
SO_x	0 09
PM_{10}	0 05
VOC	0 12

Table 2b
Long Slip Canal Habitat Creation Project
Air Impact Assessment - Material Transport

Emission Factor Estimation

Estimation of Emission Factor Using Mobile5b Data Tables - Fleet Mix Weighted Avera

	Table 7 4	Table 7 11A.1		Table 7.11B.1		Table 7 11C 1	
Model Year	Fraction of Fleet	NMHC gr/mile	Weighted Average	CO gr/mile	Weighted Average	NOx gr/mile	Weighted Average
1975	0.034	6 6	0 2244	19	0.646	34.3	1 1662
1976	0.067	6 5	0 4355	18 9	1 2663	34 1	2 2847
1977	0.067	6 5	0 4355	18 9	1.2663	34 4	2.3048
1978	0.067	6 4	0 4288	18 6	1.2462	33 8	2.2646
1979	0.067	3 4	0 2278	19 4	1.2998	24	1.608
1980	0.073	3 1	0 2263	17 4	1.2702	21.6	1 5768
1981	0.061	3 1	0 1891	17 3	1.0553	21.6	1.3176
1982	0.04	2 7	0 108	15 2	0.608	19	0.76
1983	0.41	2 6	1 066	14 2	5.822	18.2	7.462
1984	0.051	2 7	0 1377	15	0.765	19 2	0.9792
1985	0.053	2 5	0 1325	13 6	0.7208	17 7	0.9381
1986	0.066	2 2	0.1452	13 5	0.891	17.7	1.1682
1987	0.055	2 1	0 1155	13.1	0.7205	17.3	0.9515
1988	0.057	2 1	0.1197	12 4	0.7068	16.9	0.9633
1989	0.045	2 1	0 0945	12 2	0.549	16.9	0.7605
1990	0.019	2 1	0 0399	11 8	0.2242	9 9	0.1881
1991	0.023	2 0	0 046	11 5	0.2645	8.2	0.1886
1992	0.028	2 0	0 056	11 3	0.3164	8 2	0.2296
1993	0.024	2 0	0 048	11 1	0.2664	8 2	0.1968
1994	0.016	2 0	0 032	10 9	0.1744	8 2	0 1312
1995	0.011	2 0	0 022	10 7	0.1177	8 2	0.0902
1996	0.009	2 0	0 018	10 4	0 0936	8 2	0 0738
1997	0.007	2 0	0 014	10 2	0.0714	8 2	0 0574
1998	0.005	2 0	0.01	9 9	0.0495	6 5	0.0325
1999	0.016						
Total Mix	1.371		4 3724		20.4113		27 6937
Fleet Mix Weighted Average Emission Factor (gr/mile)			**3.19** **NMHC**		**14.89** **CO**		**20.20** **NOx**

Source of above data is pending 5th edition of Volume II Mobile Sources of Compilation of Air Pollutant Emission Factors, (commonly referred to as "AP-42") Appendix H: Highway Mobile Source Emission Factor Tables - Heavy-Duty Diesel Trucks

PM10 and SOx emission Factors are estimated from the fuel consumption and general emission factors for IC engines as follows:
Assume 0.18 gallons per mile fuel usage (source SCAQMD CEQA Manual, Table A9-5-O, 1
And use general combustion emission factors from Table A9-3-B from the same reference s
SOx emission factor: 31 2 lb/1000 gallons PM emission Factor: 16 75 lb/10

Table 3
Long Slip Canal Habitat Creation Project
Air Impact Assessment - Onsite Construction Activities

Fugitive Dust Emission Estimation

Estimated Disturbed Acreage	2 average per month over project duration.
Fugitive Dust Emission Factor	1.2 tons TSP per month per acre disturbed Note: assumes 30 day per month and is generally considered a conservatively high estimate. AP-42 Section 13 2.3, 1/1995 Miscellaneous Sources, Heavy Construction Operations

It was assumed that PM10 would be 50% of this value, and that dust will be controlled 50% by maitaining moisture content in handeled materials as necessary and watering unpaved surfaces during construction.

Monthly Emission Rate Estimate	0 6 tons per month
Daily Emission Rate Estimate	40 pounds per day, non-mitigated
Total Length of Project	19 months
Total Project Fugitive PM10 Emissions	11 tons

Table 4
Long Slip Canal Habitat Creation Project
Air Impact Assessment - Summary of Construction Impacts

PROJECT TOTAL EMISSION ESTIMATES

	NO_X	CO	SO_X	PM_{10}	VOC
Onsite Construction	17.30	3.72	1.14	1.23	1.38
Material Transport	0.75	0.55	0.09	0.05	0.12
Fugitive Dust Emissions	-	-	-	11.36	-
Project Total	18.05	4.27	1.24	12.64	1.49

ANNUAL EMISSION RATE ESTIMATES

Project Duration 19 months 1.58 years

	NO_X	CO	SO_X	PM_{10}	VOC
Onsite Construction	10.96	2.36	0.72	0.78	0.87
Material Transport	0.47	0.35	0.06	0.03	0.07
Fugitive Dust Emissions	-	-	-	7.20	-
Project Total - Tons/Year	11.44	2.71	0.78	8.01	0.95

APPENDIX 3

NOISE ASSESSMENT

CONTENTS:

IMPACT CALCULATIONS

Noise Impact Assessment of the Long Slip Canal Habitat Creation Project

Federal Transit Adminstration
General Transit Noise Assessment
Case: **With Proposed Project Sources**

RESULTS			
Noise Source	Ldn (dB)	Leq - daytime (dB)	Leq - nighttime (dB)
All Sources	72	73	62
Source 1	72	72	62
Source 2	58	56	50
Source 3	62	64	16

Enter noise receiver land use category below.

LAND USE CATEGORY	
Noise receiver land use category (1, 2 or 3)	2

Enter data for each noise source below - see reference list for source numbers.

NOISE SOURCE PARAMETERS						
Parameter	Source 1		Source 2		Source 3	
Source Num.	Rail Yard or Shop	12	Automobiles	9	Commuter Buses	11
Dist. to receiver	distance (ft)	100	distance (ft)	25	distance (ft)	400
Daytime Hours (7 AM - 10 PM)	trains/hour	10	speed (mph) vehicles/hour	25 100	speed (mph) vehicles/hour	60 240
Nighttime Hours (10 PM - 7 AM)	trains/hour	1	speed (mph) vehicles/hour	30 25	speed (mph) vehicles/hour	
Jointed Track?						
Embedded Track?						
Aerial Structure?						
Barrier Present?	Y/N	N	Y/N	N	Y/N	N
Intervening Rows of Buildings	number	0	number	0	number	0

SOURCE REFERENCE LIST	
Source	Number
Electric Loco.	1
Diesel Loco	2
Comm. Rail Cars	3
RRT/LRT	4
AGT, Steel Wheel	5
AGT, Rubber Tire	6
Monorail	7
Maglev	8
Automobiles	9
City Buses	10
Commuter Buses	11
Rail Yard or Shop	12
Layover Tracks	13
Bus Storage Yard	14
Bus Op. Facility	15
Bus Transit Center	16
Parking Garage	17
Park & Ride Lot	18

Federal Transit Adminstration
General Transit Noise Assessment
Case: With Proposed Project Sources

CALCULATIONS			
Term	Sou 1	Sou 2	Sou 3
SELref	118.0	73.0	85.0
C1 - Coef	10.0	23.1	14.5
C1 - Denom	20.0	50.0	50.0
C1 - Day Num	10.0	30.0	60.0
C1 - Night Num	1.0	30.0	30.0
C1 - Day	-3.0	-6.2	1.2
C1 - Night	-13.0	-6.2	-3.2
C2 - Coef	0.0	10.0	10.0
C2 - Denom	0.0	1.0	1.0
C2 - Day Num	0.0	100.0	240.0
C2 - Night Num	0.0	25.0	0.0
C2 - Day	0.0	20.0	23.8
C2 - Night	0.0	14.0	-20.0
C3 - Coef	0.0	0.0	0.0
C3 - Denom	0.0	0.0	0.0
C3 - Day Num	0.0	0.0	0.0
C3 - Night Num	0.0	0.0	0.0
C3 - Day	0.0	0.0	0.0
C3 - Night	0.0	0.0	0.0
Leq50ft - Day	79.4	51.2	77.4
Leq50ft - Night	69.4	45.1	29.2
Ldn50ft	79.4	53.1	75.3
Dist Coef	25.0	15.0	15.0
Adj. Dist	-7.5	4.5	-13.5
Adj. Jointed	0.0	0.0	0.0
Adj. Embed	0.0	[illegible]	[illegible]
Adj. Aerial	0.0	0.0	[illegible]
Adj. Shield	0.0	[illegible]	[illegible]
Leq - Day	71.9	[illegible]	[illegible]
Leq - Night	61.9	[illegible]	15.5
Ldn	71.9	57.6	[illegible]
Need Land Use			[illegible]
Calc Leq			[illegible]

Noise Impact Assessment of the Long Slip Canal Habitat Creation Project

Federal Transit Adminstration
General Transit Noise Assessment
Case: Existing Conditions

Sponsored by FTA contract #DTUM60-92-C-41008

RESULTS			
Noise Source	Ldn (dB)	Leq - daytime (dB)	Leq - nighttime (dB)
All Sources	72	72	62
Source 1	72	72	62
Source 2	54	56	16
Source 3	0	0	0

Enter noise receiver land use category below.

LAND USE CATEGORY	
Noise receiver land use category (1, 2 or 3)	2

Enter data for each noise source below - see reference list for source numbers.

NOISE SOURCE PARAMETERS					
Parameter	Source 1		Source 2		Source 3
Source Num.	Rail Yard or Shop	12	Automobiles	9	
Dist. to receiver	distance (ft)	100	distance (ft)	25	
Daytime Hours (7 AM - 10 PM)	trains/hour	10	speed (mph) vehicles/hour	25 100	
Nighttime Hours (10 PM - 7 AM)	trains/hour	1	speed (mph) vehicles/hour		
Jointed Track?					
Embedded Track?					
Aerial Structure?					
Barrier Present?	Y/N		Y/N		
Intervening Rows of Buildings	number		number		

SOURCE REFERENCE LIST	
Source	Number
Electric Loco	1
Diesel Loco	2
Comm. Rail Cars	3
RRT/LRT	4
AGT, Steel Wheel	5
AGT, Rubber Tire	6
Monorail	7
Maglev	8
Automobiles	9
City Buses	10
Commuter Buses	11
Rail Yard or Shop	12
Layover Tracks	13
Bus Storage Yard	14
Bus Op. Facility	15
Bus Transit Center	16
Parking Garage	17
Park & Ride Lot	18

Federal Transit Adminstration
General Transit Noise Assessment
Case: Existing Conditions

CALCULATIONS			
Term	Sou 1	Sou 2	Sou 3
SELref	118.0	73.0	0.0
C1 - Coef	10.0	28.1	0.0
C1 - Denom	20.0	50.0	0.0
C1 - Day Num	10.0	30.0	0.0
C1 - Night Num	1.0	20.0	0.0
C1 - Day	-3.0	-6.2	0.0
C1 - Night	-13.0	-6.2	0.0
C2 - Coef	0.0	10.0	0.0
C2 - Denom	0.0	1.0	0.0
C2 - Day Num	0.0	100.0	0.0
C2 - Night Num	0.0	0.0	0.0
C2 - Day	0.0	20.0	0.0
C2 - Night	0.0	-20.0	0.0
C3 - Coef	0.0	0.0	0.0
C3 - Denom	0.0	0.0	0.0
C3 - Day Num	0.0	0.0	0.0
C3 - Night Num	0.0	0.0	0.0
C3 - Day	0.0	0.0	0.0
C3 - Night	0.0	0.0	0.0
Leq50ft - Day	79.4	51.2	
Leq50ft - Night	69.4	11.2	
Ldn50ft	79.4	49.1	#VALUE
Dist Coef	25.0	15.0	0.0
Adj. Dist	-7.5	4.5	
Adj. Jointed	0.0	0.0	0.0
Adj. Embed	0.0	0.0	[illegible]
Adj. Aerial	0.0	0.0	[illegible]
Adj. Shield	0.0	0.0	
Leq - Day	[illegible]	[illegible]	[illegible]
Leq - Night	61.9	[illegible]	[illegible]
Ldn	71.9	53.6	[illegible]
Need Land Use			[illegible]
Calc Leq			[illegible]

Noise Impact Assessment of the Long Slip Canal Habitat Creation Project

REFERENCE DATA

Num	Desc	Ref SEL	Dist Term	Term 1 Desc	Denom	Min	Coef	Term 2 Desc	Denom	Min	Coef	Term 3 Desc	Denom	Min	Coef	Jointed	Embedded	Aerial	Barrier	Combine 1&2?
0		0	0		0	0	0													
1	Electric Loco	90	15	speed (mph)	60	20	10.0	trains/hour	1	0.01	10.0	locos/train	1	1	10	5.0	3.0	4.0	-5.0	0.0
2	Diesel Loco	92	15	speed (mph)	50	20	10.0	trains/hour	1	0.01	10.0	locos/train	1	1	10	5.0	3.0	4.0	-5.0	0.0
3	Comm. Rail Cars	82	15	speed (mph)	50	20	20.0	trains/hour	1	0.01	10.0	cars/train	1	1	10	5.0	3.0	4.0	-5.0	0.0
4	RRT/LRT	82	15	speed (mph)	50	20	20.0	trains/hour	1	0.01	10.0	cars/train	1	1	10	5.0	3.0	4.0	-5.0	0.0
5	AGT Steel Whe	80	15	speed (mph)	50	20	20.0	trains/hour	1	0.01	10.0	cars/train	1	1	10				5.0	0.0
6	AGT Rubber Ti	78	15	speed (mph)	50	20	20.0	trains/hour	1	0.01	10.0	cars/train	1	1	10				-5.0	0.0
7	Monorail	82	15	speed (mph)	50	20	20.0	trains/hour	1	0.01	10.0	cars/train	1	1	10				-5.0	0.0
8	Maglev	72	15	speed (mph)	50	20	20.0	trains/hour	1	0.01	10.0	cars/train	1	1	10			4.0	-5.0	0.0
9	Automobiles	73	15	speed (mph)	50	30	26.1	vehicles/ho	1	0.01	10.0								-5.0	0.0
10	City Buses	84	15	speed (mph)	50	30	23.0	vehicles/ho	1	0.01	10.0								5.0	0.0
11	Commuter Buses	84	15	speed (mph)	50	30	14.0	vehicles/ho	1	0.01	10.0								-5.0	0.0
12	Rail Yard or Sho	118	25	trains/hour	20	0.01	10.0												-5.0	0.0
13	Layover Tracks	118	25	trains/hour	1	0.01	10.0												5.0	0.0
14	Bus Storage Yar	111	25	buses/hour	100	0.01	10.0												5.0	0.0
15	Bus Op. Facility	114	25	buses/hour	200	0.01	10.0	buses serv	80	0.01	10.0								-5.0	1.0
16	Bus Transit Cent	101	25	buses/hour	20	0.01	10.0												-5.0	0.0
17	Parking Garage	92	25	autos/hour	1000	0.01	10.0												5.0	0.0
18	Park & Ride Lot	101	25	autos/hour	2000	0.01	10.0	buses/hour	24	0.01	10.0								5.0	1.0

LAND USE DATA

Category	Ldn/Leq
0	
1	Leq
2	Ldn
3	Leq

APPENDIX 4

WATER QUALITY

CONTENTS:

NJ TRANSIT

Long Slip Canal Habitat Creation Project

Hoboken Terminal, Hoboken, Jersey City, NJ

APPLICATION OF A THREE-DIMENSIONAL NUMERICAL MODEL TO EVALUATE WATER QUALITY IMPROVEMENTS IN THE LONG SLIP CANAL ENTRANCE BASIN

June 1997

DAMES & MOORE
A DAMES & MOORE GROUP COMPANY

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Executive Summary

The Long Slip Habitat Creation Project is a component of an overall effort to rehabilitate the Hoboken Rail Yard. The new habitat will promote more diverse fish species and improved water quality in the Long Slip Canal Entrance Basin adjacent to the Lower Hudson River Estuary. A three-dimensional circulation and water quality model is used to optimize the topographic configuration of the Entrance basin to improve tidal flushing, increase dissolved oxygen levels in the water column, and generally improve water quality by promoting stronger hydrodynamic exchange with the Hudson River Estuary. Phase I of the modeling work, which is described in this report, includes selection of the appropriate modeling scheme, model setup to simulate circulation and mixing in the Long Slip Canal Entrance basin and the adjacent Hudson River, and model runs to test the benefits of topographic modification by dredging to improve flushing of the basin. Phase II to be added to this report as an appendix will describe predicted improvements in dissolved oxygen levels based on test cases. Phase II of the modeling effort will predict wave and storm surge impacts to be used for designing structural loads for bulkheads and retaining walls in the Entrance Basin.

The Environmental Fluid Dynamics Code (EFDC) hydrodynamic/eutrofication model was selected from among several models for 3-D simulations in the Entrance basin. The EFDC model is well tested and documented for application in shallow marine waters and includes special enhancements for application to the stratified conditions of river and tide influenced estuaries like the lower Hudson River. EFDC was set up using a computational grid containing approximately 1000 cells in the horizontal dimension and 5 vertical layers. The Entrance basin area is resolved by 60 rectangular cells having an average dimension of 125 on a side. The EFDC model is driven by tidal inputs at the south end (the Battery) and at the North End (Castle). Salinity inputs are described as a tidally varying time series at the north and south end of the model and are consistent with a mean freshwater discharge of approximately 170 m^3/s (6000 ft^3/s). Meteorological forcing is supplied to the model from time series of wind velocity, rainfall, air temperature and evaporation rates. The EFDC model was setup to simulate circulation and mixing in the Lower Hudson River and Long Slip Canal Entrance basin for the month of May 1996.

Three test cases were examined using the 3-D model including the base condition of exiting topography (Case 1), a north south cut across the axis of the Entrance basin and through a field of piles, and an east-west cut between the Entrance basin and the Hudson River. Results of model runs show that the Hudson River is a partially stratified estuary having much lower salinity and stronger ebb-directed flows in the upper layers of the water column. Residual flows in the estuary are directed seaward at the surface and landward at the bottom to maintain the mass balance. Under present conditions the Entrance basin in characterized by weak tidal flushing and exchanges only with the upper layers of the stratified Hudson Estuary. Results of modeling under test Cases 2 (north-south cut) and Cases 3 (east-west cut) show that tidal flushing improves and salinity level increases within the Entrance basin. The greatest benefit is realized for Case 3 (east-west cut) the results of which show increased vertical mixing within the inner portion of the Entrance basin and higher salinity levels for the mid and outer portion of the basin. These benefits are due to larger connection with the Hudson River through the east-west cut, which provided for increased tidal flushing and stronger exchange with the lower layers of the estuary. The stronger exchange under Case 3 will improve dissolved oxygen levels by more efficiently flushing low oxygen waters from the Entrance basin. Improved flushing and exchange with the Hudson River along with diversion or reduction of combined sewer overflows, will improve the overall water quality in the Long Slip Habitat

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Hudson River Estuary. Tasks accomplished in Phase I of the numerical modeling effort, which are described in this report, include selection of the appropriate modeling scheme, model setup to simulate circulation and mixing of the Lower Hudson River and Long Slip Canal Entrance area, and a series of model runs according to test cases. The test cases include specific modifications of bottom topography in the Canal Entrance basin designed to improve flushing. Phase II of the modeling effort will address improvemnts in dissoved oxygen level, whereas Phase III of modeling work will assess and optimize the structural design loads asociated with waves and storm surges.

1.2 The Study Area

The Canal Entrance Basin is defined by the Long Slip Canal Bulkhead to the west and the Hudson River Channel to the east, the existin pier to the north and the pile field to the south. Dimensions of the Canal Entrance basin are approximately 300 feet wide and 1000 feet long. The pile field is a significant contributing feature of the habitat area and is therefore included in the modeled area for salinity, dissolved oxygen, and pollutant capacity. Improved water quality in the Canal Entrance basin, including the pile field, will encourage a diverse community to re-establish itself. The calculation of water quality improvments provided by the Habitat Creation Plan will allow projection of this projects benefits in terms of improved density and diversity of marine life in the Canal Entrance basin.

1.3 Report Organization

The remainder of this report is organized into two sections as summarized below. Section 2 reviews available information concerning hydrodynamic models. This section provides the justification for selecting a particular model for evaluation of existing conditions and proposed changes at Long Slip Canal. This section discusses the three-dimensional (3-D) models considered for this study and compares several aspects of their capabilities. In addition, Section 3 provides an overview of the hydrodynamic and water quality model selected to simulate conditions at Long Slip Canal and describes model characteristics and model features. More detailed information on the model is available in Appendix A

Section 4 reviews the model set-up for the Long Slip Canal area and the lower Hudson. Section 5 reviews the design of the model runs to optimize the Entrance area configuration. Section 6 reviews model results for the lower Hudson River Estuary and demonstrates that the model is providing reaslistic simulations. Section 7 reviews the model results specific to the Canal Entrance area. Results of simulations of dissolved oxygen levels and wave impacts will be included in Appendices B and C to be added to this report as they are completed.

2.0 Model Selection

The availability of relatively inexpensive computing resources has shifted three-dimensional numerical modeling from academic research to practical applications. This section surveys the most widely used and accepted 3-D estuarine hydrodynamic and consituent transport models. The lower Hudson River adjacent to the Long Slip Canal Entrance basin is considered to be a partially mixed estuary having strong vertical differences in salinity and flow patterns. Therefore only 3-D models capable of predicting the vertical distribution of currents, salinity, and water quality parameters were considered for this application. There are likely to be strong vertical gradients in constituents like dissolved oxygen, which influence productivity and water of the lower Hudson River.

All of the models reviewed in this report employ finite difference methods for solving the model equations on a spatial computational grid. This is in contrast to finite element schemes, that divide the computational domain into triangular cells of various sizes to accomodate the irregular shape of estuarine topography. Whereas finite element schemes may have some advantage over finite difference schemes in their ability to easily resolve the complex geometry of estuaries, finite difference schemes now routinely employ curvilinear orthogonal computational grids having variable cell sizes, which provides for a boundary-fitted coordinate system to accurately resolve estuarine geometry. The major advantage of finite difference schemes currently in use is their successful coupling to water quality and eutrofication models. The finite difference models considered for application to the lower Hudson River and Long Slip Canal Entrance have been widely used to drive water quality models of similar estuaries.

2.1 Available Models

There are several three-dimensional (3-D) models in current use that have been widely used for simulations of the estuariine environment and shallow area of the coastal ocean. These models are the Princeton Ocean Model (POM) described by Blumberg Mellor (1987), the Environmental Fluid Dynamics Code (Hamrick (1990a and 1990b), and the U.S. Army Corps of Engineers 3-D model known as CH3D (Johnson et al., 1989). In general, these models have similar capabilities and are related in their evolution and development. Some key properties of the aforementioned models are described in Table 1. This table lists various methods introduced to treat variations in the vertical axis, the horizontal dimensions, and the time dependency. All three models assume that the water is incompressible, and invoke the hydrostatic and Boussinesq approximations to three orders of magnitude smaller than the horizontal dimension. A simple order of magnitude argument can be used to reduce the z-momentum equation to the so called hydrostatic (Boussinesq) approximation. The Boussinesq approximation assumes that the density is a constant except in the baroclinic terms.

The governing equations are not a closed set until some approximations are introduced to relate turbulent correlation terms to the mean variables. There are two major turbulence closure models for estuaries, namely, eddy viscosity-diffusivity models and second-order closure schemes. Eddy viscosity models are useful when sufficient data are available to validate model parameters for a particular application. However, when sufficient data do not exist and the model parameters must be extrapolated, the resulting predictions are rather speculative. Turbulence closure models solve two transport equations for the turbulent kinetic energy and turbulent macrolength scale. These transport equations provide realistic parameterization of the vertical mixing, eliminating the need for model coefficient adjustment.

Table 1 - Features of three-dimensional models.

Feature	Model Options	EFDC (1990)	POM (1987)	US Army (CH3D1990)
Advection	Nonlinear	•	•	•
Bottom Friction	Turbulent boundary layer	•	•	•
Density	Baroclinic coupled	•	•	•
Turbulence Model		Two-equation model (level 2½)	Two-equation model (level 2½)	Algebraic
s Transformation		•	•	z-plane
x and y transformation		Cartesian and Curvilinear orthogonal	Curvilinear orthogonal	Boundary fitted
Treatment of z-variable	Numerical finite difference	•	•	•
Treatment of x and y variables	Finite difference	•	•	•
Treatment of time variable	Internal-External mode splitting	•	•	•

• Option included in model

All three models employ second-order closure schemes. The specification of the turbulent correlations, or the use of different turbulence closure models, constitute one important difference among the four models. The CH3D model assumes local equilibrium of turbulence (i.e. no time evolution or spatial diffusion of the second-order correlations), reducing the second-order quantities to a set of algebraic equations. This method is strictly valid when the turbulence time scale is much less than the mean flow time scale and when turbulence does not change rapidly over the macroscale length On the other hand, both the

Princeton Ocean Model and the EFDC Model hydrodynamic model employ Mellor and Yamada's (1982) level 2-1/2 closure scheme. All numerical constants in the level 2-1/2 closure scheme are analytically predetermined, and require no further adjustment.

In addition to the specification of the turbulent correlations appearing in the governing equations, the appropriate initial and boundary conditions must be given. Typically, at the air-water interfaces, no fluxes of mass or conservative solutes are permitted. Further, the loss of momentum at the water-sediment interface is given in a form of bottom stress (turbulent boundary layer).

In most estuaries, because the ratio of vertical length scale to horizontal length scale is very small, the horizontal mixing terms are orders of magnitude smaller than the vertical mixing terms. Therefore, the use of a sophisticated turbulence closures model for horizontal mixing terms is generally not warranted. All four models treat the horizontal eddy viscosity-diffusivity coefficients as constants. In addition, both EFDC and POM relate the horizontal eddy viscosity-diffusivity coefficients to the local velocity deformation field as suggested by Smagorinsky (1963).

After the various approximations have been introduced, the resultant system of equations is then solved numerically. First, the subject embayment, or the computational domain, must be divided into computational cells, and numerical solutions can be attempted using fixed computational stencils in all spatial directions

All three models integrate the governing equations in the time domain by a finite difference method (referred to as a time-stepping integration). If the governing equations are solved fully implicitly, then the resultant algebraic system of equations is large and is costly to solve. If an explicit solution is attempted, then the numerical scheme is subject to the limitation of Courant stability condition. A physical interpretation of the Courant condition implies that the gravity wave in the system should not propagate over one spatial grid spacing in one time step. The Courant requirement is very stringent, implying that the maximum water depth is large or the minimum grid size is small. Therefore, for the EFDC application the integration time step must be kept small enough to insure numerical stability using an explicit numerical scheme.

The EFDC model uses both explicit and implicit schemes, and thus allows for a longer time step and a lesser constraint on the minimum grid size compared to an explicit scheme. This approach provides great flexibility allowing the model user to specify more cells in areas where more detail is needed (for example, sharp salinity gradient regions), and still run faster than an explicit scheme. The EFDC model (Hamrick, 1990a and 1990b)was selected for the development of the Long Slip Canal/Lower Hudson model after a review of all applicable 3D models and incorporates the best features of these models. The model features of EFDC and history of application to hydrodynamics and water quality simulations in estuarine environments, make it ideal for application to the lower Hudson River.

3.0 Overview of The EFDC Model

The Environmental Fluid Dynamics Code (EFDC) used to predict erosion patterns and geomorphic change of the delta EFDC is a modeling package for simulating three-dimensional flow, transport and biogeochemical processes in surface water systems including: rivers, lakes, estuaries, reservoirs, wetlands and near shore to shelf scale coastal regions. In addition to hydrodynamic, salinity and temperature transport simulation capabilities, EFDC is capable of simulating cohesive and noncohesive sediment transport, near field and far field discharge dilution from multiple sources, eutrophication processes, the transport and fate of toxic contaminants in the water and sediment phases, and the transport and fate of various life stages of finfish and shellfish. Special enhancements to the hydrodynamic portion of the code, including: vegetation resistance, drying and wetting, hydraulic structure representation, wave-current boundary layer interaction and wave induced currents, allow refined modeling of wetland and marsh systems, controlled flow systems, and nearshore wave induced currents and sediment transport. The EFDC code has been extensively tested and documented and for more than twenty modeling studies. The code is currently used by university, govermental, engineering and environmental consulting organizations. The major features and capabilities of the EFDC modeling package, including the water quality and eutrofication components are described in **Appendix A.**

4.0 Model Set-up for Simulations of the Long Slip Entrance Basin

The EFDC model was setup for the Long Slip Canal entrance area and the Lower Hudson River between the Battery and Castle point approximately 1 mile to the north of the Canal Entrance. Model setup required acquisition of topographic data (Fig 1) and boundary (shoreline) coordinates for the project area and the surrounding Hudson River. These data were digitized from National Ocean Survey chart 12335 and used as input to the software that generates the computational grid for EFDC. The overall grid includes approximately 1048 active water cells. The grid is curvilinear-orthogonal and includes smaller cells in areas where good resolution is required (Canal Entrance Basin) and larger cells in areas distal from the project site (Fig. 2). This provides for computational efficiency.

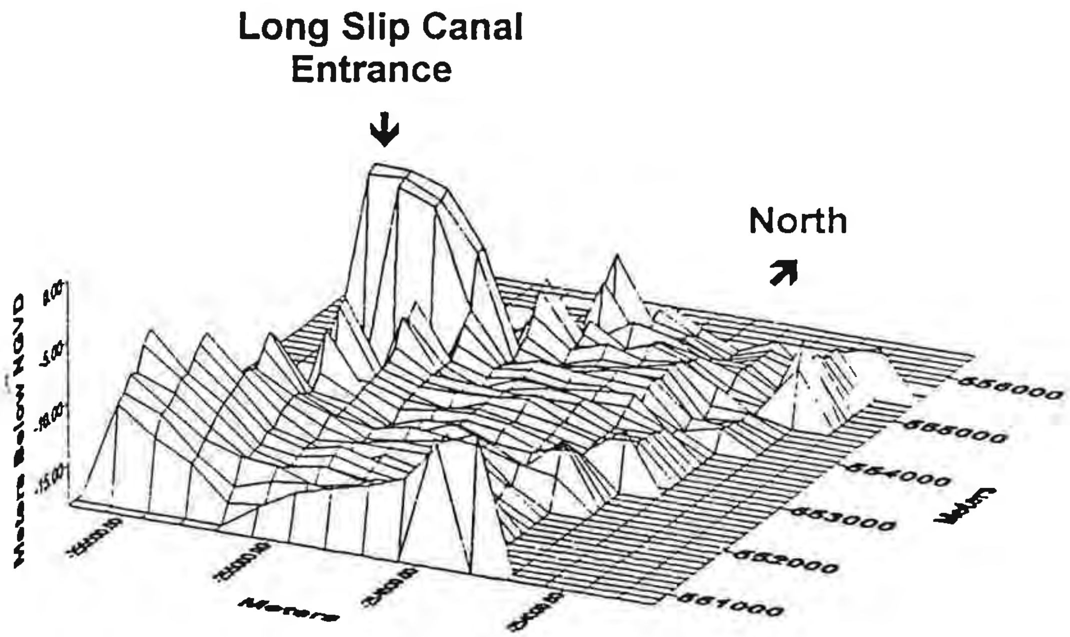

Figure 1. Bottom topography of the Lower Hudson River (from NOS Chart 12335) (vertical exaggeration approx 125x).

The EFDC model required a number of input data files to set-up the initial conditions of the physical domain and to provide boundary conditions during simulation. Boundary conditions for model runs include times series of water surface elevation, salinity, water temperature, freshwater inflow, meteorological parameters and other measured water quality parameters that may be available. A master input file directs the input time series to specific cells within the model domain and sets all time-related and space-related parameters.

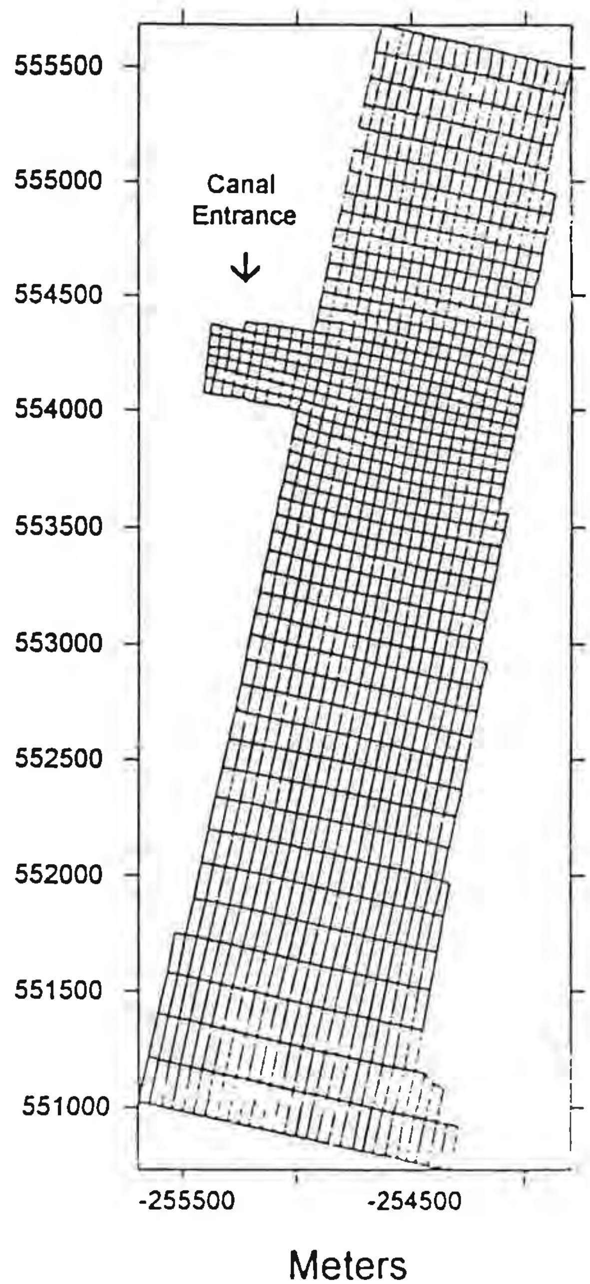

Figure 2. Computational grid for the Hydrodynamic /Salinity Model f Long Slip Canal and the Lower Hudson River.

A time series of elevation for driving the model from the south boundary was acquired from the National Ocean Survey real time water level gage located at the Battery. A thirty-day time series of water elevation (leveled to mean low water) was down loaded for the month of May, 1996. The data, in six-minute intervals were subsampled at hourly intervals for input to the model. There are no recording stations in the vicinity of Castle Point at the north end of the model domain. However, the National Ocean Survey provides predictions of high tide, and low tide for Castle Point. These predictions were compared with real time data at the Battery and a relationship between the phase and amplitude of the tidal signal at both stations was established. The Battery record was then adjusted to simulatedthe tidal predictions (time and amplitude of high and low tide) at Castle Point. It was assumed that the subtidal or low frequency changes in water level were similar at both stations.

The EFDC model also requires meteorological input to drive the air-sea interaction at the water surface. For the experiments performed under this study meteorological conditions were set according to data collected from several recording weather stations that report data from within a 50-mile radius of the project site. Data sets were obtained from the National Weather Service, Laguardia International Airport, and NOAA Oceanographic Buoys in the nearby coastal ocean. From these data, time series of wind velocity, barometric pressure, rainfall and air temperature were input to the model.

The EFDC model also requires input describing salinity at model boundaries. This is particularly important when simulating salinity fluctuations within the interior of the model grid. No salinity records of long enough duration in the project area or the lower Hudson are available for driving simulations. However, there are published data and descriptions of the salinity regime of the lower Hudson available in the scientific and engineering literature (Oey et al, 1985). In addition, the US Geological Survey maintains a station that records water conductance and temperature near the George Washington Bridge several miles to the north of the project site. Data from this recording station, along with published data were used to develop a realistic 30-day time series of salinity fluctuation to drive salt transport at the north and south ends of the model. The initial salinity field was also set according to published data. A tidally varying signal was placed in the salinity record from measured records showing the phasing between tide and salinity in the lower Hudson River. The model was not asked to provide temperature prediction (heat transport calculations) and therefore no time series of water temperature was required.

The EFDC model can also be driven by flows specified at the boundaries of the model grid. Similar to water level data, there are no flow gaging stations in the vicinity of the Long Slip project area. In addition, flow values must be specified in some detail in water bodies of wide and relatively deep cross-section, like the lower Hudson. Therefore, no flows were specified at model boundaries. The influence of freshwater on salinity structure and flow patterns in the model are calculated from the water level and salinity time series specified at the boundaries. Results of model runs described in later sections were consistent with flow patterns described for the lower Hudson by Officer (1975).

5.0 Design of the Model Application Runs

Three distinctive conditions were simulated in model runs in order to meet the objectives outlined under Section 1. A base condition termed Case 1 (Fig 3) was run to simulate the salinity and flow fields for the existing topography of the Long Slip Canal Entrance. Under this condition the model was run for 30-days and model output was designed to show the vertical salinity structure and flow patterns at tidal frequencies. The model was also instructed to calculate the salinity and flow patterns as a daily average. Model simulations viewed as a daily average can provide insight of trends that may occur due to mixing and flushing over a 30-day period.

The first proposed modification to increase flushing and water quality in the Canal Entrance area was a north-south oriented cut through the field of pilings within the Long Slip Canal entrance area (Fig 4). Depths in this area were increased by 2 to 3 meters to an average of about 7 meters. This modification is termed Case 2. The model was then re-run for the entire 30-day period to determine if the salinity and overall flushing of the Canal Entrance basin area increased according to model predictions.

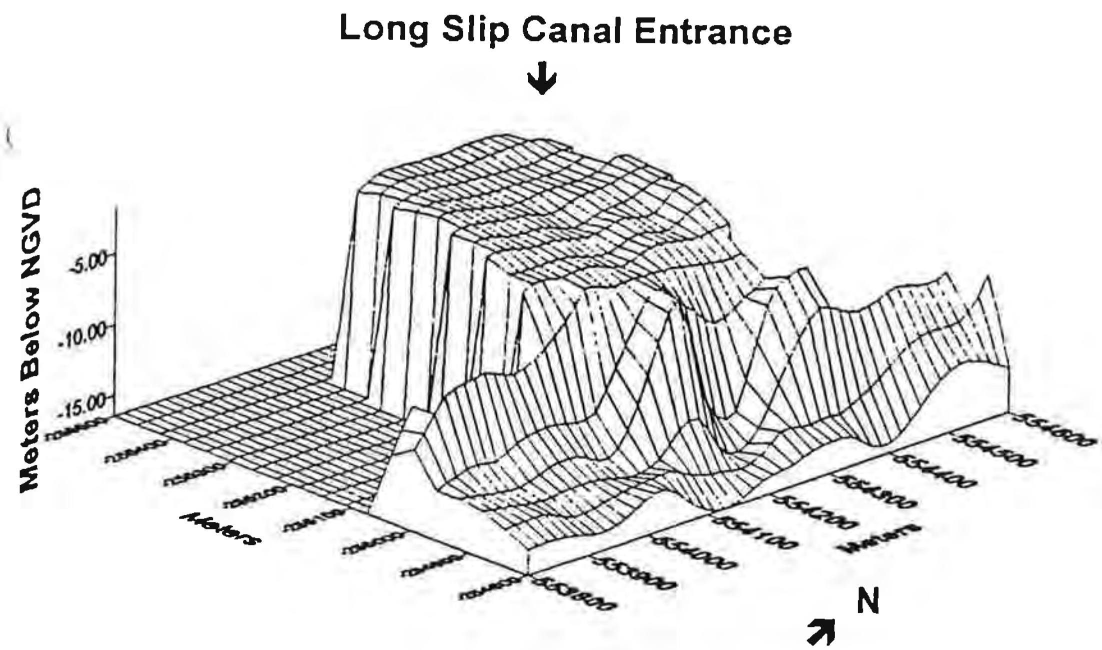

Figure 3. Case 1: Existing topographic conditions in the Long Slip Canal Entrance area.

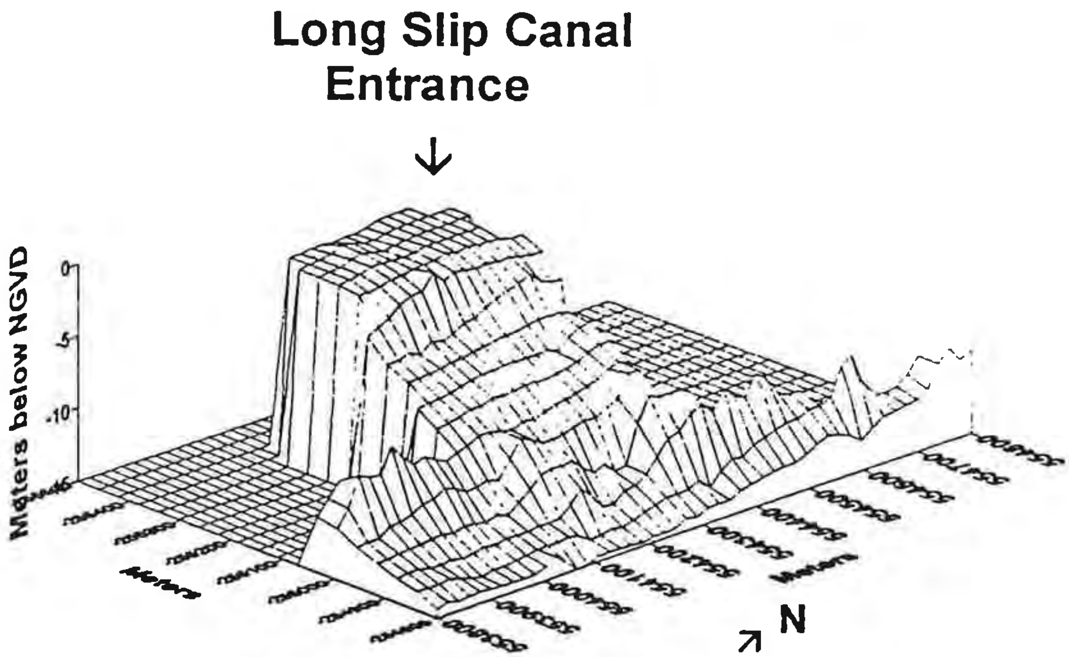

Figure 4. Case 2: North-south oriented cut through the Long Slip Canal Entrance area.

Based on the results of the first two model runs, a second modification to the Canal Entrance was tested by a 30-day model run (Fig. 5) In Case 3, an east-west oriented cut was placed in the canal entrance that included a supra-tidal berm just beyond the eastern terminus of Long Slip Canal Predicted salinity and flow patterns were then compared to the base conditions and the results of the north-south cut through the Canal Entrance.

Long Slip Canal Entrance

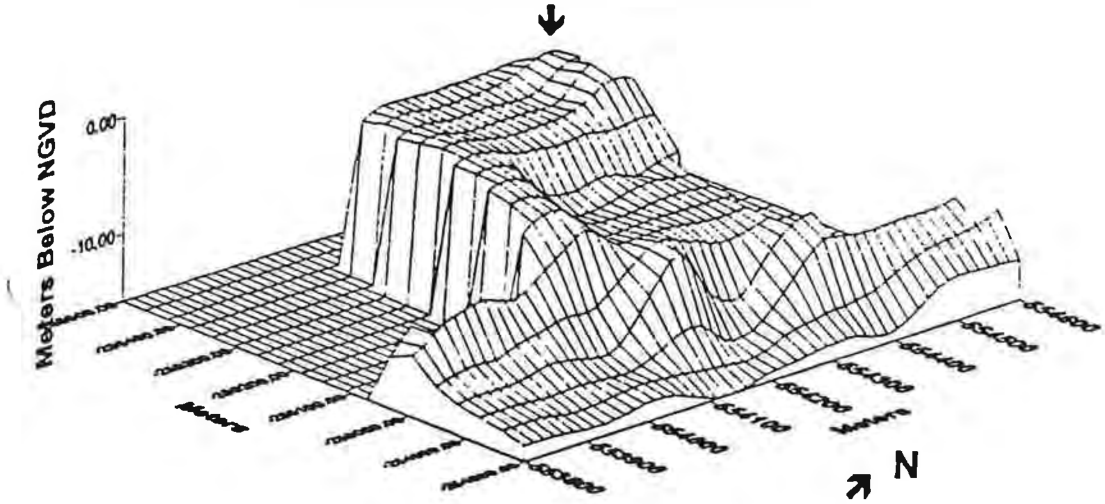

Figure 5. Case 3: East-west oriented cut through the Long Slip Canal Entrance area

6.0 Model Simulation of Salinity and Flow in the Lower Hudson River

In this section the results of 3-D modeling of hydroynamics and salinity in the Hudson River Estuary adjacent to the Long Slip Canal are reviewed to clearly establish the conditions that influence water quality in the Canal Entrance basin The ability to accurately model hydrodynamics, salinity regime and specific water quality paremeters in the Long Slip Canal Entrance area depends on the ability to accurately simulate condiions in the adjacent Hudson River Estuary. The Hudson River, in combination with meteorological forcing, inputs from surface water runoff, and CSO inputs determine conditions in the Entrance Basin.

Results of model simulations are consistent with observations in the lower Hudson River between Castle Point and the Battery. Observation of tidal and residual flows indicate that the lower Hudson River between the Battery and the George Washington Bridge is partially stratified with respect to salinity and residual flows (Officer, 1975, Simmons, 1966). Figure 6a shows the near-surface salinity and flow fields during a flooding tide, whereas Fig 6b shows the near-bottom conditions during the same flood tide. The difference between surface and near bottom salinities indicates only partial mixing in the vertical dimension of the estuary. Salinity differences between the surface and bottom in this example range from 1 to nearly 3 psu. Within the Long Slip Canal Entrance basin, shown as the rectrangular area on the left side of the figure, surface to bottom salinity differences are more than 2 psu.

Further analysis of flow velocity computed by the model clearly demonstrates that the lower Hudson River is a partially stratified (partially mixed) estuary. A predicted time series of currents from a point in the center of the Hudson River shows the tidal signal in both the near-surface and near bottom currents (Fig. 7a). However, surface currents are stronger and ebb-

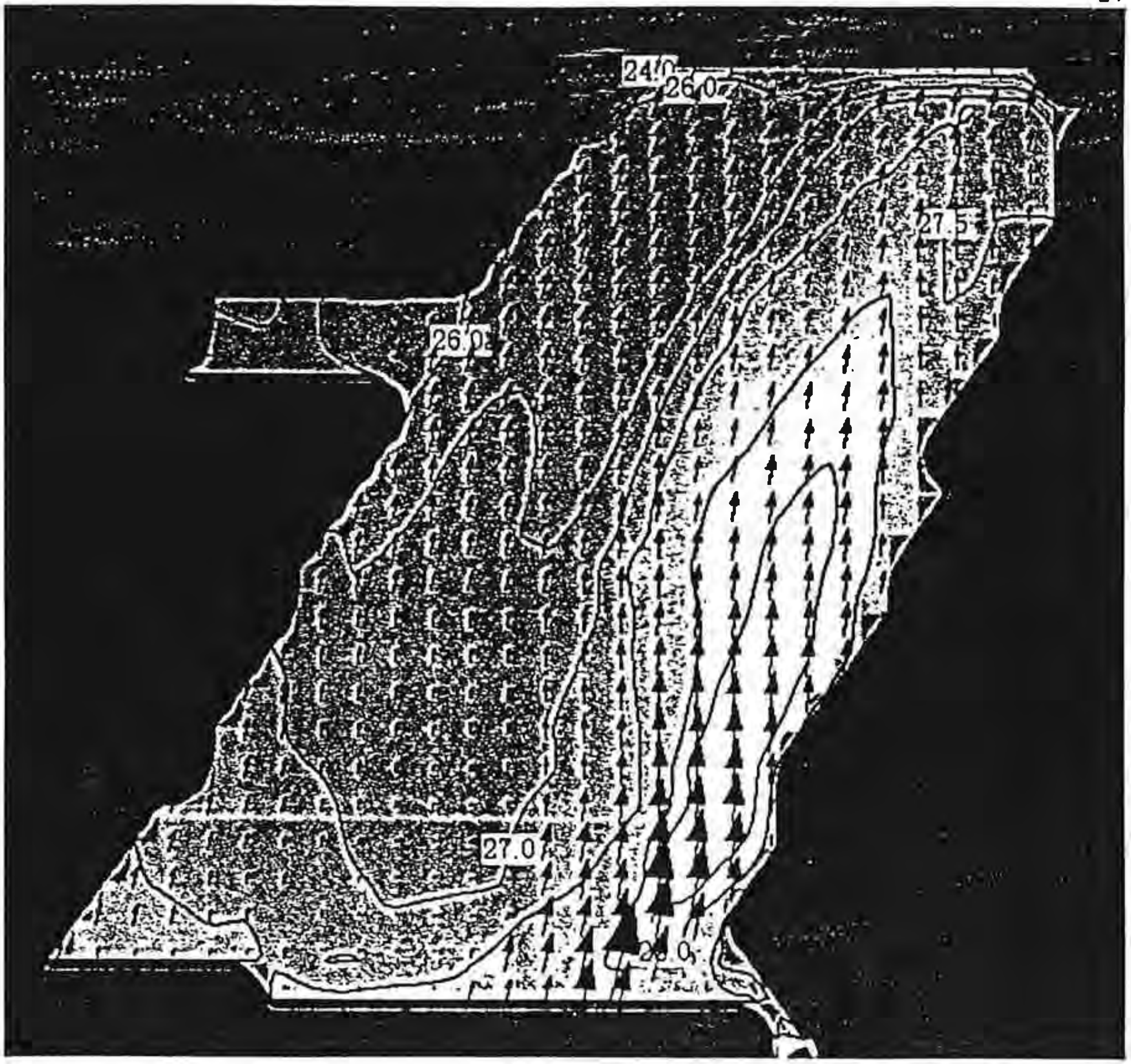

Figure 6a. Near-surface currents and surface salinity in the Hudson River Estuary during a flood tide on May 3, 1996.

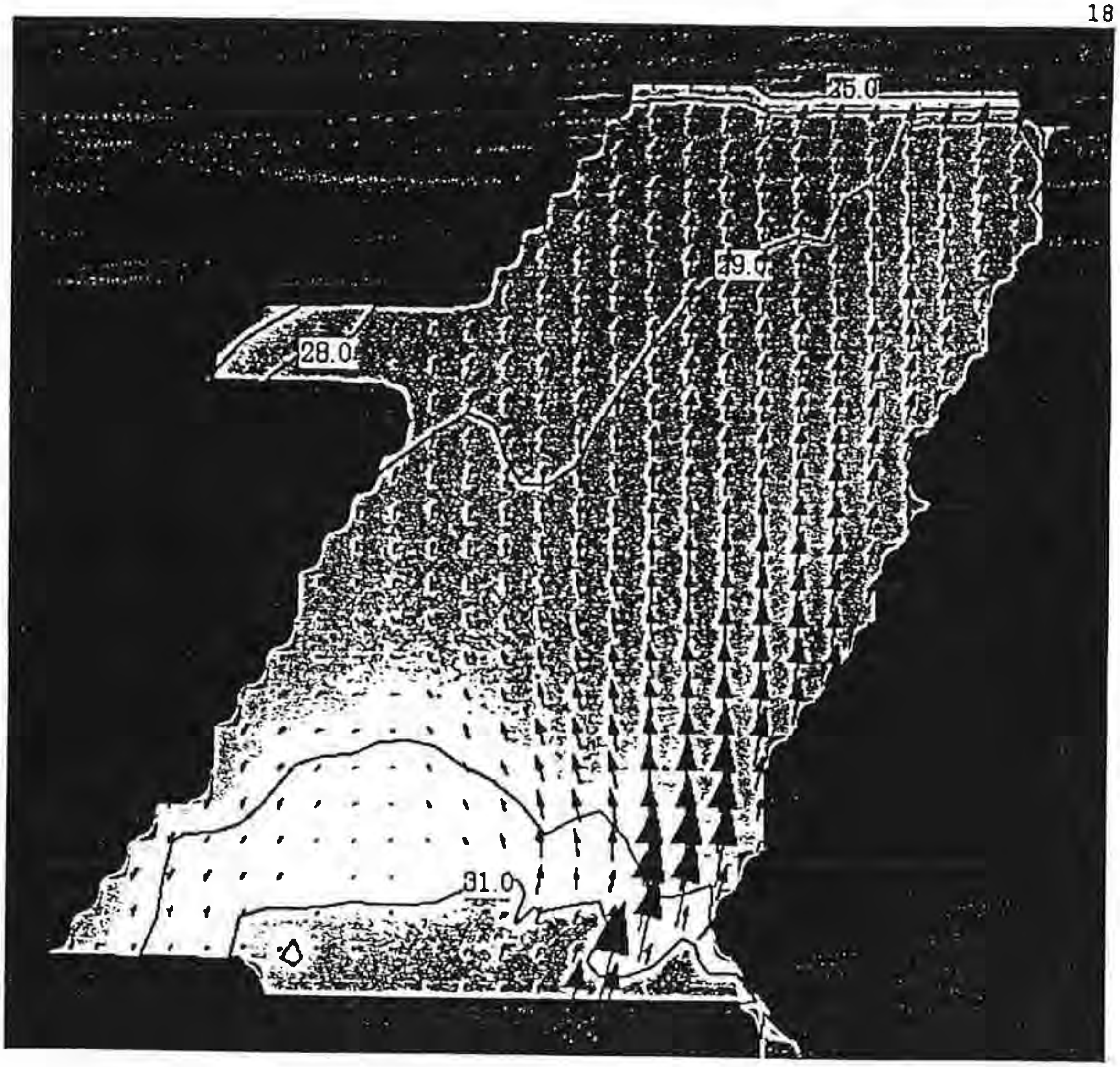

Figure 6b. Near-bottom currents and bottom salinity in the Hudson River Estuary during a flood tide on May 3, 1996

dominated with respect to direction. Near-bottom currents are weaker due to bottom frictional effects and are flood dominated with respect to direction. This pattern is consistent with the seaward directed flows of lower salinity water due to Hudson River freshwater discharge. Flood-dominated, near bottom currents reflect the headward-directed residual flows that compensate for the persistent seaward residual flows in the upper layers of the river. Currents at mid-depth are weaker and more evenly distributed with respect to flood

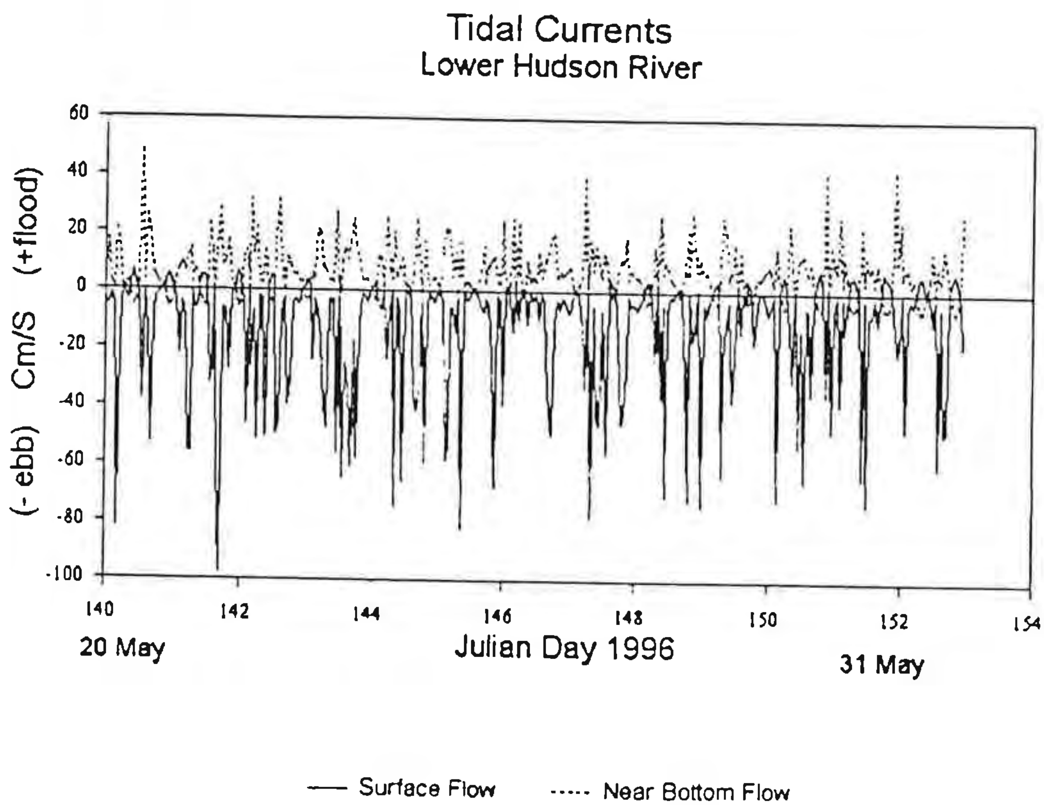

Figure 7a. Predicted surface and near-bottom currents in the lower Hudson River

and ebb directions compared to surface and bottom flows (Fig 7b). At mid-depth currents are less influenced by the freshwater discharge of the Hudson River and the residual or mean currents that are characteristic of partially mixed estuaries.

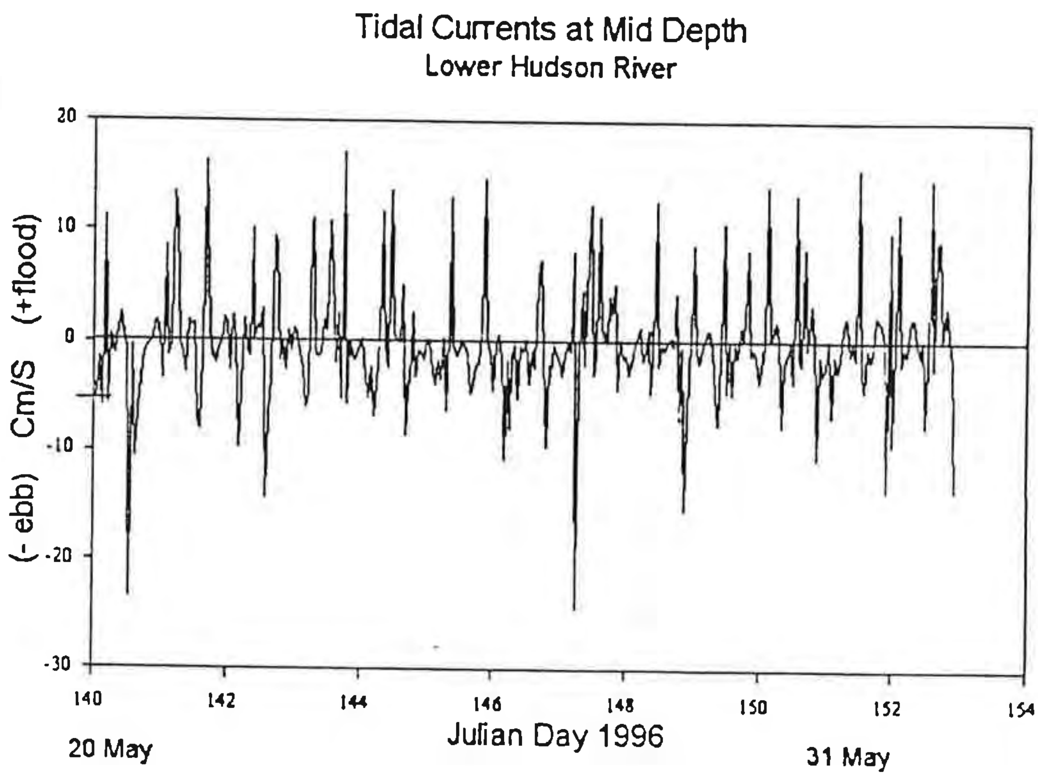

Figure 7b. Predicted currents at mid-depth in the lower Hudson River Estuary

The predicted flows in the lower Hudson River demonstrate that the estuary is partially stratified and that circulation and associated dissoved constituents in the upper layes can be significantly different than condiditons in the lower layers of the water column. In the lateral areas like the Long Slip Canal Basin, water quality is in part determined by near-surface conditions of the adjacent estuary.

The features of a partially stratified estuary can be more clearly seen by filtering out the oscillatrions caused by the tides. The semidiural Lunar M2 tide, having a period of 12.42 hours is the principal tidal constituent in the Hudson River Estuary. Averaging over this signal using a digital filter reveals the residual flows associated with partially mixed estuaries, which are oftem termed estuarine circulation (Fig. 8). The residual, or estuarine circulation at the surface is directed seaward and includes the effects of freshwater discharge of the Hudson River as well as denser water mixed upward into surface layers by tide-generated turbulence. The near bottom flow is directed headward into the estuary, thus compensating for water driven out of the estuary by seaward moving residual flows in the surface layers of the estuary. At mid-depth, near the surface of uniform density, the residual flow is near zero. Tidally averaged or residual flows of this nature are driven by the force of gravity acting on salinity derived density differences. This type of flow is known as baroclinic flow.

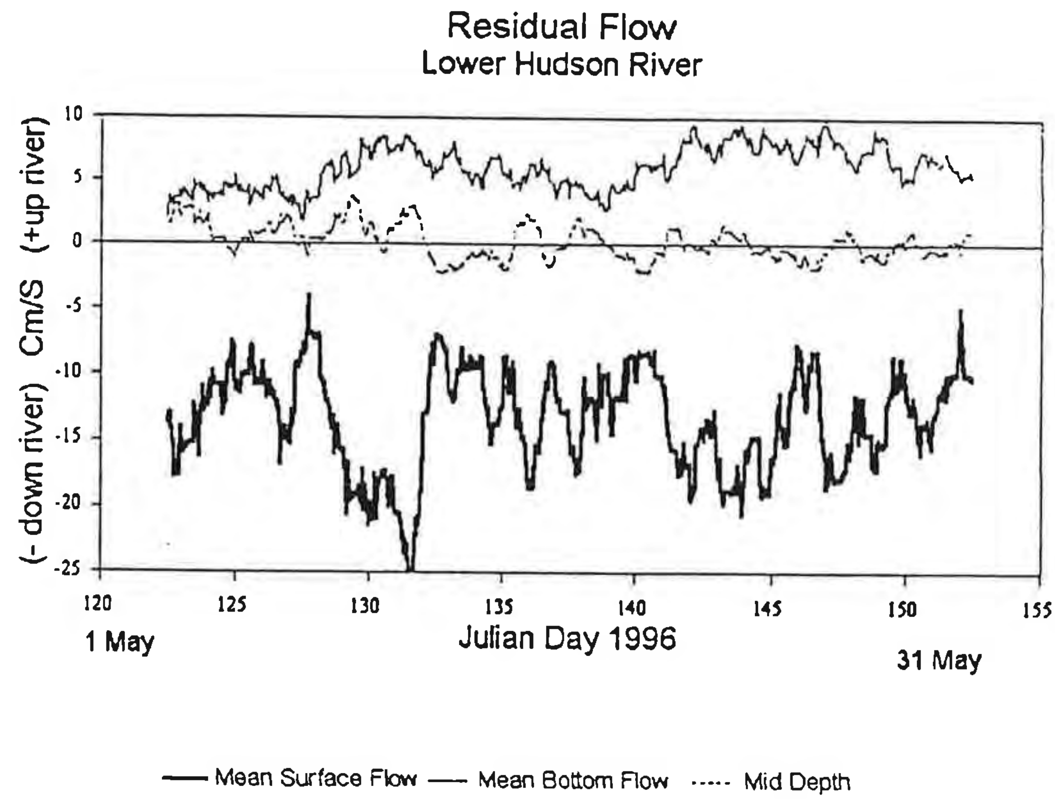

Figure 8. Predicted residual flows in the lower Hudson River during May 1996

A salinty record from a central point in the lower Hudson River, which has been filtered to remove the tidal signal also exemplifies a partially mixed estuary (Fig. 9). Salinity near the surface is substantially lower compared with the lower layers of the estuary reflecting the discharge of the less dense, fresher water . At mid-depth and in near bottom layers the average salinity is greater. Furthermore, the difference in average salinity between mid-depth and the bottom is small indicating that the lower layers of the estuary are relatively well mixed. This also reflects the fact that the less dense and fresher water is confined to the surface layers and even the strong tides of the lower Hudson River cannot completely mix fresh and salt water.

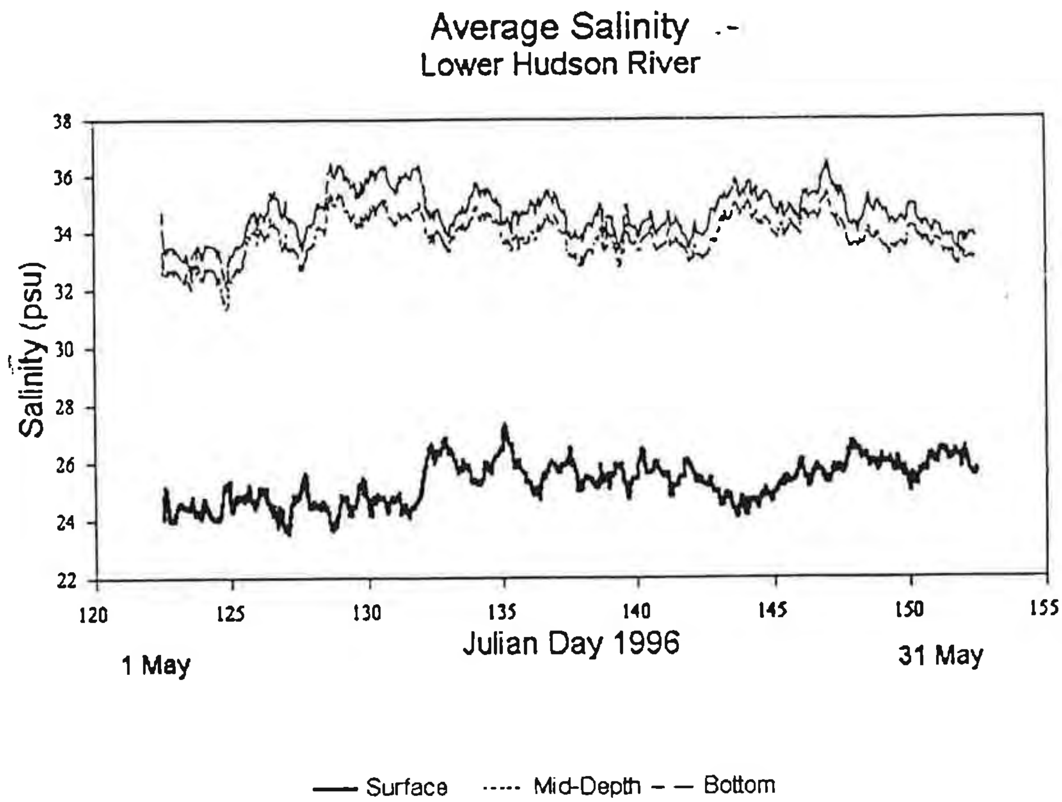

Figure 9. Average salinity in the center of the lower Hudson River Estuary in May, 1996.

The vertical distribution of currents and salinity as well as the tidally averaged residual currents ans salinity patterns in the lower Hudson River Estuary influence the salinity regime and overall water quality within the Entrance area of the Long Slip Canal. At present, the Entrance basin to the east of the Canal averages approximately 2.5 meters (8 feet) in depth and increases to approximately 4.5 meters (15 feet) at the boundary with the Husdon River. Within 400 feet of the Entrance area depth of the Hudson River increases to about 15 meters (50 feet) at a slope of 1:1.5. However, due to stratification of the Hudson River, salinity and water quality regimes will be influenced by the upper layers of the Estuary. For example, average surface salinity of the Hudson River during May, 1996 (Fig. 9) is in the range of 24 to 26 psu and therefore the salinity range in the Entrance basin will be in this range or less.

The water quality in the basin will be determined by a combination of the impacts of the CSO's entering the basin and quality of the Hudson River surface layers. Inputs of tidal and wind energy will determine the magnitude of exchange between the Entrance area and the Hudson Estuary.

7.0 Model Results in the Long Slip Canal Entrance Area

Present conditions in the Canal Entrance area are strongly influenced by exchanges with the upper portion of the Hudson River water column. The test cases examined in this section of the report describe the predicted changes in hydrodynamic and salinity regime that are inducded by modifying the bottom topography of the Entrance area to promote stronger vertical mixing and exchange with the Hudson Estuary. The goal of these changes is to increase the flushing of Entrance area to improve dissolved oxygen levels and overall water quality through stronger iflushing and nteracton with the Hudson River.

A comparison of predicted surface currents flushing in and out of the Long Slip Canal Entrance area at tidal frequency indicates little difference among the three cases tested using the 3-D hydrodynamic model (Fig. 10). Predicted surface tidal currents are similar in amplitude for all three cases (base, north-south cut, east-west cut) and reach a maximum speed of about 3 cm/s when flowing both west into the Entrance basin and east out of the Entrance.

A comparison of bottom tidal currents (Fig. 11) shows that on most tidal cycles maximum currents predicted for the east-west cut test case are slightly greater for flows into and out of the Canal Entrance area. For the surface currents the phase (time) of peak predicted flows correspond among all three cases. However, for the bottom the phasing of peak currents predicted for the east-west cut (Case 3) is much different compared with the other two cases, both of which are similar in their phase or time of maximum flows. It is possible that decreases frictional effects on the bottom with the east-west channel in place resulted in slightly stronger currents near the bottom and a shift in the phase or time of maximum flood and ebb currents in the Canal Entrance area. Tidal current predictions as shown in Figure 11 indicate that Case 3 (east-west cut) will result in some increase in tidal action with the Entrance basin, particularly near the bottom where dissoved oxygen levels are the lowest under present conditions

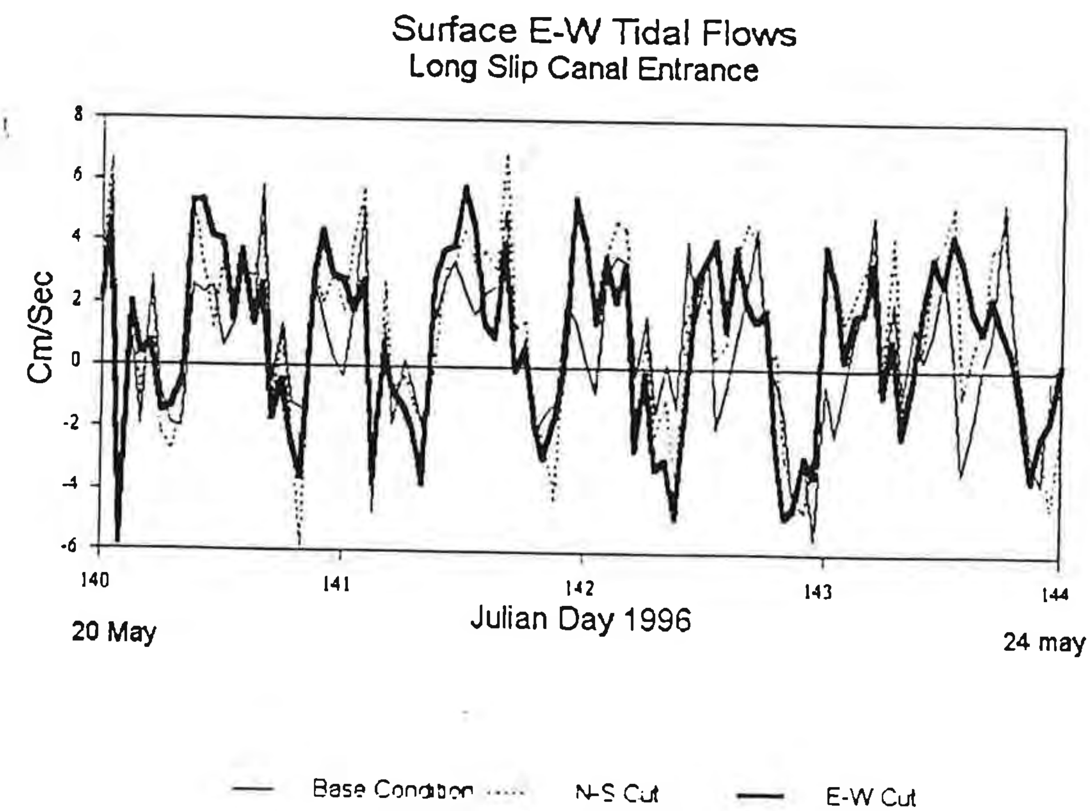

Figure 10. Comparison of east-west directed surface currents at tidal frequency in the Long Slip Canal Entrance area for the three cases using the 3-D hydrpdynamic model. Positive flow is directed to the east out of the Entrance, negative flow values are directed to west into the Canal Entrance basin.

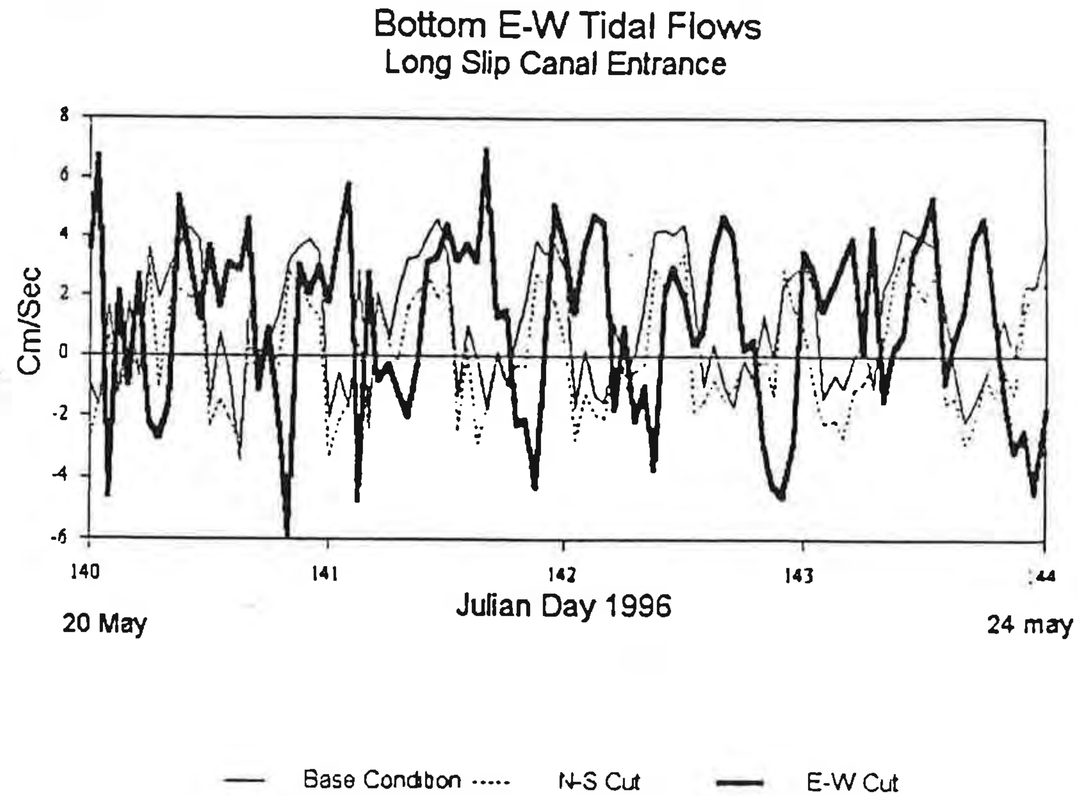

Figure 11. Comparison of east-west directed bottom currents at tidal frequency in the Long Slip Canal Entrance area for the three cases using the 3-D hydrodynamic model. Positive flow is directed to the east out of the Entrance, negative flow values are directed to the west into the Canal Entrance basin.

Among the three cases tested using the 3-D model, Case 3 (east-west cut) resulted in the displacement of salinity toward higher values during each tidal cycle. Figures 12a and 12b compare the tidal variation in salinity (vertically averaged) predicted for the middle of the Canal Entrance area approximately half way between east terminous of Long Slip Canal and the west boundary of the Hudson River proper. For all three cases, the vertically averaged salinity predicted for the east-west cut was slightly higher compared with the base condition and the north-south cut. The predicted maximum and minimum values of salinity during each tidal cycle are slightly higher for Case 3. Predictions for the inner portion of the Canal Entrance area, approximately 200 feet from the present location of the east end of Long Slip Canal, show only slight differences in salinity when considered at the tidal frequency. (Figs 13a and 13b). This indicates that stronger tidal flows are bringing lower salinity surface waters of the Hudson wel into the Entrance basin and turbulence generated by increased tidal currents is mixing lower salinity water into the water column of the inner Entrance area.

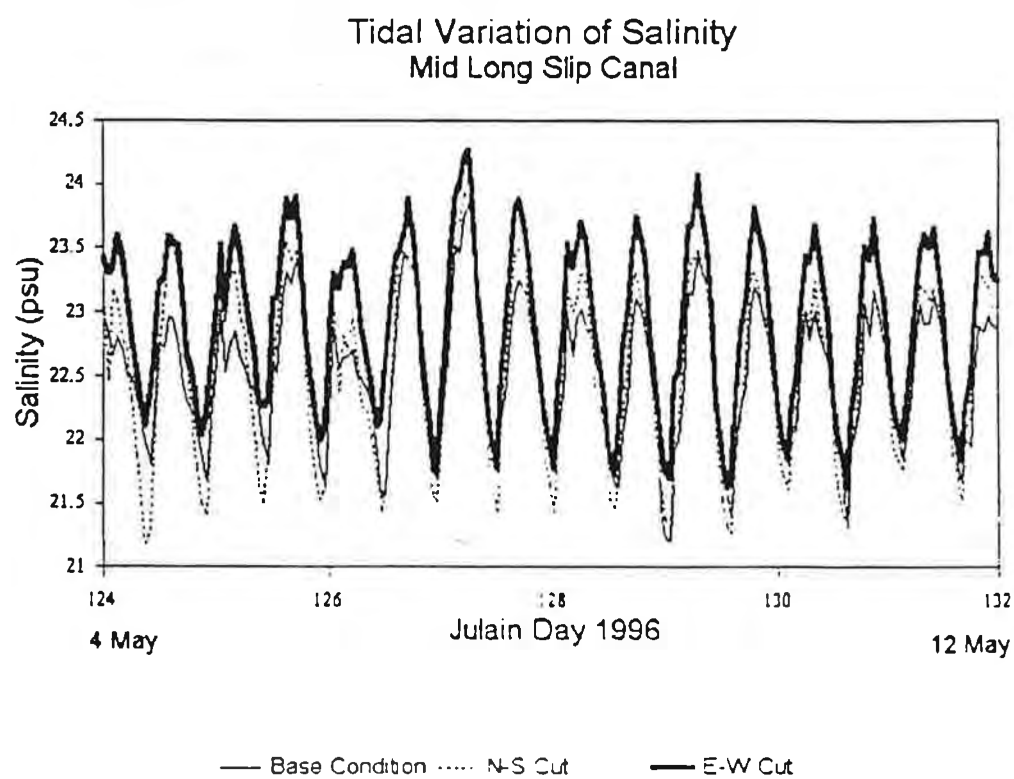

Figure 12a. Comparison of tidal variation in salinity among the three test cases predicted for the period of 4 May to 12 May 1996 Salinity is vertically averaged over the 5 layers in the 3-D model.

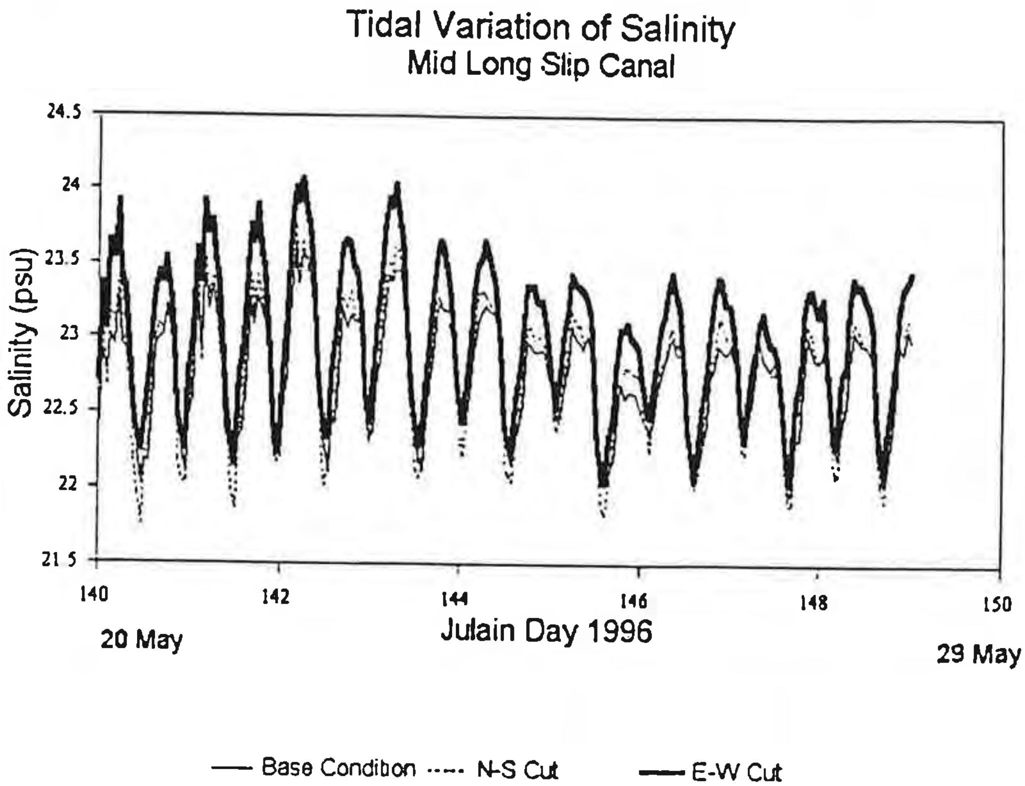

Figure 12b. Comparison of tidal variation in salinity among the three test cases predicted for the period of 20 May to 29 May 1996. Salinity is vertically averaged over the 5 layers in the 3-D model.

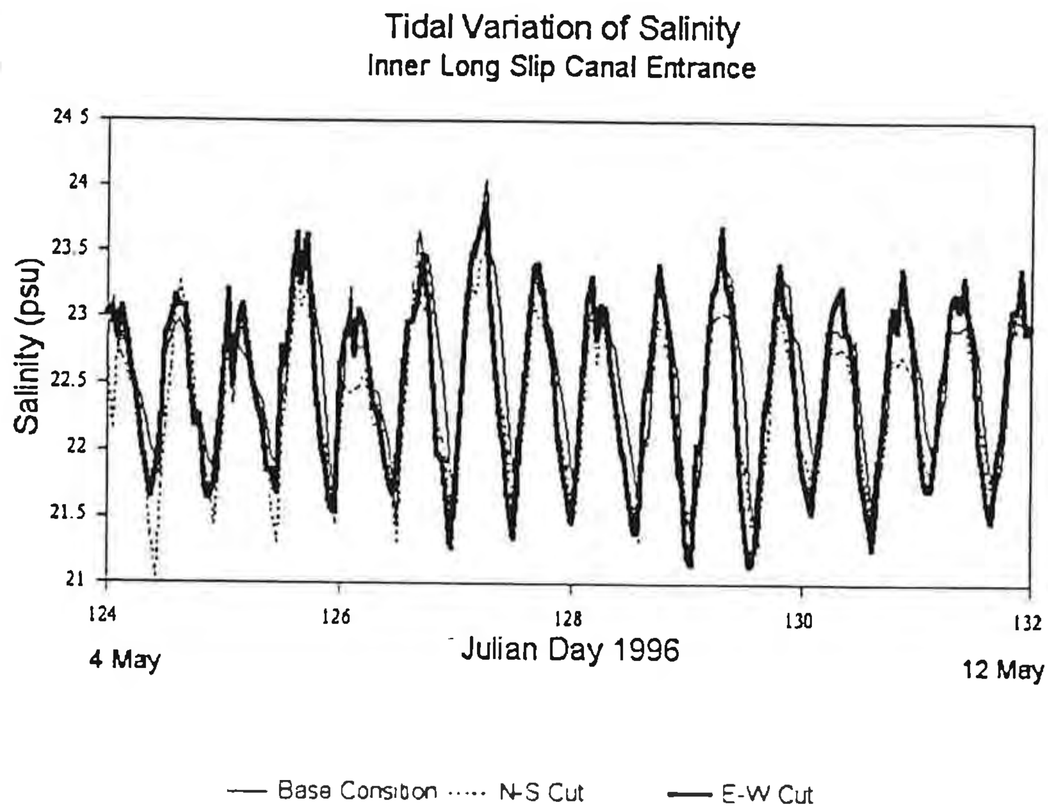

Figure 13a. Comparison of tidal variation in salinity among the three test cases predicted for the period of 4 May to 12 May 1996 Salinity is vertically averaged over the 5 layers in the 3-D model simulation of the inner Entrance basin

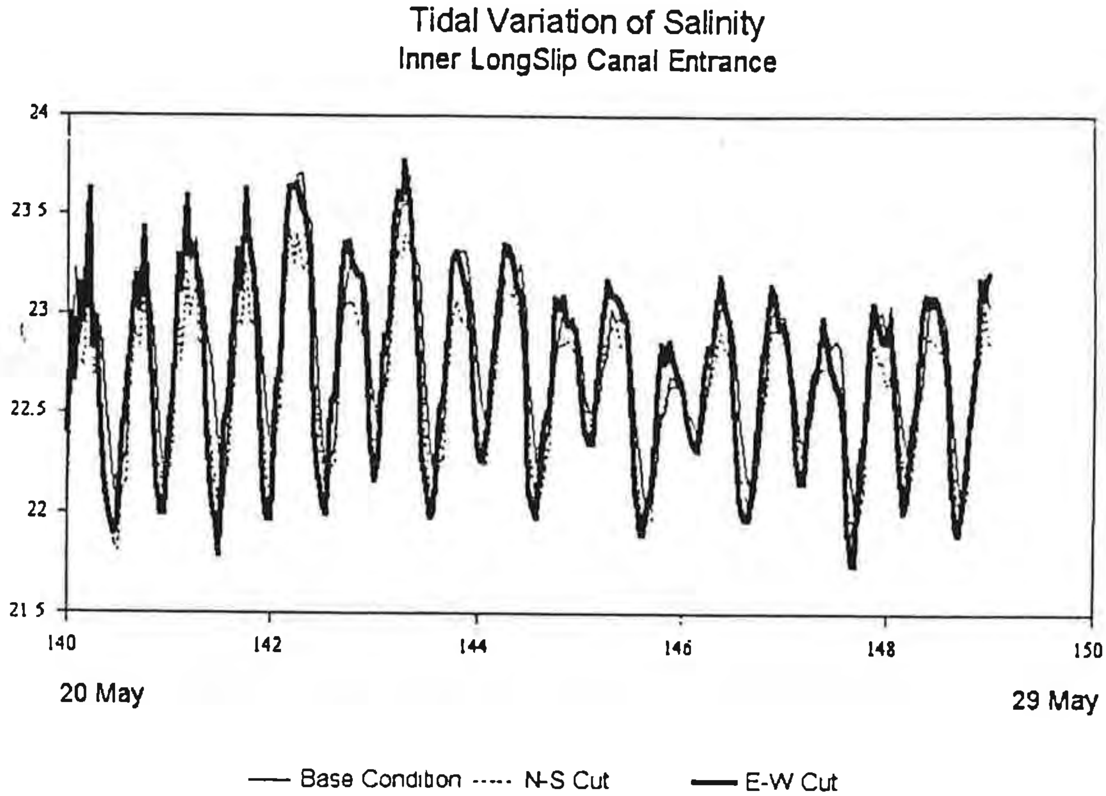

Figure 13b. Comparison of tidal variation in salinity among the three test cases predicted for the period of 20 May to 29 May 1996 Salinity is vertically averaged over the 5 layers in the 3-D model simulation of the inner Entrance basin

Further insight concerning predicted improvments in circulation and mixing in the Entrance basin can be gained by considering the vertical distribution of salinity once the day to day tidal variation is removed by filtering. Similar to the analysis for the Hudson River Estuary, the residual salinity field in the Entrance area reveals differencs among the test cases and the features of stratification. Using a digital filter to eliminate the tidal signal within the inner Entrance basin, the daily average surface salinity for Case 3 (east-west cut) is higher compared to Case 1 (base condition) and Case 2 (Fig 14a). In contrast, the daily average salinity predicted in the bottom layer of the model for this location is slightly lower for Case 3 compared with test Cases 1 and 2 (Fig 14b). The interpretation for this pattern of increased surface salinity and decrease in bottom salinity for Case 3, is improved vertical mixing due to the east-west cut. This portion of the Entrance area is relatively shallow, even after the east-west cut is in place. Therefore, a slight increase in the magnitude of tidal currents compared to the other two test cases results in the mixing of lower salinity water at the surface downward in the water column and mixing of higher salinity water upward in the water column.. The overall water quality is likely to benefit most at this location from an east-west cut designed to increase depth and tidal flushing, and overall mixing of the water column.

Closer to the Hudson River, in the mid-Entrance area, average salinity predicted for Case 3 is larger than for either Case 1 (base condition) or Case 2 (north-south cut). The increase in average salinity in Case 3 was predicted for all five layers of the 3-D model . Figures 15a and 15b show the surface and bottom daily average salinity for May 1996 in the mid Entrance area. Similarly to the inner zone of the Entrance area the changes in salinity are attributable to better tidal flushing and mixing. However, in this case the predicted bottom salinity increased as higher salinity water moves from the deeper layers of the Hudson River into the deeper layers of the Entrance basin.

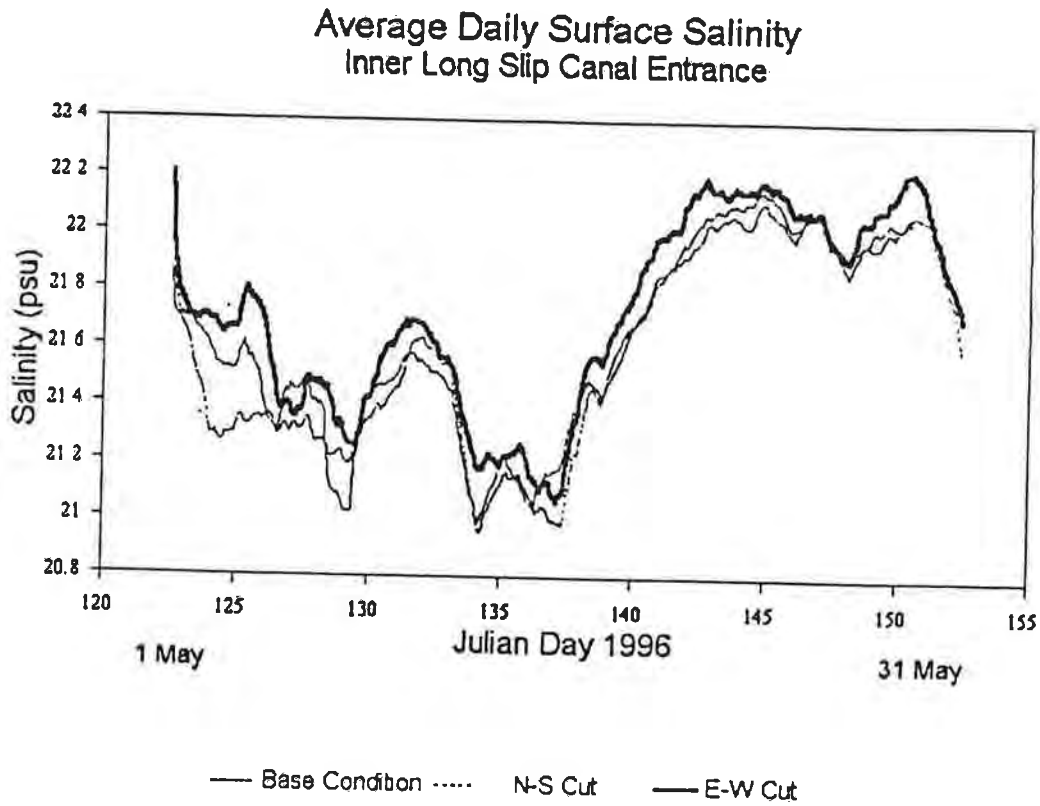

Figure 14a. Average daily surface salinity predicted for the inner Entrance area

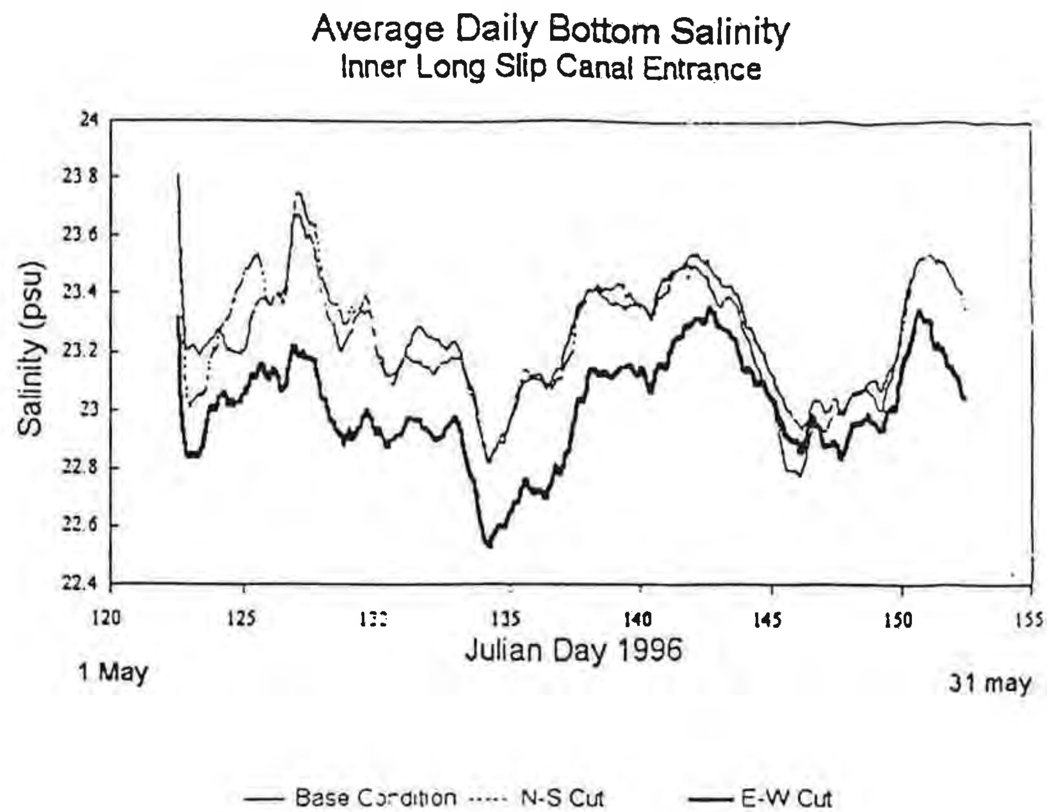

Figure 14b. Daily average bottom salinity predicted for the inner Entrance area.

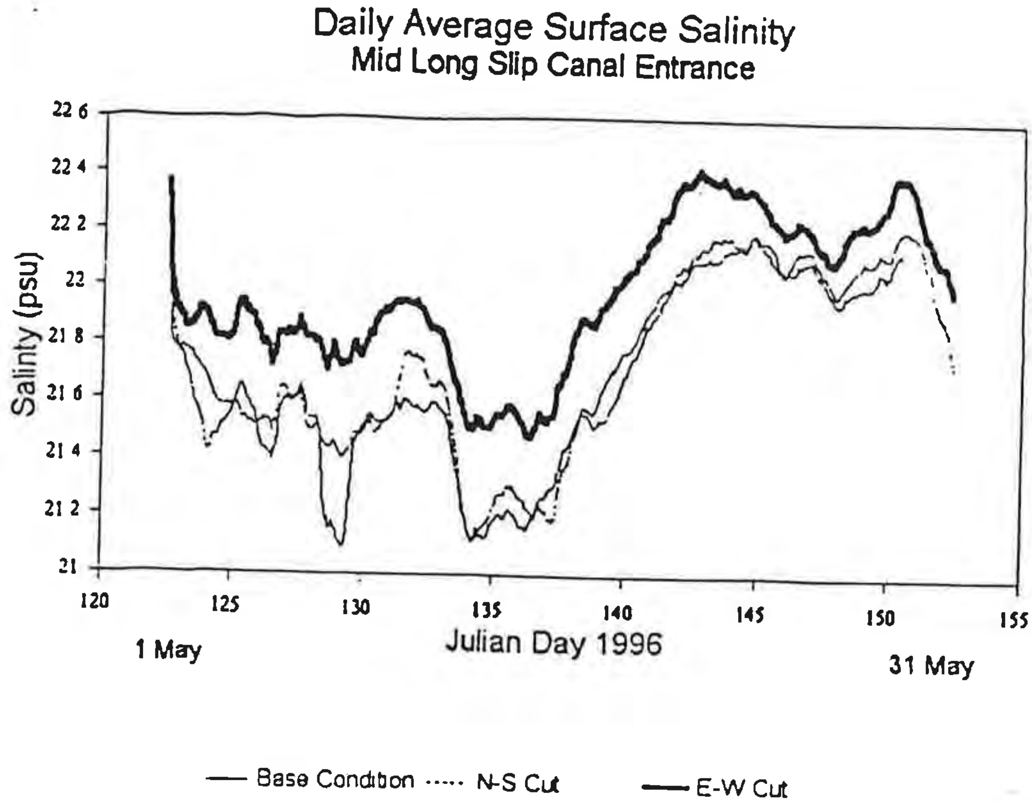

Figure 15a. Daily average surface salinity predicted for the mid Entrance basin

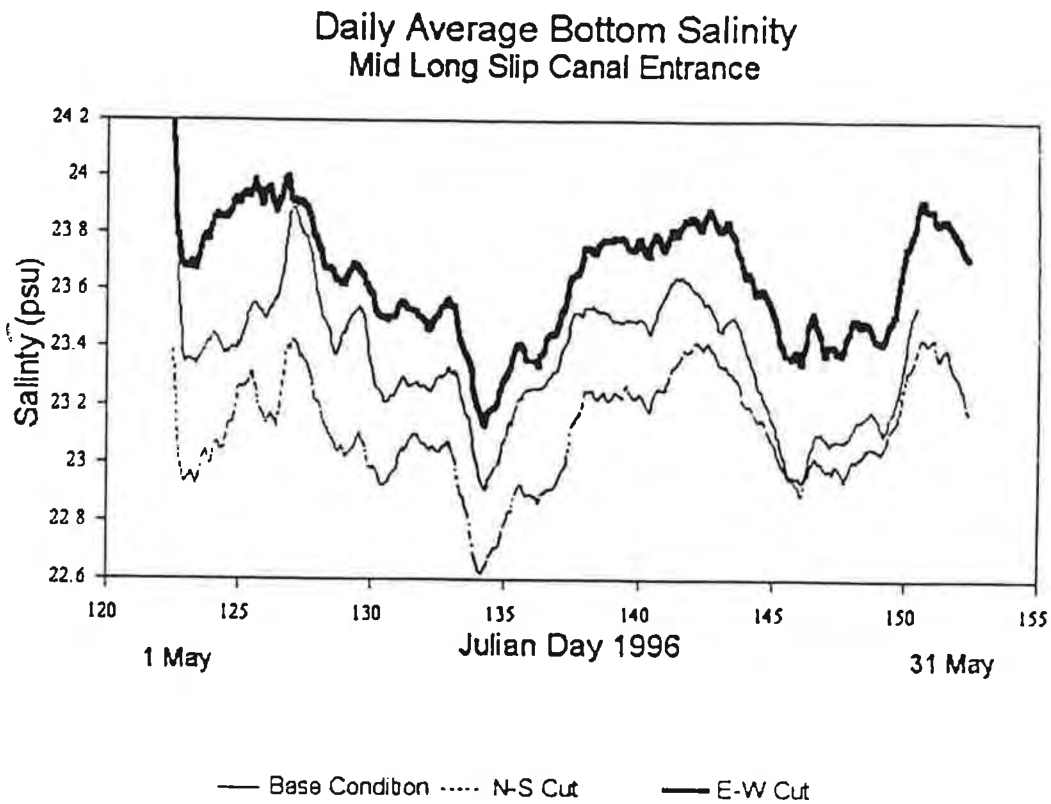

Figure 15b. Daily average bottom salinity predicted for the mid-Entrance basin.

Figures 14 and 15 show that Case 3 results in changes in the salinity in the Entrance basin indicative of better flushing and vertical mixing Figure 16a compares surface and botom salinity predicted for the inner Entrance basin under Case 1 (Base) and Case 3 (E-W cut) showing that the decrease in stratification is due to a decrease in bottom salinity Figure 16b makes the same comparison for the middle of the Entrance basin. The relative difference between surface and bottom salinity remains the same between test cases, but for Case 3 both the surface and bottom salinity are predicted to increase compared to Case 1.

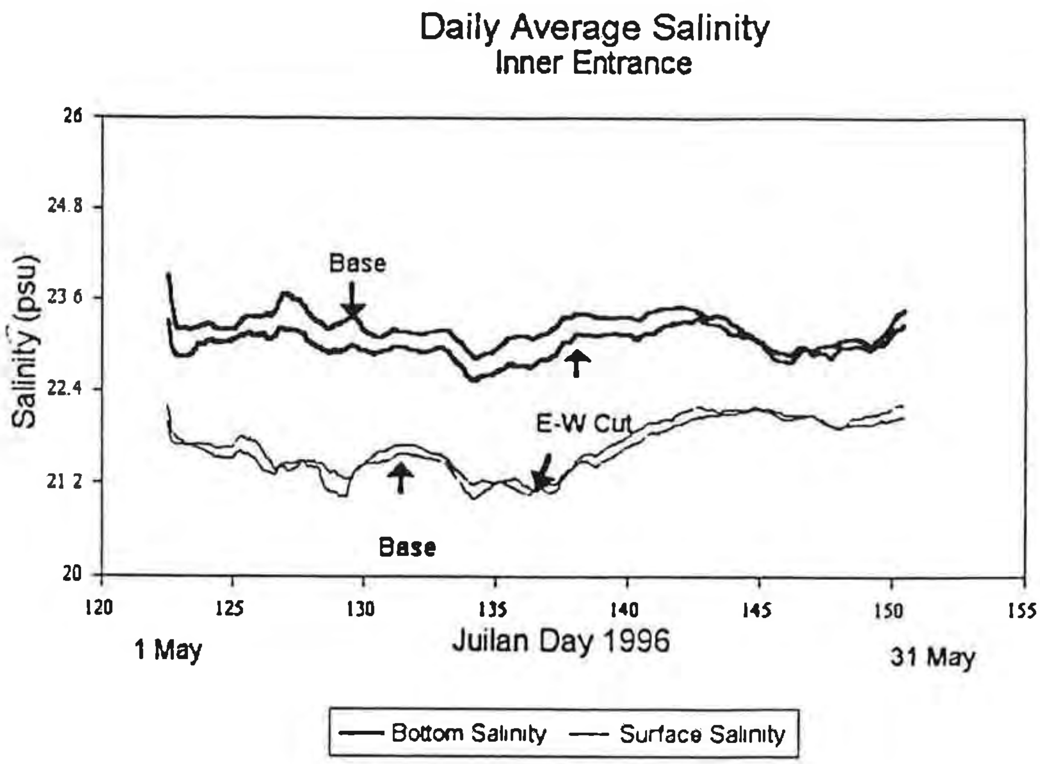

Figure 16a. Comparison of predicted surface and bottom salinity for Case 1 and Case 3 for the inner Long Slip Canal Entrance basin

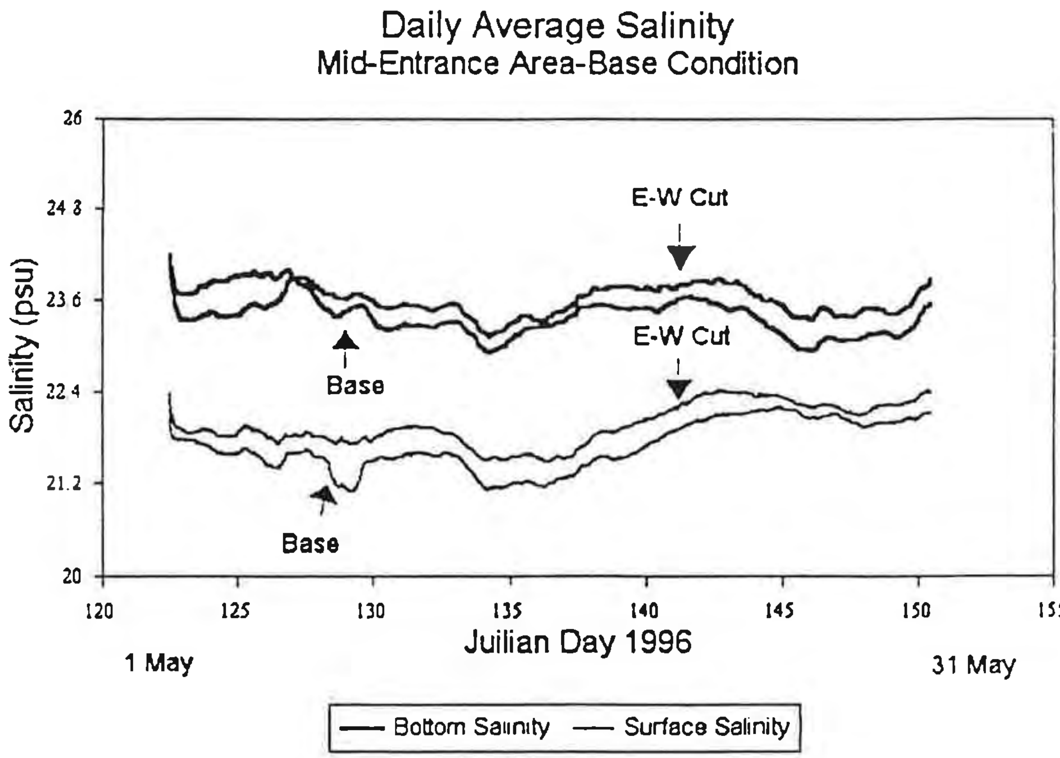

Figure 16b. Comparison of surface and bottom salinity for Case 1 and Case 3 for the middle of the Long Slip Canal Entmance basin.

Figures 12 through 16 present the results of salinity and current predictions as a time series from a particular location in the Hudson River Estuary or in the Entrance area of the Long Slip Canal. Figures 17a and 17b compare the spatial distribution of the average surface salinity on day 140 (May 20) in the Entrance basin for Case 1 (base condition) and Case 3 (east-west cut). Figures 18a and 18b compare average bottom salinity distribution for the same cases. The spatial distribution of salinity within the Entrance basin exemplifies the changes in salinity distribution that are predicted to result from placing an east-west cut in the Entrance basin.

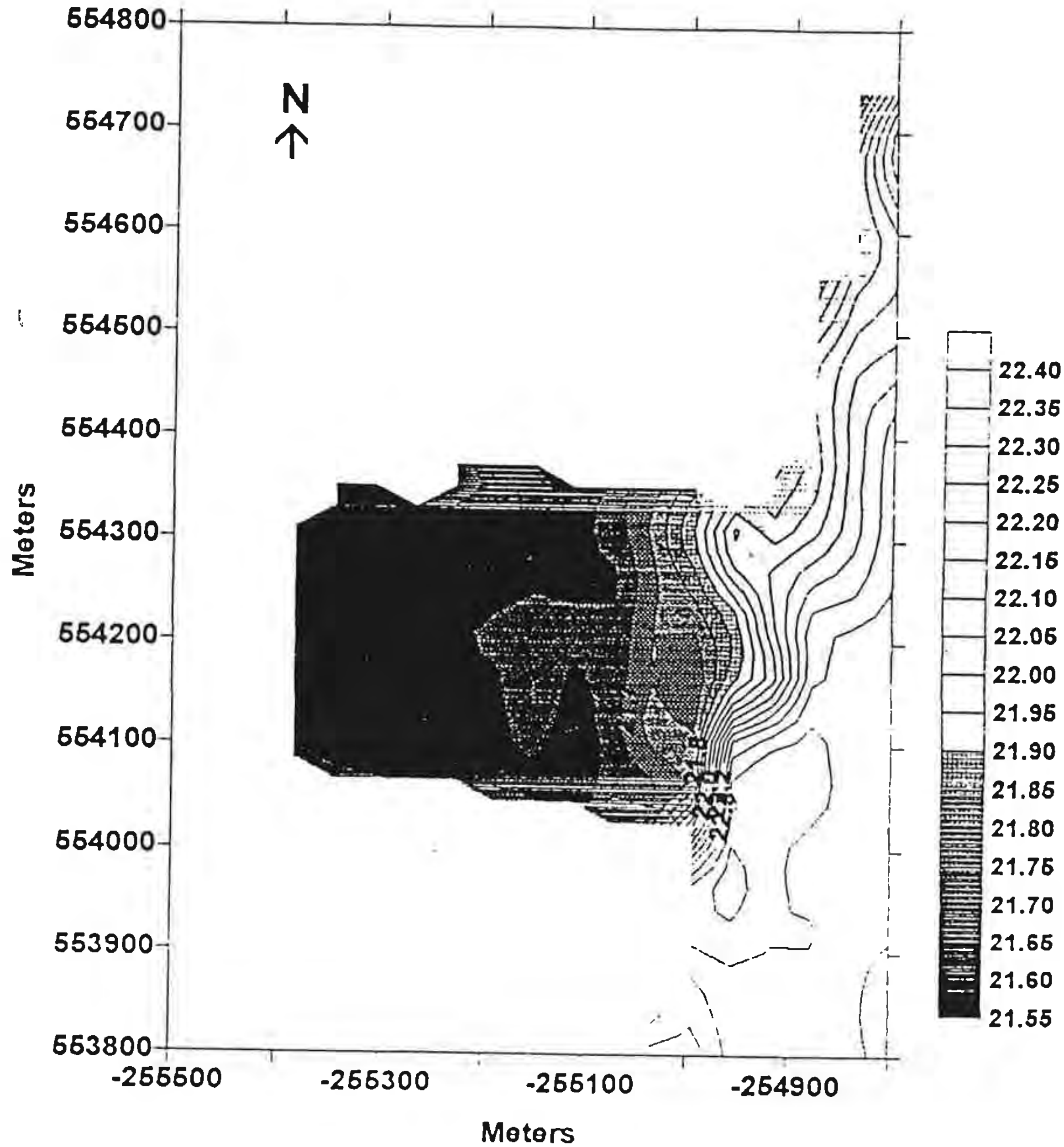

Figure 17a. Average surface salinity in the Canal Entrance area for the base condition (Case 1) predicted for 20 May, 1996. Salinity values are in practical salinity units (psu).

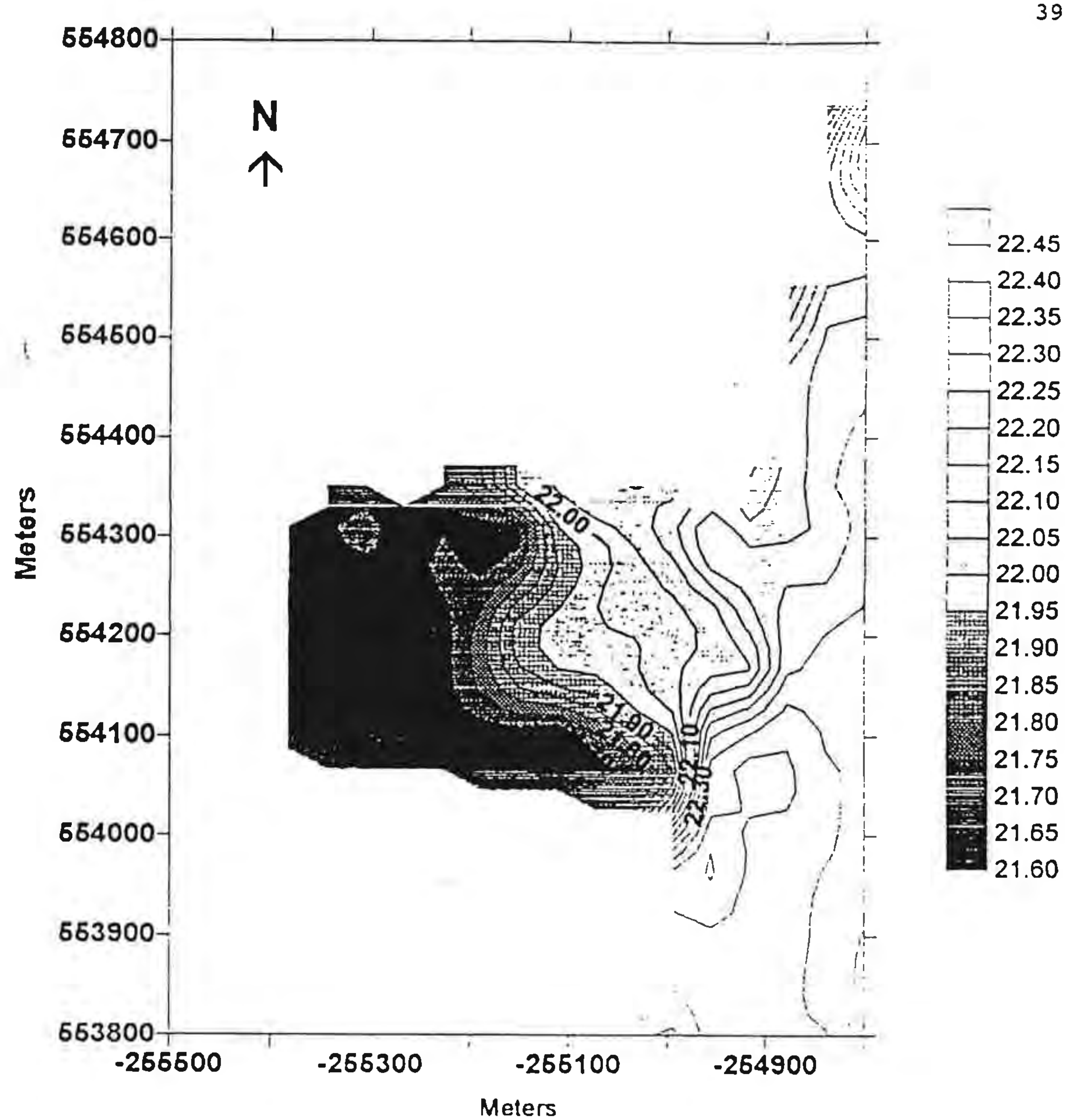

Figure 17b. Average surface salinity in the Canal Entrance area for the east-west cut (Case 3) predicted for 20 May, 1996. Salinity values are in practical salinity units (psu).

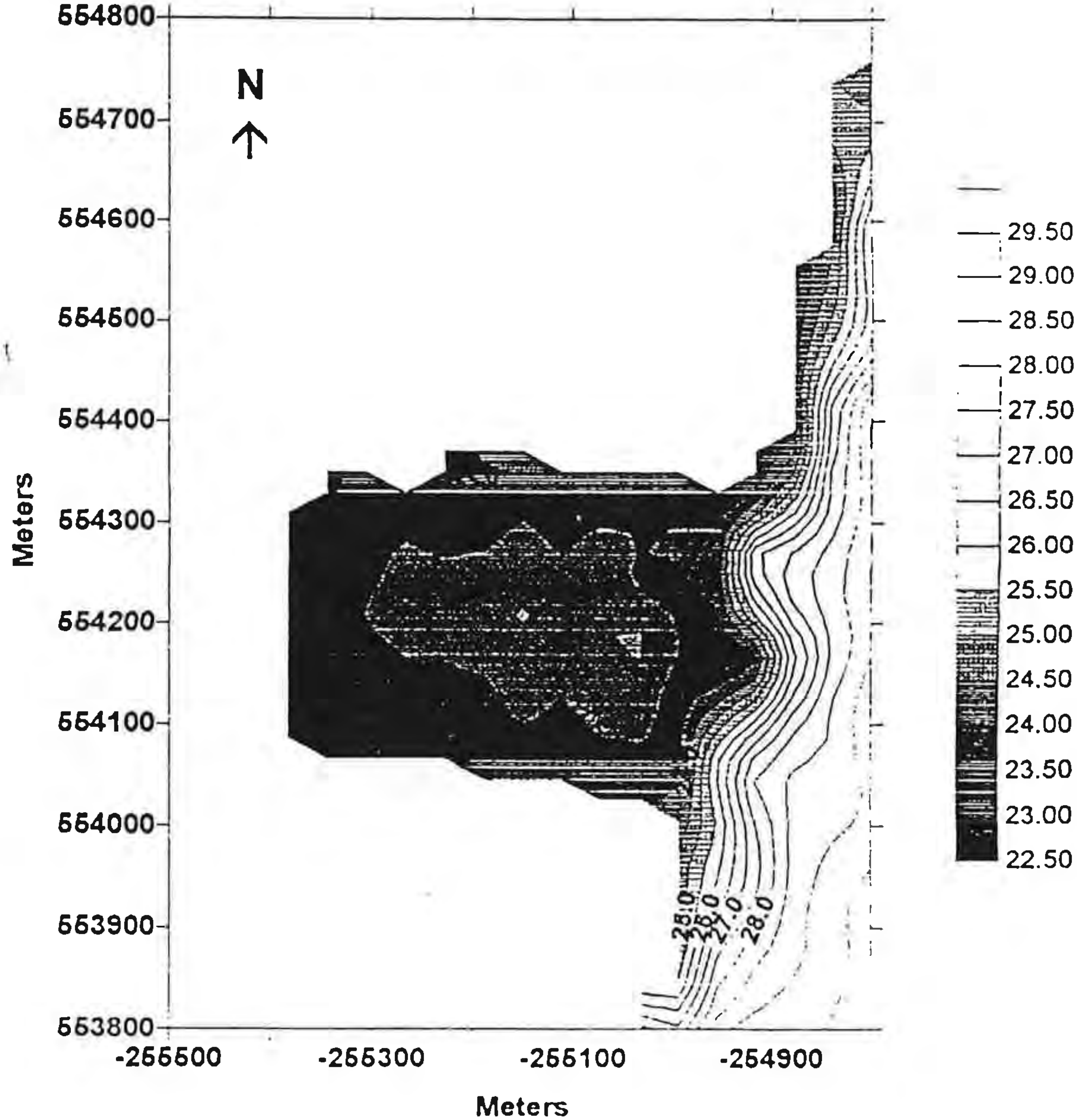

Figure 18a. Average bottom salinity in the Canal Entrance area for the base condition (Case 1) predicted for 20 May, 1996 Salinity values are in practical salinity units (psu).

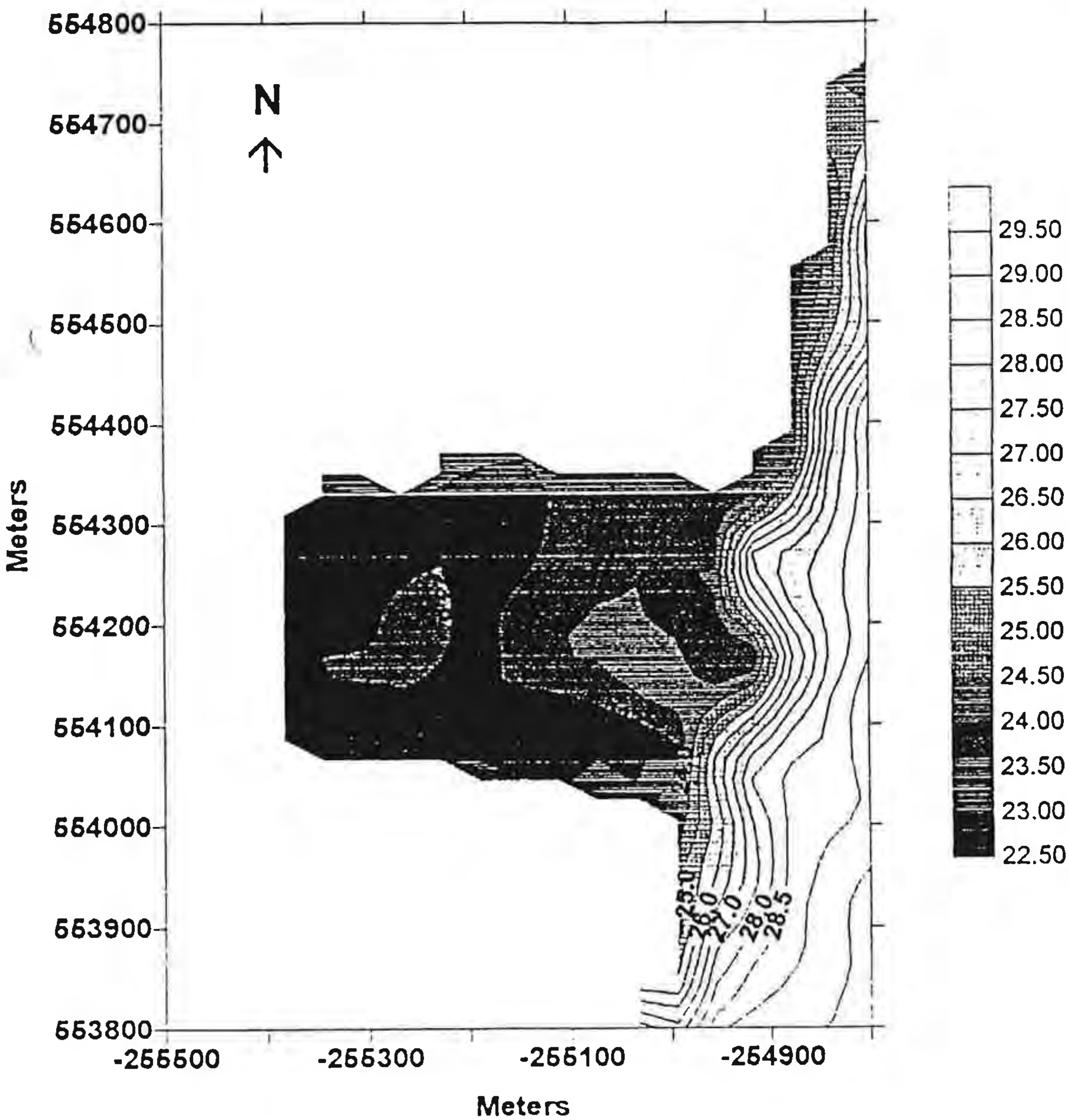

Figure 18b. Average bottom salinity in the Canal Entrance area for the east-west (Case 3) predicted for 20 May, 1996. Salinity values are in practical salinity units (psu).

8.0 Conclusions and Recommendations for Modification of the Long Slip Canal Entrance Basin

Results of model simulations of the Hudson River Estuary between Castle Point and the Battery are consistent with previous observations of circulation and mixing in the region. Surface tidal currents are ebb-dominated and enhanced by seaward flowing fresh water mixed in the upper layers of the estuary. Tidal currents at mid-depth are more evenly distibuted with respect to the strength of ebb and flood and largely below the most significant portion of freshwater discharge. Mid-depth currents are also in the portion of the water column least affected by residual (estuarine) circulation. Near bottom flows in the Hudson River flood dominated when viewed at tidal frequency and influenced by residual flows directed headward into the estuary.

Residual flows, which become apparent when tidal currents are removed from predicted currents by averaging, indicate that the lower Hudson River is a partially mixed estuary. Near-surface residual currents are directed seaward consisting of a mixture of fresh and salt water. Bottom residual flows of high salinity water are directed headward into the estuary to balance the net seaward loss of salt water in the upper layers of the estuary advected seaward with freshwater discharge

The vertical salinity distribution predicted for lower Hudson River is consistent with the partially mixed condition of the Estuary. Salinity in the surface layers of the estuary is significantly lower compared to salinity at mid-depth and lower. This pattern is due to the lighter, more buoyant fresher water moving seaward in surface layers and the denser, higher salinity water moving headward in the lower layers of the estuary.

Model simulations using the EFDC 3-D hydrodynamic and salt transport model indicate that the Entrance area adjacent to the Long Slip Canal is weakly flushed by small tidal currents and retains the vertical stratification of the partially mixed Hudson Estuary. Under present conditions it is likekly that flushing of this area and water quality conditions will remain poor.

Results of circulation and salinity simulations in the Long Slip Canal Entance area indicate that excavation by dredging to increase depth will increase tidal flushing and salinity levels by promoting stronger mixing and exchange with the adjacent Hudson River Estuary. Model predictions to determine the optimal configuration for tidal flushing and mixing in the Long Slip Canal Entrance area indicate that an increase in depth having the configuration of an east-west oriented channel will provide the most improvement. Compared with the exisiting topography and a north-south oriented cut through the pile filed in the Entrance area, the east-west cut (Case 3) resulted in slightly stronger tidal currents and an increase in salinity at both tidal frequencies and on a daily average basis. Stronger tidal flows are likely to promote better exchange of high salinity water from the adjacent Hudson River and better vertical mixing. The result of these process is most apparent in prediction of daily average salinity. Predictions of salinity for the mid-to outer Entrance area show an increase in salinity for Case 3 relative to the other test cases. Predicted salinity results for the inner zone of the Canal Entrance area, adjacent to Long Slip Canal, show an increase In surface salinity and at some locations, a decrease in bottom salinity for Case 3 relative to the other cases. This indicates vertical mixing of lower salinity surface water downward to the bottom layers of the water column.

Based on model simulations the recommended modification to the Long Slip Canal Entrance area is a channel-like cut having an east-west orinentation. This modification will promote better exchange between the Entrance basin and the Hudson River, stronger vertical mixing within the Entrance, and overall improvment of flushing. The recomended dimensions of the cut are approximately 120 feet wide and 400 feet long in the east-west dimension toward the Hudson River. Under the recommended configuration low oxygen water in the Canal Entrance area will be more efficiently replaced by the better oxygenated waters of the Hudson River .

8.0 References

Blumberg, A.F., and H.J. Herring. 1987. Circulation modeling using orthogonal curvilinear coordinates, In: Three Dimensional Models of Marine and Estuarine Dynamics, J.C.J. Nihoul and B.M. Jamart, Ed., Elsvier Oceanography Series, 45, 55-88.

Blumberg, A.F., and G.L. Mellor, 1987: A description of a three-dimensional coastal ocean circulation model. Three-Dimensional Coastal Ocean Model, N.S. Heaps, E., American Geophysical Union.

Blumberg, A.F., and L.H. Kantha. 1985. Open boundary condition for circulation models, J. Hydraul. Eng., 111, 237-255.

Byran, K. 1969. A numerical method for the study of the circulation of the world ocean, J. Comput. Phys., 4, No. 3, 347-376.

Caponi, E.A. 1976. A three-dimensional model for the numerical simulation of estuaries, in Advances in Geophysics, Vol. 19, 189-310.

Chanley, P. 1958. Survival of some juvenile bivalves in water of low salinity. Proc. Nat. Shellfisheries Assoc. 48:52-65.

Cheng, R.T. and P.E. Smith, 1989. "A Survey of Three-Dimensional Numerical Estuarine Models." Proceedings of Estuarine and Coastal Modeling, New port, RI.

Davies, A.M. 1980. Application of the Galerkin method to the formulation of a three-dimensional numerical sea model. Applied Math. Modelling, Vol. 4, 245-256.

Davies, A.M. 1983. Numerical modeling of stratified flow; a spectral approach, Continental Shelf Research, Vol. 2, No. 4, 275-300.

Davis, H.C. 1958. Survival and growth of clam and oyster larvae at different salinities. Biol Bull. 114(3): 296-307.

Dombrowski, M., F. Morris, and Richard. 1987. Hydrodynamics. 3-1 through 3-27, In: Indian River Lagoon Joint Reconnaissance Report (J. Steward and J. Van Armen, eds.) St. Johns River Water Management Dist. and South Florida Water Management Dist.

Dortch, M.S., R.S. Chapman, J.M. Hamrick and T.K. Gerald. 1989: Interfacing three-dimensional hydrodynamic and water quality models of Chesapeake Bay. Estuarine and Coastal Modeling, M.L. Spaulding, Ed., American Society of Civil Engineers.

Duwe, K.C., R.R. Hewer, and J.O. Backhaus. 1983. Results of a semi-implicit two-step method for the simulation of markedly nonlinear flow in coastal seas, Continental Shelf Research, Vol. 2, No. 4, 255-274.

Feng, Shih-zao. 1977. A three-dimensional nonlinear model of tides, Scientia Sinica, Vol. XX, No. 4, 436-446.

Galperin, B., L.H. Kantha, S. Hassid, and A. Rosati. 1988: A Quasi-equilibrum turbulent energy model for geophysical flows. J, Atmos. Sci, 45, 55-62.

Glaztel, K.A.R. 1986. Water budget for the Indian River lagoon: an overview of land use effects, M.S. Thesis, Florida Institute of Technology, Melbourne, Florida.

Gordon, R.B., and M.L. Spaulding. 1987. Numerical Simulations of the tidal - and wind-driven circulation in Narragansett Bay, Estuarine, Coastal and Shelf Science, Vol. 24, 611-636.

Gunter, G., B.S. Ballard, and A. Venkataramalah. 1973. Salinity problems of organisms in coastal areas subject to the effect of engineering works. Contract Report H-73-3. U.S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi.

Hamrick, J.M. 1990a: Computing the mean mass transport field for interfacing hydrodynamic and water quality models. Virginia Institute of Marine Science, Division of Physical Oceanography, Report to the U.S. Army Corps of Engineers, Water-ways Experiment Station.

Hamrick, J.M. 1990b. Numerical predictions of estuarine physical processes over a range of time scales. EOS, Transactions, American Geophysical Union, 71, 1415.

Heaps, N.S. 1973. Three-dimensional numerical model of the Irish Sea, Geophy. J.R. Astron. Soc., Vol. 35, 99-120.

Johnson, B.H., K.W. Kim, Y.P. Sheng and R.E. Heath. 1989. "Development of Three-Dimensional Hydrodynamic Model of Chesapeake Bay". Proceedings of Estuarine and Coastal Modeling, Newport, R.I.

Kawahara, M., M. Kobayashi, and K. Nakata. 1983. Multiple level finite element analysis and its application to tidal current flow and its application to tidal current flow in Tokyo Bay, Applied Math, Modelling, Vol. 7, No. 6, 197-211.

King, Ian P. 1985. Strategies for finite element modeling of three-dimensional hydrodynamic systems. Adv. Water Resour., Vol. 8, 69-76

Kjerfve, B.J. 1986. Comparative Oceanography of Coastal Lagoons. 63-81. In: Wolfe, D.A. (ed), Estuarine Variability. Academic Press, New York.

Leendertse, J.J., and S.K. Liu. 1975. A three-dimensional model for estuaries and coastal seas, Volume II: Aspects of computation, R-1764-OWRT, Rand Corp, Santa Monica.

Liu, S.K., and J.J. Leendertse. 1978. Multidimensional numerical modeling of estuaries and coastal seas, in Advances in Hydroscience, Vol. II, 95-164.

Lynch, D.R., and F.E. Werner. 1987. Three-dimensional hydrodynamics on finite elements. Part I: Linearized harmonic model, Inter. J. for Num. Meth. in Fluids, Vol. 7, 871-909.

Mellor, G.L., and T. Yamada. 1982: Development of a turbulence closure model for geophysical fluid problems, Rev. Gaffes. Space Phys., 20, 851-875.

Mellor, G.L., and T. Yamada. 1974. A hierarchy of turbulence closure models for planetary boundary layers, J. Atmos. Sci., 31, 1871-1986.

Owen, A. 1980. A three-dimensional model of the Bristol Channel, J. Phys. Oceano., Vol. 10, No. xx, 1290-1302.

Oey, L.Y., G. Mellor, and R.I. Hires. 1985a. A three-dimensional simulation of the Hudson-Raritan Estuary. Part I: Description of the model and model simulations, J. Phys. Oceano., Vol. 15, No. 12, 1676-1692.

Oey, L.Y., G. Mellor, and R. I. Hires. 1985b. A three-dimensional simulation of the Hudson-Raritan Estuary. Part II. Comparison with observation, J. Phys. Ocean., Vol. 15, 1711-1720.

Oey, L.Y., G. Mellor, and R.I. Hires. 1985c. A three-dimensional simulation of the Hudson-Raritan Estuary. Part III: Salt flux analyses, J. Phys. Oceano., Vol. 15, No. 12, 1711-1720.

Phillips, N.A. 1957. A coordinate system having some special advantages for numerical forecasting, J. Meteorol., 14, 184-185

Roache, P.J. 1976. Computational Fluid Dynamics. Hermosa Publishers: Albuquerque.

Sheng, Y.P. and J-K Choi, 1990 A three-dimensional Numerical Model of the James River and Hampton Roads Estuarine Systems, University of Florida COEL-89/020

Simons, T.J. 1973. Development of three-dimensional numerical models of the Great Lakes, Canada Center for Inland Waters, Scientific Series No. 12, Burlington, Ontario, Canada.

Smagorinsky, J. 1963. General circulation experiments with the primitive equations, I. The basic experiment, Mon. Weather Rev., 91, 99-164.

Stephens, C.V. 1986. A three-dimensional model for tides and salinity in the Briston Channel, Continental Shelf Research, Vol. 6. No. 4, 531-560.

Tee, K.T. 1987. Simple models to simulate three-dimensional tidal and residual currents, in Three-dimensional Coastal Ocean Models, Coastal and Estuarine Sciences, Vol. 4, N.S. Heaps, Editor, AGU, Washington, DC, 125-147.

Toth, D.J. 1982. Hydrogeology. Indian River Lagoon joint reconnaissance report. St. Johns River Water Management District, Contract No. CMB-1137.

Weatherly, G., and P.J. Martin. 1978. On the structure and dynamics of the ocean bottom boundary layer, J. Phys. Oceanogr., 8, 557-570.

APPENDIX A:

Description of the Environmental Fluid Dynamics Code

A.1 Hydrodynamics and Salinity and Temperature Transport

The physics of the EFDC model and many aspects of the computational scheme are equivalent to the widely used Blumberg- Mellor model (Blumberg & Mellor, 1987) and U. S. Army Corps of Engineers' CH3D or Chesapeake Bay model (Johnson, et al, 1993). The EFDC model solves the three-dimensional, vertically hydrostatic, free surface, turbulent averaged equations of motions for a variable density fluid. Dynamically coupled transport equations for turbulent kinetic energy, turbulent length scale, salinity and temperature are also solved. The two turbulence parameter transport equations implement the Mellor-Yamada level 2.5 turbulence closure scheme (Mellor & Yamada, 1982; Galperin et al, 1988). The EFDC model uses a stretched or sigma vertical coordinate and Cartesian or curvilinear, orthogonal horizontal coordinates. The numerical scheme employed in EFDC to solve the equations of motion uses second order accurate spatial finite differencing on a staggered or C grid. The model's time integration employs a second order accurate three-time level, finite difference scheme with a internal-external mode splitting procedure to separate the internal shear or baroclinic mode from the external free surface gravity wave or barotropic mode. The external mode solution is semi-implicit, and simultaneously computes the two-dimensional surface elevation field by a preconditioned conjugate gradient procedure. The external solution is completed by the calculation of the depth average barotropic velocities using the new surface elevation field. The model's semi-implicit external solution allows large time steps which are constrained only by the stability criteria of the explicit central difference or high order upwind advection scheme (Smolarkiewicz and Margolin, 1993) used for the nonlinear accelerations.

Horizontal boundary conditions for the external mode solution include options for simultaneously specifying the surface elevation only, the characteristic of an incoming wave (Bennett & McIntosh, 1982), free radiation of an outgoing wave (Bennett, 1976; Blumberg & Kantha, 1985) or the normal volumetric flux on arbitrary portions of the boundary. The EFDC model's internal momentum equation solution, at the same time step as the external, is implicit with respect to vertical diffusion. The internal solution of the momentum equations is in terms of the vertical profile of shear stress and velocity shear, which results in the simplest and most accurate form of the baroclinic pressure gradients and eliminates the over determined character of alternate internal mode formulations. Time splitting inherent in the three time level scheme is controlled by periodic insertion of a second order accurate two time level trapezoidal step. The EFDC model is also readily configured as a two-dimensional model in either the horizontal or vertical planes.The EFDC model implements a second order accurate in space and time, mass conservation fractional step solution scheme for the Eulerian transport equations for salinity, temperature, suspended sediment, water quality constituents and toxic contaminants. The transport equations are temporally integrated at the same time step or twice the time step of the momentum equation solution (Smolarkiewicz and Margolin, 1993). The advective step of the transport solution uses either the central difference scheme used in the POM or a hierarchy of positive definite upwind difference schemes.

The highest accuracy upwind scheme, second order accurate in space and time, is based on a flux corrected transport version Smolarkiewicz's multidimensional positive definite advection transport algorithm (Smolarkiewicz & Clark, 1986, Smolarkiewicz & Grabowski, 1990) which is monotonic and minimizes numerical diffusion. The horizontal diffusion step, if required, is explicit in time, while the vertical diffusion step is implicit. Horizontal boundary conditions include time variable material inflow concentrations, upwinded outflow, and a damping relaxation specification of climatological boundary concentration. For the temperature transport equation, the NOAA Geophysical Fluid

Dynamics Laboratory's atmospheric heat exchange model (Rosati & Miyakoda, 1988) is implemented.

A.2 Sediment Transport

The EFDC code is capable of simulating the transport and fate of multiple size classes of cohesive and noncohesive suspended sediment including bed deposition and resuspension. Water column transport is based the same high order advection-diffusion scheme used for salinity and temperature. A number of options are included for the specification of settling velocities. For the transport of multiple size classes of cohesive sediment, an optional floculation model (Burban, et al., 1989, 1990) can be activated. Sediment mass conservative deposited bed formulations are included for both cohesive and noncohesive sediment. The deposited bed may be represented by a single layer or multiple layers. The multiple bed layer option provides a time since deposition versus vertical position in the bed relationship to be established. Water column-sediment bed interface elevation changes can be optionally incorporated into the hydrodynamic continuity equation. An optional, one dimensional in the vertical, bed consolidation calculation can be performed for cohesive beds.

A.3 Water Quality and Eutrophication Simulation

The EFDC code includes two internal eutrophication submodels for water quality simulation (Park, et al., 1995) The simple or reduced eutrophication model is functionally equivalent to the WASP5 EUTRO model (Ambrose, et al., 1993). The complex or full eutrophication model is functionally equivalent to the CE-QUAL-ICM or Chesapeake Bay Water Quality model (Cerco and Cole, 1993). Both water column eutophication models are coupled to a functionally equivalent implementation of the CE-QUAL-ICM sediment diagensis or biogeochemical processes model (DiToro and Fitzpatrick, 1993). The eutrophication models can be executed simultaneously with the hydrodynamic component of EFDC, or EFDC simulated hydrodynamic transport fields may be saved allowing the EFDC code to executed in a water quality only simulation model. The computational scheme used in the internal eutrophication models employes a fractional step extension of same advective and diffusive algorithms used for salintiy and temperature, which guarantees positive constituent concentrations. A novel orderng of the reaction sequence in the reactive source and sink fractional step allows the linearized reactions to be solved implicitly further guaruntee positive concentrations. The euthrophication models accept an arbitrary number of point and nonpoint source loadings as well as atmospheric and ground water loadings. In addition to the internal eutrophication models, the EFDC model can be externally linked to the WASP5 model. In the external linking mode, the EFDC model generates WASP5 input files describing cell geometries and connectivity as well and advective and diffusive transport fields. For estuary simulation, the transport fields may be intratidally time averaged or intertidally time averaged using the averaging procedure described by Hamrick (1994a).

A.4 Toxic Contaminant Transport and Fate

The EFDC code includes two internal submodels for the simulating the transport and fate of toxic contaminants. A simple, single contaminant, submodel can be activated from the master input file. The simple model accounts for water and suspended sediment phase tranport with equilbrium partiationing and a lumped first order reaction. Contaminant mass per unit area in the sediment bed is also simulated. The second, more complex, submodel simulates the transport and fate of an arbitrary number of reacting contaminants in the water and sediment phases of both the water column and sediment bed. In this mode, the contaminant transport and fate simulation is functionally similar to the WASP5 TOXIC model (Ambrose, et al., 1993) with the added flexibility of simulating an arbitrary number of contaminants, and the improved accuracy of utilizing more complex three-dimensional physical transport fields in a highly accurate numerical transport scheme. Water-sediment phases interaction may be represented by equilibrium or nonlinear sorption processes. In this mode, the multilayer sediment bed formulation is active, with sediment bed water volume and dissolved contaminant mass balances activate to allow contaminants to reenter the water column by both sediment resuspension, pore water expulsion due to consolidation, and diffusion from the pore water into the water colunm. The complex contaminant model activates a subroutine describing reaction processes with appropriate reactions parameters provided by toxic reaction processes input file.

A.5 Finfish and ShellFish Transport

The EFDC code includes the capability of simulating the transport and fate of various life stages of finfish and shellfish. In addition to advection and diffusion by the ambient flow, mortality, predation, toxicity and swimming behavior are simulated. Organism age and ambient environment queued vertical and horizontal swimming and settling is simulated. Environmental queues include light intensity, temperature, salinity and tidal phases.

A.6 Near Field Discharge Dilution and Mixing Zone Analysis

In addition to the far field tranport and fate simulation capability incorporated into the EFDC code's water quality and toxic contaminat modules, the code includes a near field discharge dilution and mixing zone module. The near field model is based on a Lagrangian buoyant jet and plume model (Frick, 1984; Lee and Cheung, 1990) and allows representation of submerged single and multiple port diffusers and buoyant surface jets. The near field model provides analysis capabilities similar to CORMIX (Jirka and Doneker, 1991; Jirka and Akar, 1991) while offering two distinct advantages. The first advantage is that a more realistic representation of ambient current and stratification conditions, provided directly by the EFDC hydrodynamic module, is incorporated into the analysis. The second advantage is that multiple discharges and multiple near field analysis times may be specified to account for varying ambient current and stratification conditions.

For example, the analysis of ten discharges under six ambient conditions each would require 60 executions of CORMIX, while the entire analysis of the 60 situations would be produced in a single EFDC simulation. The near field simulation may be executed in two modes, the first providing virtual source information for representing the discharges in a standard EFDC far field transport and fate simulation. The second mode directly couples the near field and far field transport modes, again using a virtual source formulation, during simultaneous near and far field transport and fate simulation.

A.7 Spill Trajectory and Search and Rescue Simulation

In addition to the Eulerian transport equation formulation used for far field analysis and the Lagrangian jet and plume module used for near field analyis, the EFDC code incorporates a number of Lagrangian particle transport fromulations based on an implicit trilinear interpolation scheme (Bennett & Clites, 1987). The first formulation allows release of neutrally buoyant or buoyant drifters at user specified locations and times. This formulation is useful in simulating spill trajectories, search and rescue operations, and oceanographic instrument drifters. The second formulation releases drifters in each three-dimensional model cell at a specified sequence of times and calculates the generalized Lagrangian mean velocity field (Andrews and McIntyre, 1978) relative to a users specified averaging interval.

A.8 Wetland, Marsh and Tidal Flat Simulation Extension

The EFDC model provides a number of enhancements for the simulation of flow and transport in wetlands, marshes and tidal flats. The code allows for drying and wetting in shallow areas by a mass conservative scheme. The drying and wetting formulation is coupled to the mass transport equations a manner which prevents negative concentrations of dissolved and suspended materials. A number of alternatives are in place in the model to simulate general discharge control structures such as weirs, spillways, culverts and water surface elevation activated pumps. The effect of submerged and emergent plants is incorporated into the turbulence closure model and flow resistance formulation. Plant density and geometric characteristic of individual and composite plants are required as input for the vegetation resistance formulation. A simple soil moisture model, allowing rainfall infiltration and soil water loss due to evapotranspiration under dry conditions, is implemented. To represent narrow channels and canals in wetland, marsh and tidal flat systems, a subgrid scale channel model is implemented. The subgrid channel model allows a network of one-dimensional in the horizontal channels to be dynamically coupled to the two-dimensional in the horizontal grid representing the wetland, marsh or tidal flat system. Volume and mass exchanges between 2-D wetland cells and the 1-D channels are accounted for. The channels may continue to flow when the 2-D wetland cells become dry.

A.9 Nearshore Wave Induced Currents and Sediment Transport Extensions

The EFDC code includes a number of extensions for simulation of nearshore wave induced currrents and noncohesives sediment transport. (Zarillo et al., 1996). The extensions include: a wave-current boundary layer formulation similar to that of Grant and Madsen (1986); modifications of the hydrodynamic model's momentum equations to represent wave period averaged Eulerian mean quantities; the inclusion of the three-dimensional wave induced radiation or Reynold's stresses in the momentum equations; and modifications of the velocity fields in the transport equations to include advective transport by the wave induced Stoke's drift. High frequency surface wave field are provide by an external wave refraction-diffraction model or by a internal mild slope equation submodel similar to that of Madsen and Larsen (1987). The internal refraction-diffraction computation is executed on a refined horizontal grid coincident with the main model's horizontal grid.

A.10 References

Ambrose, R. B., T. A. Wool, and J. L. Martin, 1993: The water quality analysis and simulation program, WASP5: Part A, model documentation version 5.1. U. S. EPA, Athen Environmental Research Laboratory, 210 pp.

Andrews, D. G., and M. E. McIntyre, 1978: An exact theory for of nonlinear waves on a Lagrangian flow. J. Fluid Mech., 89, 609-646.

Bennett, A. F., 1976: Open boundary conditions for dispersive waves. J. Atmos. Sci., 32, 176-182.

Bennett, A. F., and P. C. McIntosh, 1982: Open ocean modeling as an inverse problem: tidal theory. J. Phys. Ocean., 12, 1004-1018.

Bennett, J. R., and A. H. Clites, 1987: Accuracy of trajectory calculation in a finite-difference circulation model. J. Comp. Phys., 68, 272-282.

Blumberg, A. F., and L. H. Kantha, 1985: Open boundary condition for circulation models. J. Hydr. Engr., 111, 237-255.

Blumberg, A. F., and G. L. Mellor, 1987: A description of a three-dimensional coastal ocean circulation model. In: Three-Dimensional Coastal Ocean Models, Coastal and Estuarine Science, Vol. 4. (Heaps, N. S., ed.) American Geophysical Union, pp. 1-19.

Burban, P. Y., W. Lick, and J. Lick, 1989: The flocculation of fine-grained sediments in estuarine waters. J. Geophys. Res., 94, 8323-8330.

Burban, P. Y., Y. J. Xu, J. McNeil, and W. Lick, 1990: Settling speeds of flocs in fresh and seawater. J. Geophys. Res., 95, 18,213-18,220.

Cerco, C. F., and T. Cole, 1993: Three-dimensional eutrophication model of Chesapeake Bay. J. Environ. Engnr., 119, 1006-1025.

Cole, T. M., and E. M. Buchak, 1994: CE-QUAL-W2: A two-dimensional laterally averaged, hydrodynamic and water quality model, Version 2.0. U. S. Army Corps of Engineers, Waterway Experiment Station, Vicksburg, MS, Report ITL-93-7.

DiToro, D. M., and J. F. Fitzpatrick, 1993: Chesapeake Bay sediment flux model. Prepared by HydroQual, Inc. for U. S. EPA Chesapeake Bay Program, U. S. Army Engineer District, Baltimore, MD, and U. S. Army Engineer Waterways Exp. Station. Contract Report EL-93-2, 200 pp.

Frick, W. E., 1984: Non-empirical closure of the plume equations, Atmospheric Environment, 18, 653-662

Galperin, B., L. H. Kantha, S. Hassid, and A. Rosati, 1988: A quasi-equilibrium turbulent energy model for geophysical flows. J. Atmos. Sci., 45, 55-62.

Grant, W. D., and O. S. Madsen, 1986: The continental-shelf bottom boundary layer. In: Annual Review of Fluid Mechanics, (Van Dyke, M. et al., eds.) Annual Review, Inc., pp. 365-306.

Hamrick, J. M., 1992a: A Three-Dimensional Environmental Fluid Dynamics Computer Code: Theoretical and Computational Aspects. The College of William and Mary, Virginia Institute of Marine Science. Special Report 317, 63 pp.

Hamrick, J. M., 1992b: Estuarine environmental impact assessment using a three-dimensional circulation and transport model. Estuarine and Coastal Modeling, Proceedings of the 2nd International Conference, M. L. Spaulding et al, Eds., American Society of Civil Engineers, New York, 292-303.

Hamrick, J. M., 1994: Linking hydrodynamic and biogeochemcial transport models for estaurine and coastal waters. Estuarine and Coastal Modeling, Proceedings of the 3nd International Conference, M. L. Spaulding et al, Eds., American Society of Civil Engineers, New York, 591-608.

Hamrick, J. M., 1996a: A User's Manual for the Environmental Fluid Dynamics Computer Code (EFDC). The College of William and Mary, Virginia Institute of Marine Science, Special Report 331, 234 pp.

Hamrick, J. M., and T. S. Wu, 1996. Computational design and optimization of the EFDC/HEM3D surface water hydrodynamic and eutrophication models. Computational Methods for Next Generation Environmental Models, G. Delich, Ed., Society of Industrial and Applied Mathematics, Philadelphia, in press.

Jirka, G. H., and R. L. Doneker, 1991 Hydrodynamic classification of submerged single-port discharges, Journal of Hydraulic Engineering, 117, 1095-1112.

Jirka, G. H., and P. J. Akar, 1991: Hydrodynamic classification of submerged multiport-diffuser discharges, Journal of Hydraulic Engineering, 117, 1113-1128.

Johnson, B. H., K. W. Kim, R. E. Heath, B. B. Hsieh, and H. L. Butler, 1993: Validation of three-dimensional hydrodynamic model of Chesapeake Bay. J. Hyd. Engrg., 119, 2-20.

Kang, I. S., and L. G. Leal, 1992. Orthogonal grid generation in a 2D domain via the boundary integral technique. J. Comp. Phys., 102, 78-87.

Lee, J. H. W., and V. Cheung, 1990: Generalized Lagrangian model for buoyant jets in a current. J. Environ. Engrg., 116, 653-662.

Madsen, P. A., and J. Larsen, 1987: An efficient finite-difference approach to the mild-slope equation. Coastal Engr., 11, 329-351.

Mellor, G. L., and T. Yamada, 1982: Development of a turbulence closure model for geophysical fluid problems. Rev. Geophys. Space Phys., 20, 851-875.

Mobley, C. D., and R. J. Stewart, 1980: On the numerical generation of boundary-fitted orthogonal Curvilinear coordinate systems. J. Comp. Phys., 34, 124-135.

Moustafa, M. Z., and J. M. Hamrick, 1994: Modeling circulation and salinity transport in the Indian River Lagoon. Estuarine and Coastal Modeling, Proceedings of the 3nd International Conference, M. L. Spaulding et al., Eds., American Society of Civil Engineers, New York, 381-395.

Park, K., A. Y. Kuo, J. Shen, and J. M. Hamrick, 1995: A three-dimensional hydrodynamic-eutrophication model (HEM3D): description of water quality and sediment processes submodels. The College of William and Mary, Virginia Institute of Marine Science. Special Report 327, 113 pp.

Rennie, S., and J. M. Hamrick, 1992: Techniques for visualization of estuarine and coastal flow fields. Estuarine and Coastal Modeling, Proceedings of the 2nd International Conference, M. L. Spaulding et al, Eds., American Society of Civil Engineers, New York, 48-55.

Rosati, A. K., and K. Miyakoa, 1988 A general circulation model for upper ocean simulation. J. Phys. Ocean., 18, 1601-1626

Ryskin, G. and L. G. Leal, 1983 Orthogonal mapping. J. Comp. Phys., 50, 71-100.

Smolarkiewicz, P. K., and T. L. Clark, 1986: The multidimensional positive definite advection transport algorithm: further development and applications. J. Comp. Phys., 67, 396-438.

Smolarkiewicz, P. K., and W. W. Grabowski, 1990: The multidimensional positive definite dvection transport algorithm: nonoscillatory option. J. Comp. Phys., 86, 355-375.

Smolarkiewicz, P. K., and L. G Margolin, 1993: On forward-in-time differencing for fluids: extension to a curvilinear framework. Mon. Weather Rev., 121, 1847-1859.

Wu, T. S., J. M. Hamrick, S. C. McCutechon, and R. B. Ambrose, 1996. Benchmarking the EFDC/HEM3D surface water hydrodymamic and eutrophication models. Computational Methods for Next Generation Environmental Models, G. Delich, Ed., Society of Industrial and Applied Mathematics, Philadelphia, in press.

Zarillo, G. A., and Surak, C.R., 1996. Testng the feasibility of a submerged reef for shore protection using a three-dimensional numerical model.. Report to the Department of Publc Works, Indain River County , Florida.

Hoboken Rail Yard
Long Slip Canal Habitat Creation Project

Application of a Three-Dimensional Numerical Model to Evaluate Water Quality Improvements in the Long Slip Canal Entrance Basin

Dissolved Oxygen Predictions

August 25, 1997

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1.0 Introduction and Goals

The overall goal of three dimensional modeling is to optimize the topographic configuration of the Long Slip Canal Entrance area for water quality improvement. In Phase I of the modeling work three dimensional modeling was used to test various topographic configurations of the Canal Entrance area for improved tidal action, vertical mixing and flushing. The concept was to promote stronger hydrodynamic exchange with the adjacent Hudson River Estuary. Tasks accomplished in Phase I of this effort include selection of the appropriate modeling scheme, model setup to simulate tidal action, estuarine circulation of the lower Hudson River, and a series of model runs to simulate flushing action in the Long Slip Canal Entrance area. The results of Phase I demonstrated that a dredged cut in the Canal entrance area having an east-west length of approximately 300 meters (980 feet), a north-south dimension of approximately 80 meters (260 feet), and depths between 3 and 10 meters produced the greatest improvement in flushing action according to model results. Therefore, an east-west cut in the Canal Entrance area with these dimensions and a volume of approximately 133,000 cubic yards is the basic design of alterations to the Canal entrance for improving and maintaining water quality.

In this phase of the modeling effort the existing configuration and altered configuration of the Canal Entrance area are tested for effects on dissolved oxygen (DO) concentration, which is considered a good indicator of overall water quality (Cerco, 1992). For the altered configuration of the Canal Entrance area, the east-west cut is used in all model test runs. However, three distinctive designs for the walkway along the perimeter of the Canal entrance basin were placed in the model since each design has a separate impact on the configuration and volume of the east-west cut. The specific objectives completed in this phase of the modeling study include 1) simulation of dissolved oxygen concentrations in the Canal entrance basin for the base condition of no topographic modification, 2) simulation of dissolved oxygen levels in the entrance area in response to the excavated east-west cut, and 3) simulation of dissolved oxygen levels for combinations of the east-west cut and three walkway designs.

2.0 Model Setup And Application

2.1 Model Description

The Environmental Fluid Dynamics Code (EFDC) was used to predict dissolved oxygen level in the Canal Entrance area. This is a comprehensive modeling package for simulating three-dimensional flow, transport and biogeochemical processes in surface water systems including: rivers, lakes, estuaries, reservoirs, wetlands and near shore to shelf -scale coastal regions (Hamrick, 1992). EFDC code has been extensively tested and documented in more than twenty modeling studies. The major features and capabilities of the EFDC modeling package are described in the Phase I report on flushing in the Canal Entrance area, which includes an appendix describing model capabilities. The three-dimensional aspect provided by EFDC is required in this case since the lower Hudson River is a partially stratified estuary having strong vertical differences in salinity and flow patterns. Therefore, only 3-D models capable of predicting the vertical distribution of currents, salinity, and water quality parameters are appropriate for this application. There are likely to be strong vertical gradients iwith respect to constituents like dissolved oxygen, which influence productivity and water quality of the lower Hudson River.

2.2 Model Setup for Dissolved Oxygen Simulations

The EFDC model was setup for the Long Slip Canal entrance area and the Lower Hudson River between The Battery and Castle Point approximately 1 mile to the north of the Canal Entrance. Model setup required acquisition of topographic data (Figure 1) and boundary (shoreline) coordinates for the project area and the surrounding Hudson River. These data were digitized from National Ocean Survey chart 12335 and used as input to the software that generates the computational grid for EFDC. The overall grid includes approximately 1048 active water cells. The grid is curvilinear-orthogonal and includes smaller cells in areas where good resolution is required and larger cells in areas distal from the project site. The Canal Basin area, which includes the proposed cut is resolved by 60 cells ranging size from 30 meters to 80 meters on a side (Figure 2). The basin dimensions are approximately 400 meters by 800 meters.

The EFDC model requires a number of input data files to set-up the initial conditions of the physical domain and to provide boundary conditions during simulation. Boundary conditions for model runs include times series of water surface elevation, salinity, water temperature, freshwater inflow, meteorological parameters and other measured water quality parameters. A master input file directs the input time series to a specific cell within the modal domain and sets all time-related and space-related parameters.

2.3 Model Application to Predict Dissolved Oxygen Concentrations

The model application for predicting oxygen concentration was accomplished in eight distinct model runs as listed in Table 1. A base condition was run to predict dissolved oxygen concentrations for the existing topography of the Long Slip Canal Basin. Under this condition the model was run for the same 31-day period as the first model application under Phase I to simulate conditions in May 1996. Model output was designed to provide daily average DO concentrations to eliminate the effects of diurnal changes in DO concentrations from water temperature fluctuation and changes due to the semidiurnal tide that dominated the hydrodynamics. Model simulations viewed as a daily average can provide insight of trends that may occur due to mixing and flushing over a 30-day period in the Canal Entrance area, as well as the trends already present in the measured DO data specified at the model boundaries (Figure 3).

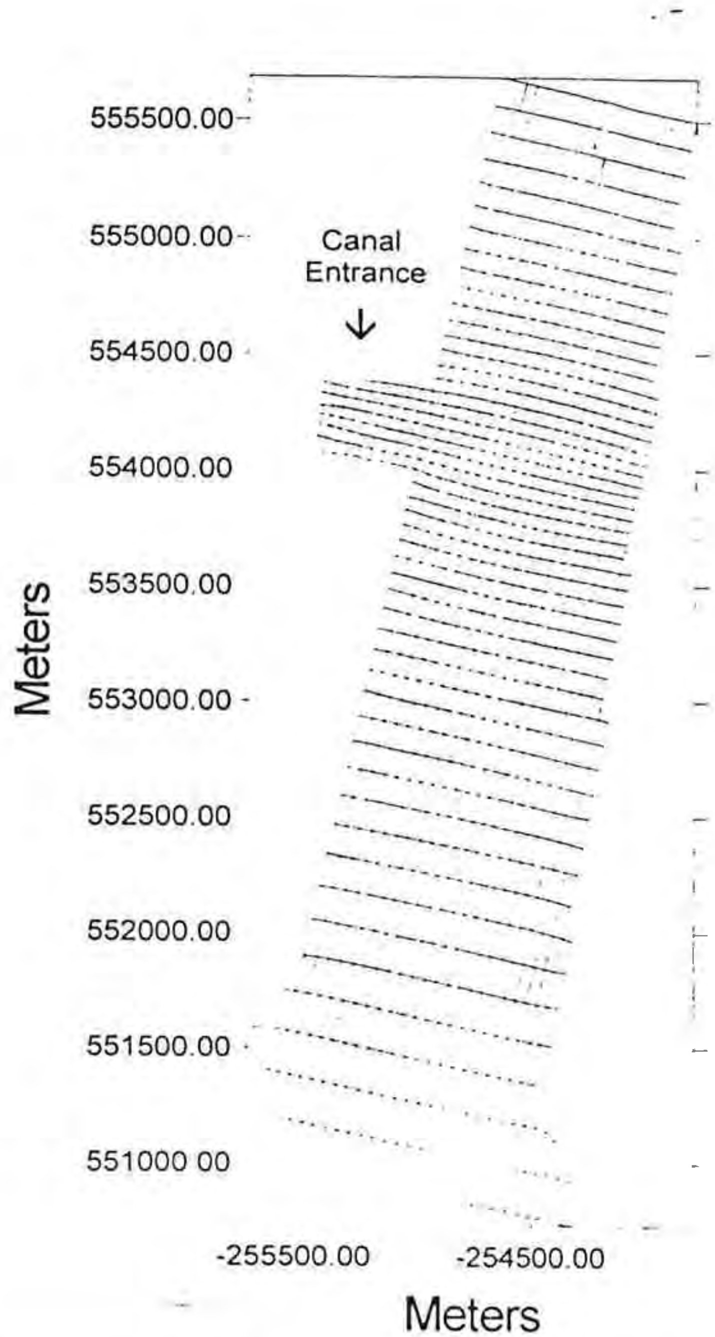

Figure 2. Computational grid for the Hydrodynamic /Salinity Model of Long Slip Canal and the Lower Hudson River

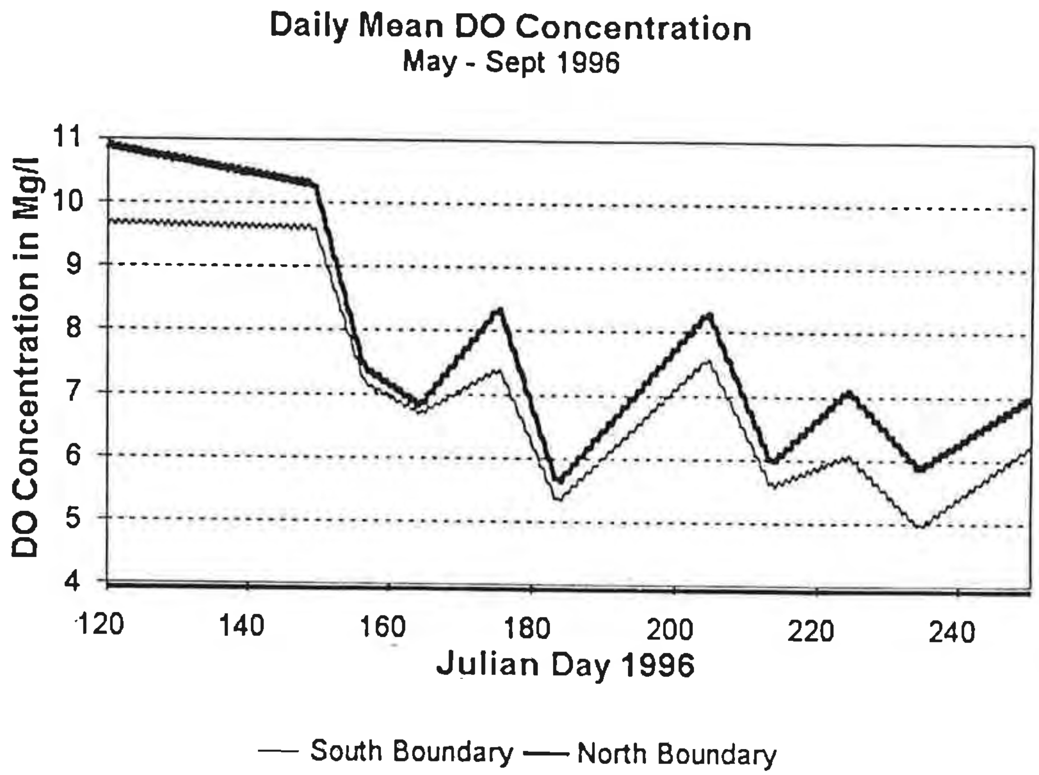

Figure 3. Dissolved Oxygen Concentrations specified at the north and south boundaries of the model based on data from the New York Department of Environmental Protection.

Table 1. Model test cases for dissolved oxygen simulation - May , 1996

Test Case	Walkway Option	Test Period	Parameters
base condition	no walkway	5/1 -5/31	v, s, do, wl*
east- west cut	1	5/1-5/31	v, s, do, wl
east -west cut	2	5/1-5/31	v, s, do, wl
east- west cut	3	5/1-5/31	v, s, do, wl
east- west cut	3A**	5/1-5/31	v, s, do, wl

* velocity, salinity, dissolved oxygen, water level **CSO on bulkhead

A second set of model runs were conducted to cover the period from August 1 through September 15, 1996 (Table 2) This period includes the low dissolved oxygen conditions that occur annually during the later summer. This model simulation was setup as a test of possible improvements to water quality under the low dissolved oxygen regime that occurs annually during the late summer.

Table 2. Model test cases for dissolved oxygen simulation - August 1 to September 15, 1996

Test Case	Walkway Option	Test Period	Parameters
base condition	no walkway	8/1 -9/15	v, s, do, wl*
east- west cut	1	8/1-915	v, s, do, wl
east -west cut	2	8/1-9/15	v, s, do, wl
east- west cut	3A**	8/1-9/15	v, s, do, wl

* velocity, salinity, dissolved oxygen, water level **CSO on bulkhead.

For comparison to the base conditions, which includes the existing topography, model runs were completed to simulate dissolved oxygen concentrations under the increased flushing provided by the east-west cut in the Canal Basin area. The three proposed walkway designs were combined with the east-west cut (Table 3). Option 1 includes a walkway extending north-south across the west end of the Canal Entrance area where Long Slip Canal now connects the entrance basin. Option 2 includes a proposed walkway that extends southwest-northeast across the west end of the Canal Entrance area. Under this option a portion of the proposed east-west cut would be eliminated by backfill behind the walkway, possibly consisting of dredge material from the cut. Option 3 tested with the model calls for a curved walkway extending well into what is now the Canal basin. Approximately one third of the east-west cut that was tested under Phase I of the modeling effort would be filled under this option and thus significantly reducing the area to be flushed.

Table 3. Walkway-cut combinations included in the model

Walkway Option	Cut Width	Cut Length	Cut volume
Option 1	80m (262 ft.)	300m (984 ft.)	122,000 m^3 (159,500 yd^3)
Option 2	80m (262 ft)	260m (852 ft.)	90,000 m^3 (117,700 yd^3)
Option 3	80m (262 ft)	200m (656ft.)	63,000 m^3 (82,000) yd^3)

Figure 4. Predicted near-bottom dissolved oxygen distribution for the existing configuration of Long Slip Canal Basin - May 15, 1996

Among the simulations that include the east-west cut, there is a range of predicted improvements in water quality compared to the base condition. The case that includes Walkway Option 1 shows the least improvement compared to the existing configuration. The case includes the east-west cut and in general results in slightly higher predicted DO concentrations in all layers of the model. However, in a zone confined to the north side of the Canal entrance area, predicted surface and bottom DO concentrations actually fall below those predicted for the existing configuration (see Figures 4 and 5). This portion of the entrance basin is probably less well flushed and some topographic trapping of the CSO effluent may be taking place in this zone.

Simulations that include Walkway Options 2 and 3 demonstrated distinct improvements over the base configuration and the test case including Option 1 (Figures 6 and 7). Both Walkway Option 2 and 3 require "filling" of a portion of the east-west cut in the model. As a result some of the poorly flushed area of Walkway Option 1 is eliminated. Under Option 3 predicted DO concentrations do not fall below 8 mg/l anywhere in the Canal Entrance area during any portion of the model run. The results of having the CSO located on the walkway bulkhead (Option 3A) were generally similar to the results for Option 3. Figure 8 shows average near-bottom DO concentrations for May 15, 1996, which are similar in distribution to predictions without the CSO on the walkway structure (Figure 7). However, when the highest predicted concentrations of DO are considered there are some differences in concentration in the near-bottom layer. These results are reviewed in the following section.

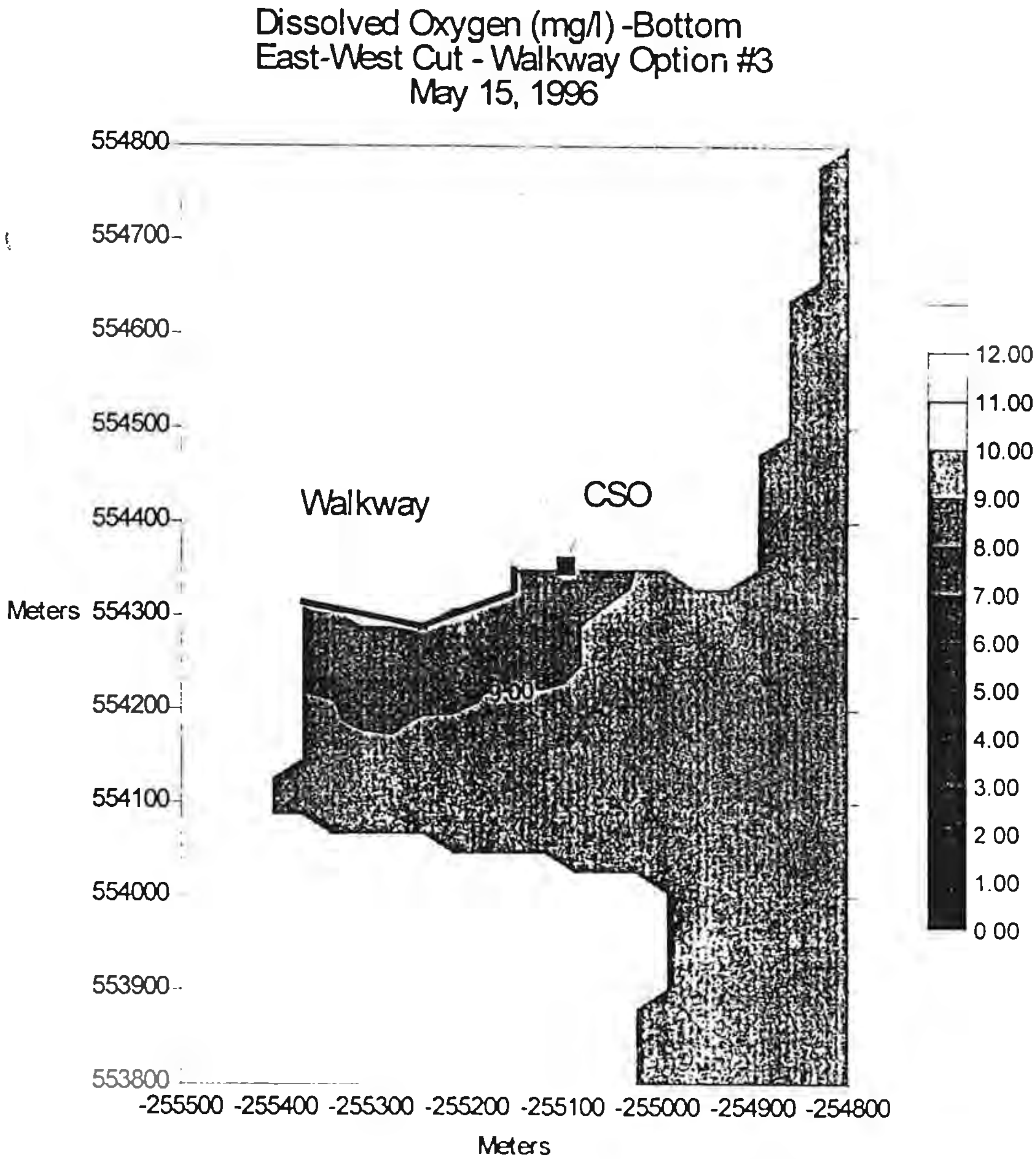

Figure 7. Predicted near-bottom dissolve oxygen distribution for the combination of east-west cut and Walkway Option 3.

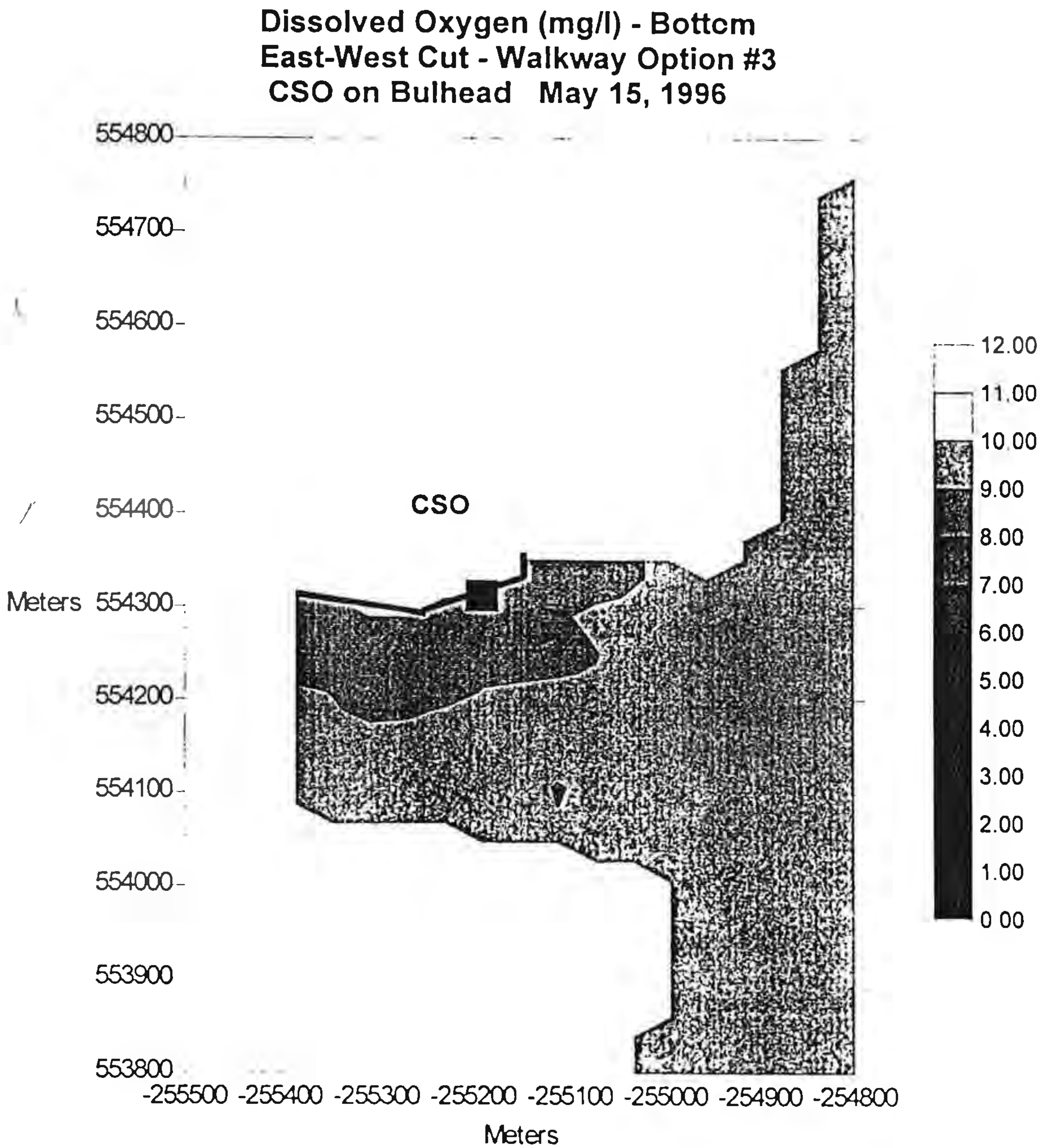

Figure 8. Predicted near-bottom dissolved oxygen distribution for the combination of the east-west cut and Walkway Option 3.A.

3.1 Near-Bottom Dissolved Oxygen Concentrations

Results of the dissolved oxygen simulations are somewhat qualitative since the discharges from the CSO's in the Canal entrance area have not been quantified and therefore, their actual impact on water quality cannot be quantitatively modeled at this time. However, the results show that near-bottom DO concentrations in particular will be improved by increased flushing provided by the excavated cut in the Long Slip Canal Basin area. To better illustrate the differences among the test cases, predictions for the lowest layer in the model where the lowest concentrations of DO are expected have been mapped according to the area covered by a particular DO value. For instance Figure 9 compares the percent area covered by DO concentrations of 5, 7, and 9 mg/l for the second day of the model run. In this case,

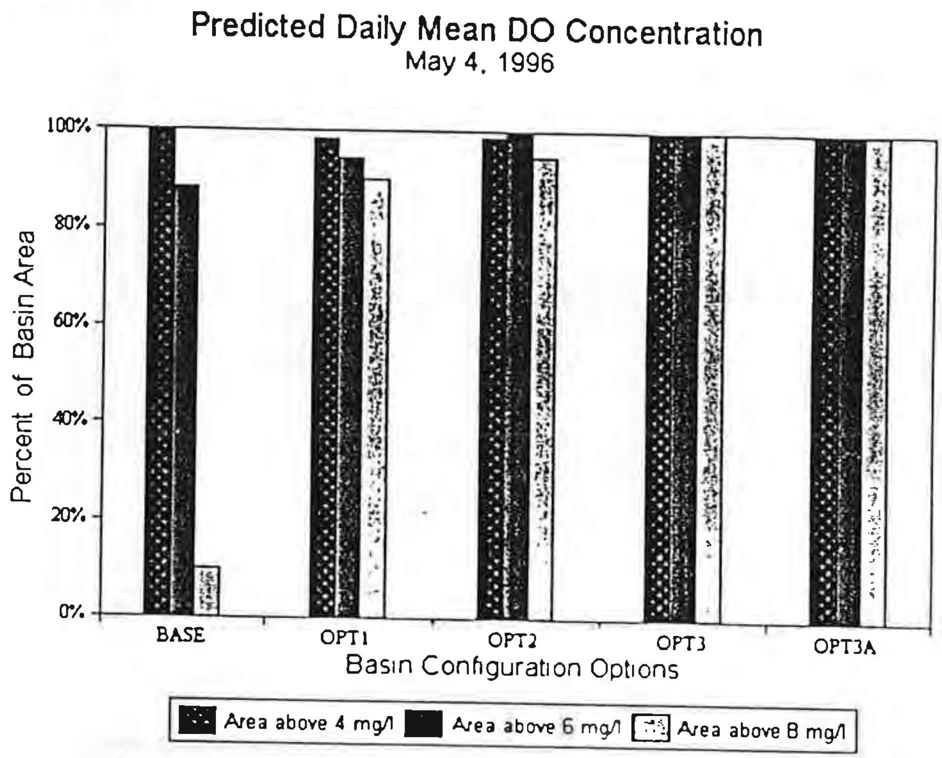

Figure 9. Comparison of dissolved oxygen concentrations predicted in the bottom layer of the model for May 4, 1996.

Option 3 provides the best performance with respect to DO concentration. At the higher concentrations of 7 and 9 (mg/l) the base configuration returns the lowest concentrations of DO. However, Option 3A, having the CSO on the bulkhead results in a decreased area covered by the highest DO concentrations above 9 mg/l.

Approximately mid way through the 30 day model run performance of the five options in the model are similar to the beginning of the model run (Figure 10). On this particular day all of the cases involving the excavated cut in the Canal basin area result in higher DO concentrations in terms of percent area covered when compared to the existing configuration. However, in this case Option 3, having the CSO displaced to the east returns a somewhat poorer performance compared to Option #3A having the CSO on the Walkway bulkhead when the highest DO concentrations are considered.

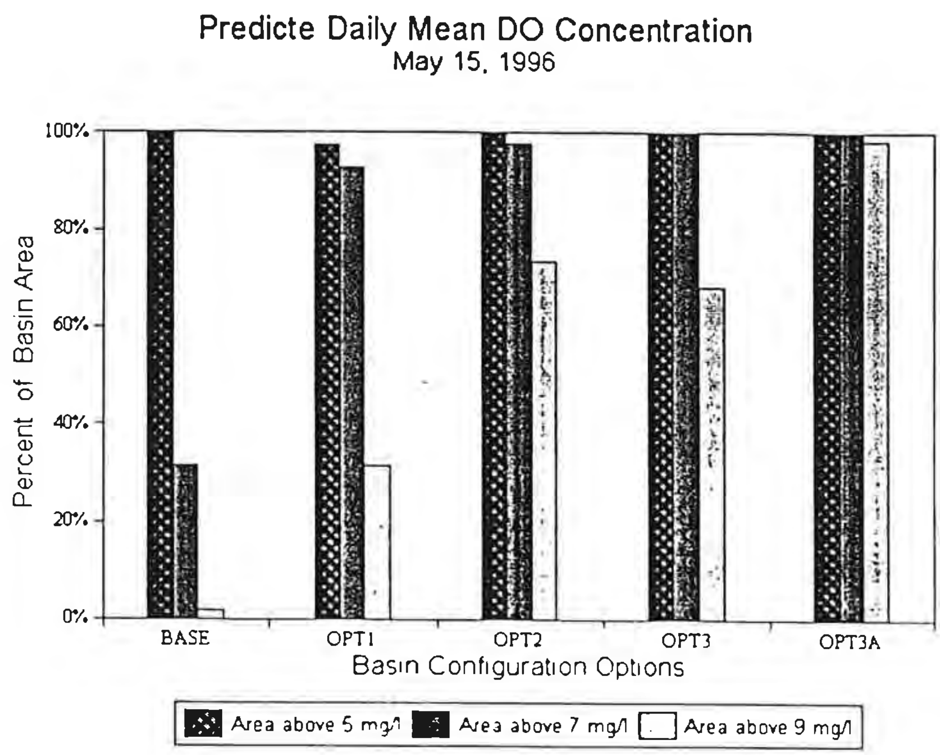

Figure 10. Comparison of dissolved oxygen concentrations predicted in the bottom layer of the model for May 15, 1996.

Near the end of the model run, on May 30, 1996 , Walkway Option 3A again results in a more extensive distribution of higher concentrations of dissolved oxygen in the bottom layer of the model (Figure 11.)

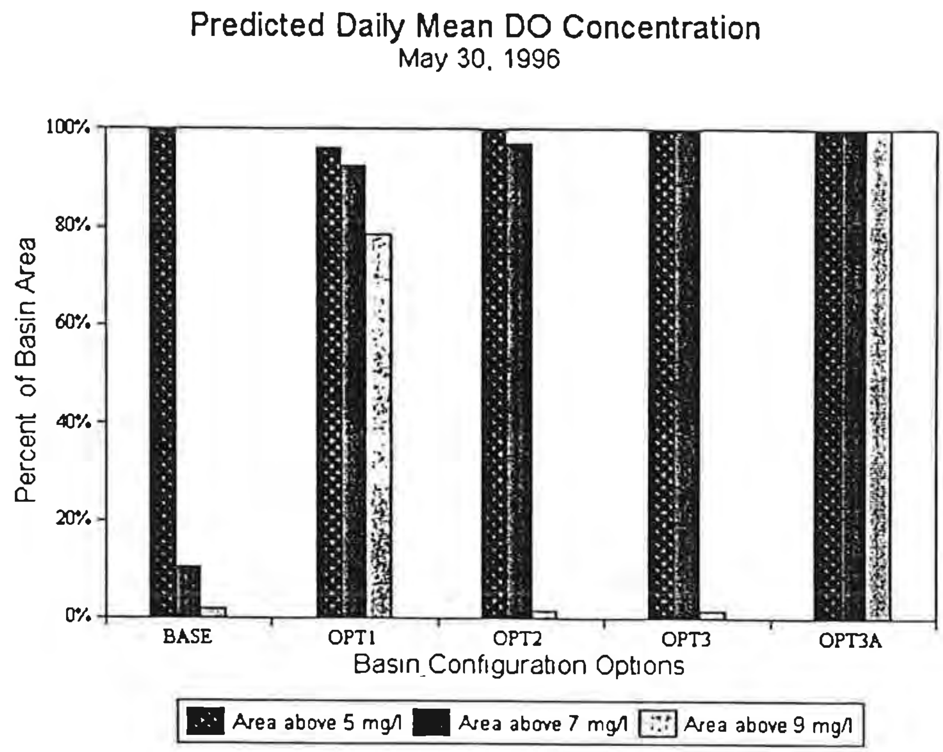

Figure 11. Comparison of dissolved oxygen concentrations predicted in the bottom layer of the model for May 30, 1996.

4.0 Results of Dissolved Oxygen Simulations - August to September, 1996

Results of model simulations of the Base condition for the period extending from August 1 to September 12, 1996 indicate that dissolved oxygen concentrations in the Canal Basin are likely to be low in the bottom layrer of the water column. Similarly to predictions from the 31 day simulation for May, 1996 , distinctive differences between the Base condition and the various test cases are predicted to occur. Under the existing or Base condition, near bottom DO concentrations are predicted to be 4 mg/l or less over a large portion of the Canal basin area. Figure 12 shows the predicted near-bottom DO concentration on August 12, 1996. Near the end of the model run predicted near-bottom DO decreased to concentrations of 3 mg/l and below (Figure 13). This reflects the trend of decreasing DO concentration in the Hudson estuary during this period, which reach a near-bottom minimum of between 5 and 6 mg/l (Figure 3).

Predictions according to the Walkway Option 1 case indicate measurable improvement over the Base condition. Over most of the surface area of the Canal Basin DO concentrations exceed 5 mg/l (Figure 14). However along the north boundary of the canal basin where the impacts of the CSO's are greatest, DO levels drop to as low as 2 mg/l or less.

Similar to the Walkway Option 1 case, predictions for Walkway Option 2 show that DO levels will be improved compared to the Base condition (Figure 15). However, the extremely low DO levels predicted along the north boundary of the Canal Basin area for Walkway Option 1 did not occur in the Walkway Option 2 case. Minimum DO concentrations were between 2 and 3 mg/l in this area under Option 2. Overall, DO concentrations were predicted to be above 5 mg/l for Option 2.

Predictions according to Walkway Option 3 (Figure 16) are nearly identical to those for Option 2 except for DO concentrations during early to mid-August. Over this period predicted near-bottom DO concentrations above 6 mg/l occur over more than 30% of the Canal Basin area (Figure 17). For both Options 2 and 3 more than 90% of the basin includes near-bottom DO

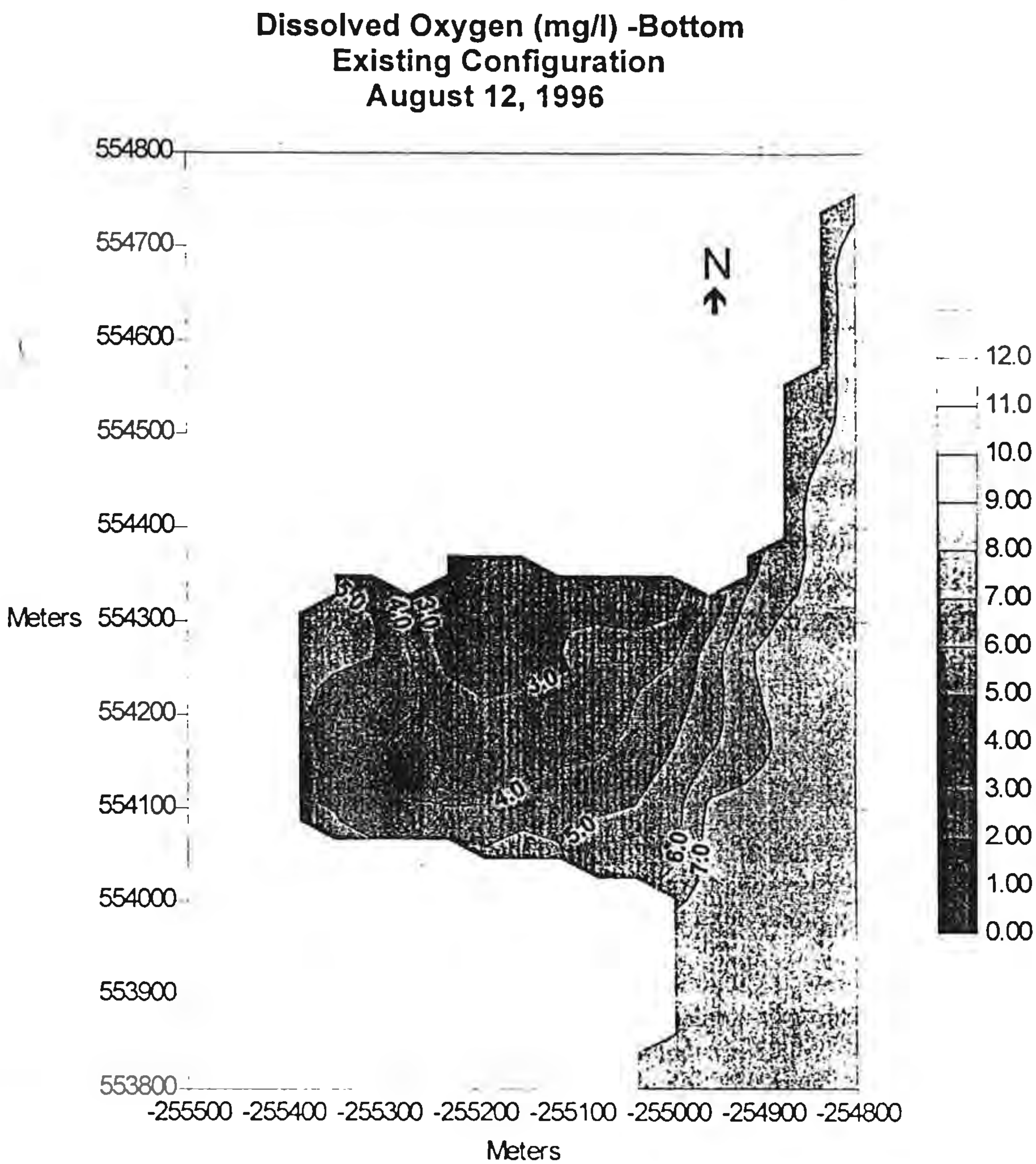

Figure 12. Predicted near-bottom dissolved oxygen concentration for the existing configuration of Long Slip Canal Entrance area - August 12, 1996

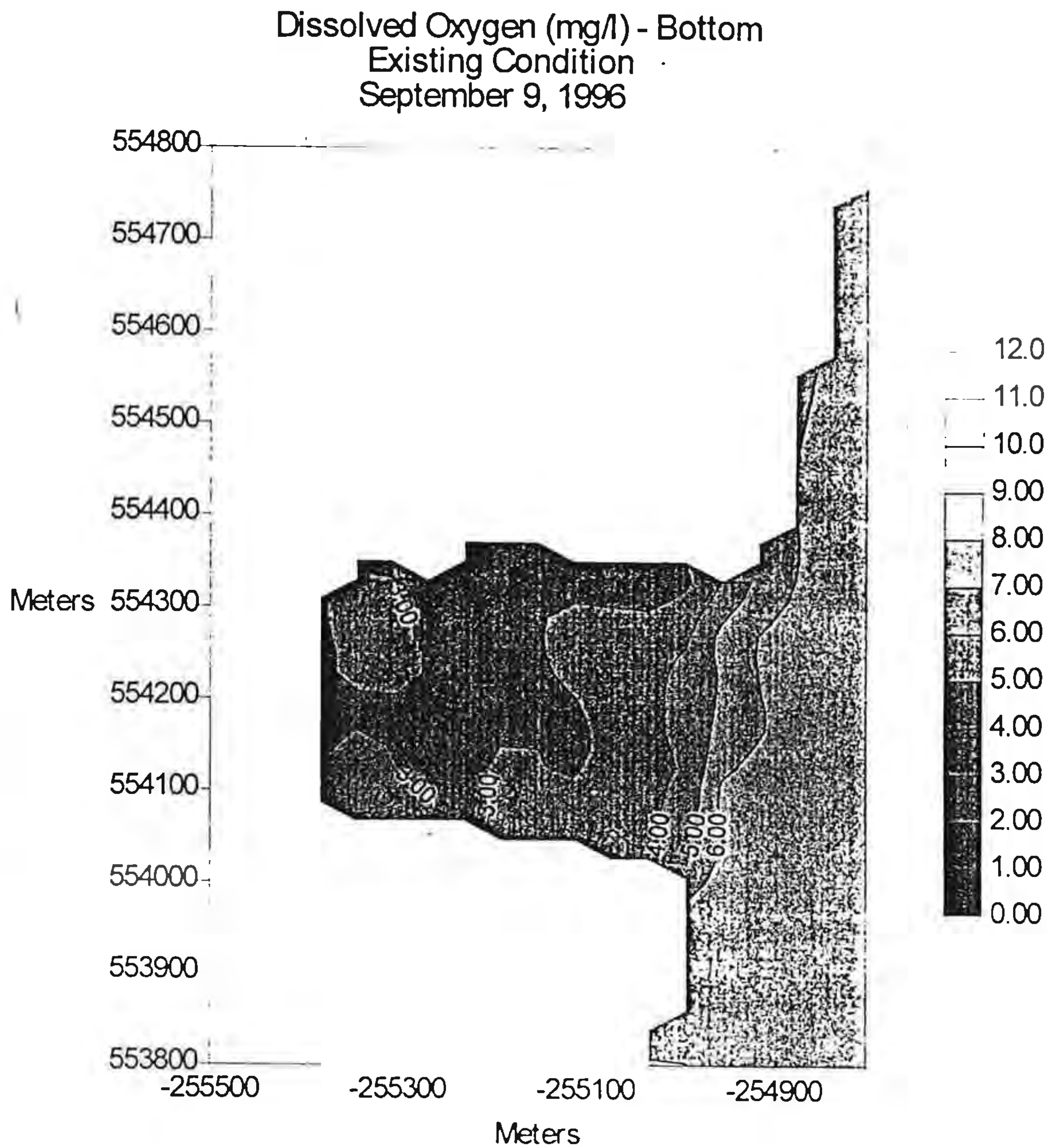

Figure 13. Predicted near-bottom dissolved oxygen concentration for the existing configuration of Long Slip Canal Entrance area, September 9, 1996.

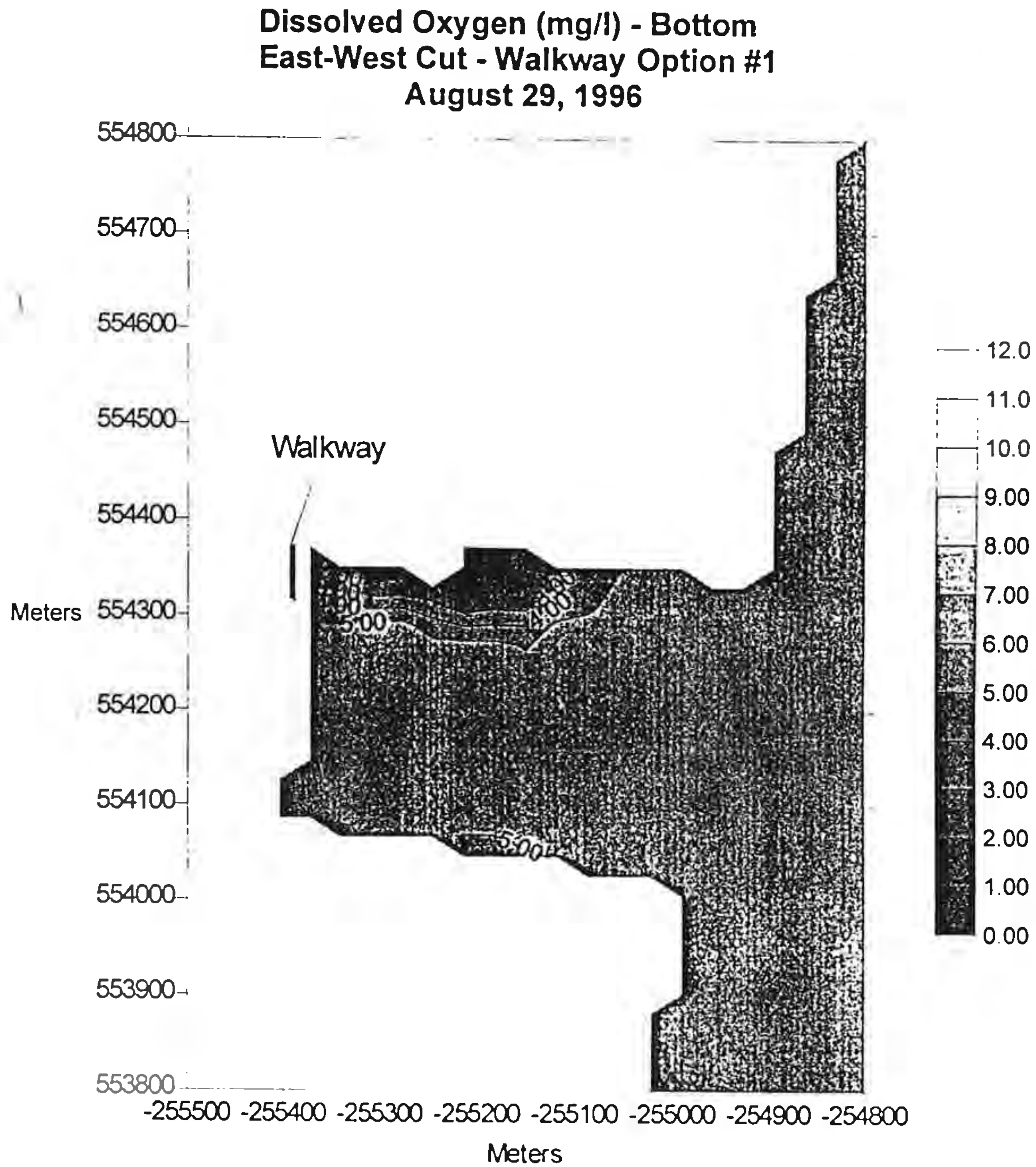

Figure 14. Predicted near-bottom dissolved oxygen distribution for the combination of the east-west cut and Walkway Option 1 - August 29, 1996.

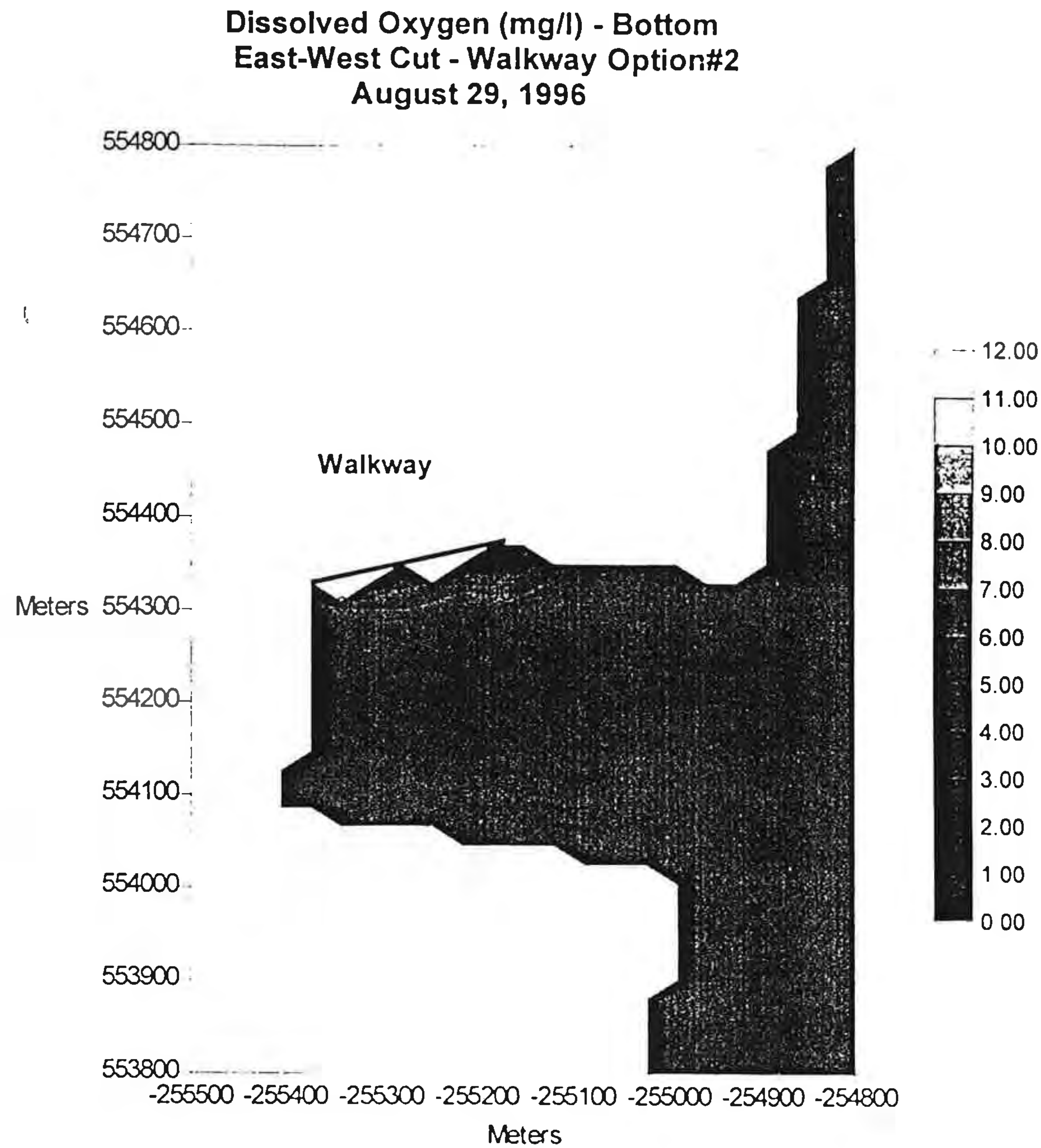

Figure 15. Predicted near-bottom dissolved oxygen distribution for the combination of the east-west cut and Walkway Option 2 - August 29, 1996.

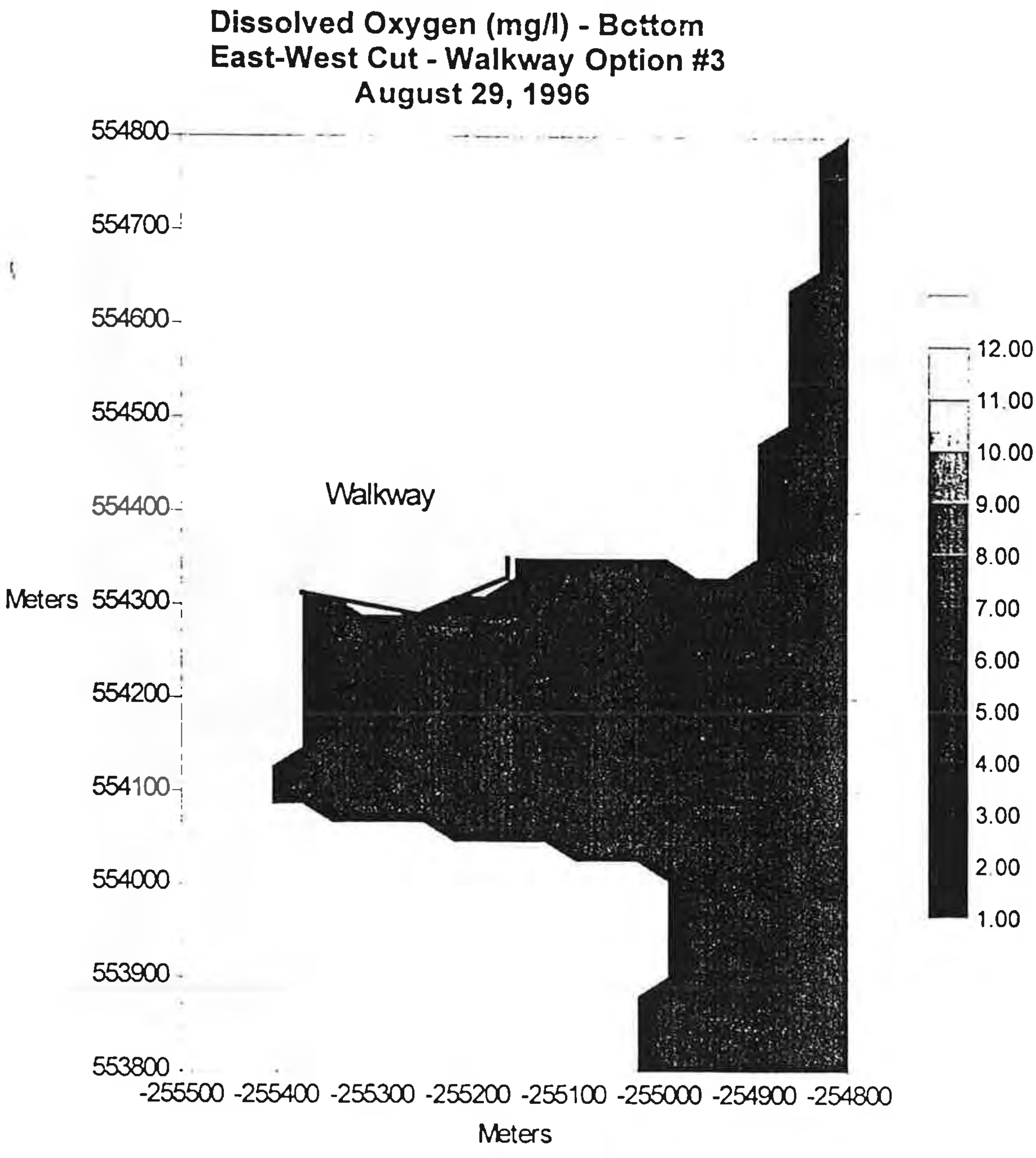

Figure 16. Predicted near-bottom dissolved oxygen distribution for the combination of the east-west cut and Walkway Option 3A - August 29, 1996.

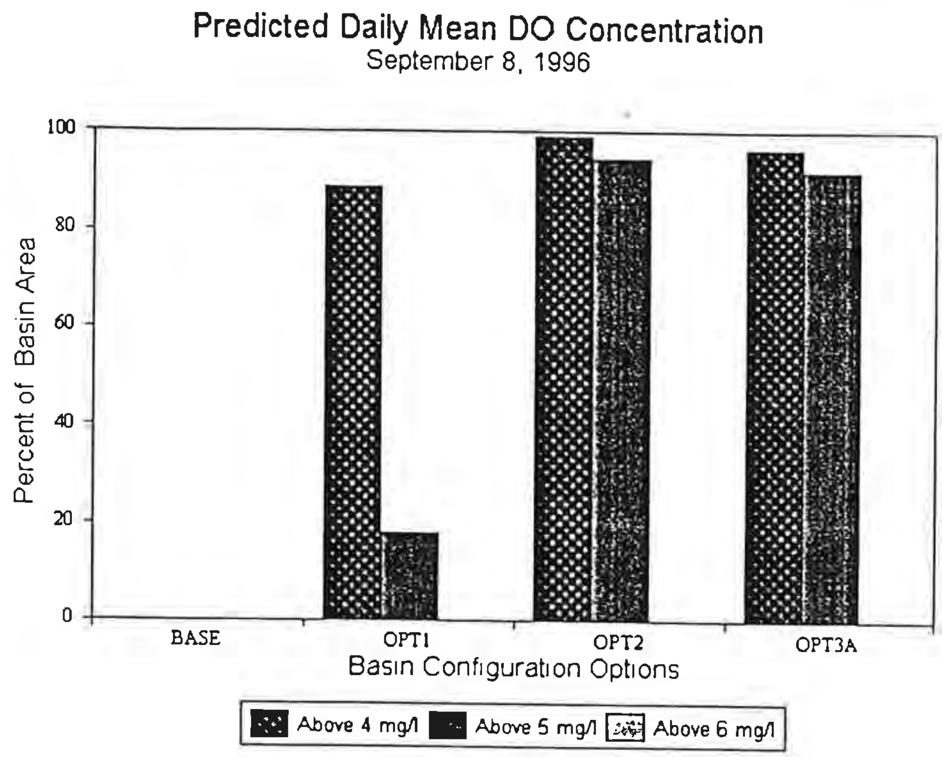

Figure 20. Comparison of dissolved oxygen concentrations predicted in the bottom layer of the model for September 8, 1996.

5.0 Conclusions

Among all the cases tested against the existing configuration, dissolved oxygen simulations having the excavated cut in the Canal Basin area are predicted to improve flushing and result in higher concentrations of dissolved oxygen. Under the existing configuration, without the excavated cut into the Canal basin, results of a 30-day run of the three-dimensional model to simulate DO concentrations during May of 1996 indicate that conditions remain stratified with respect to dissolved oxygen and that higher levels of DO concentration in the near-bottom layer of the water column are not achieved. Dissolved oxygen concentrations in the lower level of the model remain low and fluctuate only slightly in response to DO trends that drive the model. Among the test cases that include the excavated east-west cut, the case including Walkway Option 1 provides the least improvement over the existing configuration. In this case there is apparently a zone on the north side of the Canal Entrance area that remains poorly flushed. Here predicted DO concentrations reach as low as low as 4 mg/l in the bottom layer. Walkway Options 2 and 3 in combination with the east-west cut are predicted to provide an increase in DO concentrations compared to base condition and the configuration that includes Walkway Option 1. The most improvement in DO concentration is predicted to occur as a result of the cut combined with Walkway Option 3 and Option 3A in which the combined sewer outfall remains on the bulkhead of the walkway structure. In this case a portion of the Canal entrance area prone to poor flushing is eliminated by fill for the walkway. In most cases, the performance of Options 3 and 3A are nearly identical with respect to DO concentration. When the highest achievable DO concentrations are considered the performance of Options 3 and 3A alternate in their ability to produce DO concentrations above 9 mg/l in the model. Average predicted concentrations above 9 mg/l on some days are more extensive in the bottom layer of the model under Option 3, whereas on other days Option 3A results in higher DO concentration in the lower layer.

Simulation of dissolved oxygen concentrations for the late summer period when DO concentrations in the Hudson River are at their lowest level indicate that the excavated cut in the Canal Basin area will substantially improve DO levels. Under the base conditions DO concentrations remain at or below the NJDEP recommended minimum of 4 mg/l for the entire model run. Under Walkway Options 1 to 3, near bottom concentration of DO in the basin area remains above the 4 mg/l minimum except for a narrow band along the north boundary, which is directly impacted by the Jersey City CSO specified in the model.

Among the Walkway Options tested by the model, Options 2 and 3 can be distinguished from Option 1 by having persistently higher DO concentrations in the lower water column. More than 90% of the basin area is predicted to have a daily average bottom DO concentration above 5 mg/l for the duration of the August to mid-September model period.

The main conclusion that can be drawn from the results of the 3-D model simulation of DO concentrations is that excavation of a cut in the Canal Basin area will improve flushing to the point that a significant improvement in DO concentrations will occur. The most notable predicted improvement is the persistence of DO concentrations above the allowable minimum of 4 mg/l when Walkway Options 2 and 3 are specified in the model.

6.0 References

Cerco, C.F. & Cole, T.M. 1994. Three-dimensional eutrophication model of Chesapeake Bay: Volume 1, main report. Technical Report EL-94-4, US Army Engineers Waterways Experiment Station, Vicksburg, MS.

Hamrick, J. M., 1992a: A Three-Dimensional Environmental Fluid Dynamics Computer Code: Theoretical and Computational Aspects. The College of William and Mary, Virginia Institute of Marine Science. Special Report 317, 63 pp.

Hudson-Bergen Light Rail Transit System and Long Slip Canal Habitat Creation Project

Application of a Three-dimensional Numerical Model to Evaluate Water Quality Improvements in the Long Slip Canal Entrance Basin

Sedimentation and Dissolved Oxygen Predictions

October 25, 1999

Executive Summary

This fourth phase of three-dimensional modeling evaluated the performance of the Walkway Alternative 1 configuration of the Long Slip canal entrance basin (entrance basin) area with respect to water quality and sedimentation. In previous phases, three-dimensional modeling was used to test various topographic configurations of the canal entrance area for improved tidal action, vertical mixing and flushing. The concept was to promote stronger hydrodynamic exchange with the adjacent Hudson River Estuary. In model test cases that did not include the cut, the low DO impacts were widespread over the entrance basin and interpier adjacent area while the combined sewer outfalls (CSO) were discharging. Model test cases that included the entrance basin excavation to facilitate vertical mixing showed that the impacts of CSO discharge on DO concentration in the entrance basin were reduced in magnitude and distribution. For the more extreme events, the low DO impacts can be expected to be more than 50% greater compared with average CSO events. However, the relative advantage of the excavation was demonstrated to be greater for the more extreme events.

In this phase of the model testing the current entrance basin configuration associated with the Hudson Bergen Light Rail Transit (HBLRT) system has been placed in the modeling scheme and tests were conducted to determine the dissolved oxygen (DO) conditions and sedimentation rates under both dry conditions and episodes of high CSO discharge. The model test case was run for an approximate 7-month period beginning at the end of February 1996 and ending in mid-September 1996. Based on a review of long term records, this period is representative of average conditions. Five runoff events were specified to test the CSO impacts on the Long Slip canal entrance basin area, as well as the impacts from conditions in the adjacent lower Hudson River.

Model setup for the 7-month test run included time series of water elevation, salinity, water temperature, dissolved oxygen concentrations, and suspended sediment concentrations. Time series of these parameters were specified at the south and north

boundaries of the Environmental Fluid Dynamics Code (EDFC) hydrodynamic/water quality model. Model setup also includes specification of meteorological parameters for the model test period. These parameters, including wind velocity, atmospheric pressure, air temperature and rainfall were acquired from local weather stations and NOAA meteorological buoys in the nearby coastal ocean.

With the isolation of oxygen-demanding canal sediments, the elimination of dry weather CSO discharges and the improvements to the CSO discharges quality, the DO conditions in the entrance basin area were determined as a function of oxygen poor water discharged into the basin by the Jersey City CSO and the ambient DO conditions of the lower Hudson River. Sediment transport and suspended sediment concentrations in the entrance basin were likewise determined by a combination of exchange with the Hudson River and sediment introduced from the Jersey City CSO. Direct impacts from the CSO were confined to the five periods of CSO discharge, since zero flow was specified between each of the events. The duration of each event lasted from 5 to 10 days.

The results of the model showed that DO concentration in the entrance basin area is controlled by ambient Hudson River concentrations and will remain above the NJDEP 4-mg/L minimum during dry weather, no-flow conditions. However, during periods that include flows of low oxygen water from CSO discharges, predicted DO concentrations below the 4 mg/L in portions of the entrance basin. The magnitude of impacts depended on the magnitude and duration of inflows from the CSO. The model test included the excavation for the entire simulation. Therefore, as demonstrated by the Phase 2 study, the impacts of CSO discharge on DO concentration in the entrance basin were reduced in magnitude and distribution compared to the no-excavation case because of the enhanced vertical mixing and circulation provided by the excavation. For the more extreme events in which CSO flows exceed 300 cfs, the low DO impacts can be expected to be more than 50% greater compared with lesser events when discharge reached only about 100 cfs.

Predicted suspended sediment concentrations in the entrance basin area are driven by the ambient lower Hudson River conditions for periods of zero CSO discharge. Concentrations in the basin were predicted to be in the 40 to 100 mg/l range in the lower layer of the model. In the surface layer concentrations were consistently lower than about 20 mg/l under no-flow conditions. During CSO discharge events, near-bottom suspended sediment concentrations reached a maximum of approximately 180 mg/L within the basin. The EFDC model was modified to keep a running account of bed elevation change in response to either sediment deposition or resuspension. At the end of the 7-month run, the total elevation change in elevation was determined and combined with the original topography of the model. Results of the topographic prediction indicated that sedimentation within the basin would be between 0.04 and 0.6 inches. Based on this result, the maximum rate of sedimentation within the cut is expected to be about 1 foot in a 10-year period, a rate consistent with the Hudson River. The maintenance interval for the excavation is predicted to be 10 to 25 years. Future modeling during the final design process may lead to refinements that extend this interval.

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1.0 Introduction and Previous Work

This fourth phase of three-dimensional modeling evaluates the performance of the revised configuration for the Long Slip Canal entrance basin with respect to water quality and sedimentation in the adjacent interpier area over a range of environmental conditions. In Phase 4, the Jersey City combined sewer outfall (CSO) was placed on the bulkhead at the east end of the waterfront walkway (Walkway Alternative 1.) The excavation specified in the entrance basin under was reduced slightly for Phase 4 model runs to provide a 100-foot buffer between the excavation and the pile field on the south side of the basin. The excavation was specified as having an east-west length of approximately 750 feet, a north-south dimension of approximately 250 feet, and depths between 10 and 30 feet (3 - 10 meters). Similarly to model runs under the Phase 1 to 3 studies, the excavation was designed to improve flushing and water quality of the entrance basin and interpier area.

In Phases 1 to 3, three-dimensional (3-D) modeling was used to test various topographic configurations of the canal entrance basin for improved tidal action, vertical mixing and flushing. The objective is to promote stronger hydrodynamic exchange with the adjacent Hudson River Estuary. The Phase 2 and 3 modeling results demonstrated that an excavation in the entrance basin of 80,000 cubic yards (excavation) would improve flushing to the point that a significant improvement in dissolved oxygen (DO) concentrations will occur. The most notable predicted improvement is the persistence of DO concentrations above the allowable minimum of 4 mg/L when Walkway Options 2 and 3 (walkway alignments that called for fill in the entrance basin) were specified in the model.

In the Phase 3 study, the results of all model test cases showed that DO concentration in the entrance basin and interpier area would remain above the NJDEP 4-mg/L minimum during dry weather, no-flow conditions. However, Phase 3 model tests of the flows of low oxygen water from the Hoboken and combined Jersey City Hoboken CSO's predicted DO concentrations below 4 mg/l in portions of the entrance basin. The magnitude of impacts depended on the magnitude and duration of inflows from the CSO's, and the presence or absence of the excavation. In model test cases that did not include the excavation, the low DO impacts were widespread over the interpier area while the CSO's were discharging. Most cases that included the excavation showed that the impacts of CSO discharge on DO concentration in the interpier area were reduced in magnitude and distribution. Model tests under Phase 3 indicated a distinct advantage of locating the Jersey City sewer outfall on the bulkhead at the east end of the waterfront walkway as opposed to the east terminus of Long Slip Canal. In these test cases, oxygen-poor effluent from the CSO was not flushed as quickly compared to all test cases in which the CSO's are located further to the east on the Walkway

In this phase (Phase 4) of the model testing, the current configuration of the Jersey City CSO and entrance basin are used in combination with sediment transport and dissolved oxygen predictions. In order to test this combination over a range of environmental conditions, a single 7-month long model simulation was generated from field observations and published data. Conditions during the simulation were considered average, based on a review of long term data. The model run included strong runoff events typical of the wet summer season, as well as several northeaster type storms that can occur in the late fall to early spring months. Similarly to previous model tests the model year was 1996. However, the duration of the model run was extended to include the 7-month period between February and September 1996

2.0 Model Setup and Application

2.1 Model Description

The Environmental Fluid Dynamics Code (EFDC) modeling system was used to predict hydrodynamics and sediment transport, as well dissolved oxygen concentration in the entrance basin area. This is a comprehensive modeling package for simulating three-dimensional flow, transport, and biogeochemical processes in surface water systems including: rivers, lakes, estuaries, reservoirs, wetlands and near shore to shelf-scale coastal regions. EFDC code has been extensively tested and documented in more than twenty modeling studies, including application to the Hudson River on Behalf of New Jersey DOT (Zarillo, 1996).

The major features and capabilities of the EFDC modeling package were described in the Phase 1 report on flushing in the entrance basin area, which includes an appendix describing model capabilities. The three-dimensional aspect provided by EFDC is required because the lower Hudson River is a partially stratified estuary having strong vertical differences in salinity and flow patterns. There are likely to be strong vertical gradients in constituents like dissolved oxygen, which influence productivity and water of the lower Hudson River. Furthermore, in the Phase 4 study, it was critical to resolve turbulent processes in the near-bottom benthic boundary layer for realistic sediment transport predictions. Only 3-D models capable of predicting the vertical distribution of currents, salinity, and water quality parameters are appropriate for this application.

2.2 Model Setup and Data Input for Sediment Transport and Dissolved Oxygen Simulations

The EFDC model was setup for the Long Slip Canal entrance basin and interpier area and the Lower Hudson River between the Battery and Castle point approximately 1 mile to the north of the canal entrance. Model setup required acquisition of topographic data (see Figure 1) and boundary (shoreline) coordinates for the project area and the surrounding Hudson River. These data were digitized from National Ocean Survey chart 12335 and used as input to the software that generates the computational grid for EFDC. The overall grid includes approximately 1233 active water cells in the horizontal dimension and 5 layers in the vertical. The grid is curvilinear-orthogonal and includes smaller cells in areas where good resolution is required (in the entrance basin) (see Figure 2) and larger cells in areas distal from the project site. This provides computational efficiency.

A total of 100 cells resolved the entrance basin area and each had an average size of approximately 20 meters (65 feet). This provided the resolution required for detailed simulations of DO and suspended sediment concentrations, as well as predicted topographic change.

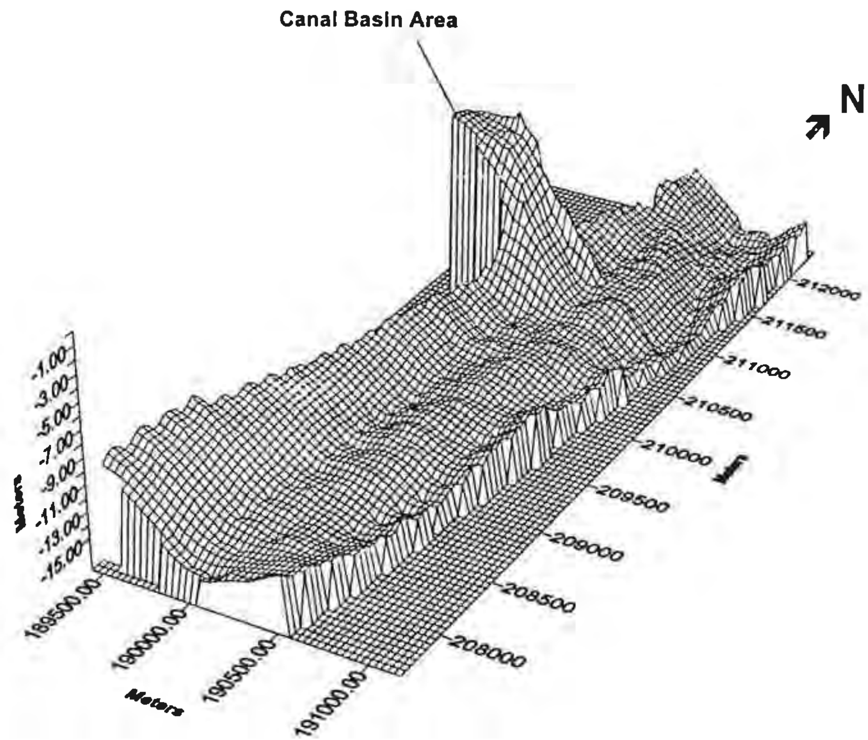


Figure 1. Bottom Topography of the Lower Hudson River (from NOS Chart 12335)

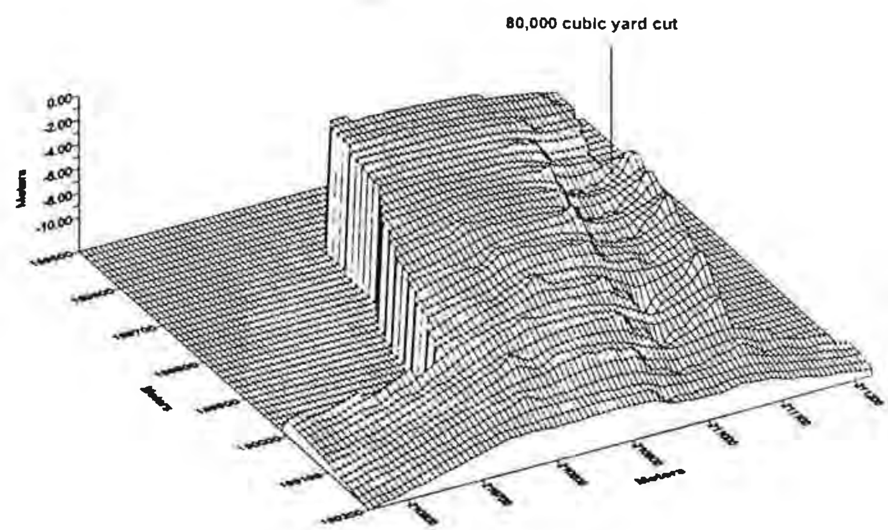


Figure 2. Topography of the Entrance Basin area for the Sedimentation/DO Model of Long Slip Canal–HBLRT System.

The EFDC model requires input data files to set-up the initial conditions of the physical domain and time series-type data files to specify boundary conditions during simulation. Boundary conditions for model runs include: time series of water surface elevation, salinity, water temperature, freshwater inflow, meteorological parameters and other measured water quality parameters that may be available. A master input file directs the input time series to the modal domain and sets all time-related and space-related parameters. A time series of water surface elevation for driving the model from the south boundary was acquired from the National Ocean Survey real-time water level gage located at Battery Park in lower Manhattan. The water level time series was applied at hourly intervals to drive the model from March 1, though September 15, 1996. This period included the high to moderate dissolved oxygen values of the late winter months, as well as low DO values typical of the late summer and early fall months. Thus, results of the model simulations provide information over the range of expected conditions.

There are no recording stations in the vicinity of Castle Point, which is located at the north end of the model domain. However, the National Ocean Survey provides predictions of high tide and low tide for Castle Point. The NOS water level record at the Battery was adjusted to simulate the tidal predictions (time and amplitude of high and low tide) at Castle Point. It was assumed that the sub-tidal, or low frequency, changes in water level were similar at both stations.

The EFDC model included meteorological inputs to drive the air-sea interaction at the water surface. Meteorological conditions for the model runs for the lower Hudson River were set according to data collected from several recording weather stations that report data from within a 20-mile radius of the project site. Data sets were obtained from the National Weather Service, Laguardia International Airport, and NOAA Oceanographic Buoys in the nearby coastal ocean. From these data time series of wind velocity, barometric pressure, rainfall and air temperature was input to the model. It was particularly important to provide real meteorological data to simulate the impacts of winter storms (Northeasters) and the impacts of high runoff events typical of the summer months.

The EFDC model also requires inputs at the model boundaries of constituents to be predicted. In the Phase 4 model tests, time series of salinity, dissolved oxygen, and suspended sediment concentrations were specified at the north and south boundaries of the model. Salinity at the model boundaries was specified from field measurements collected by the New York Department of Environmental Protection (NYDEP) and the U.S. Geological Survey (USGS). The USGS maintains a station that records water conductance and temperature near the George Washington Bridge several miles to the north of the Project site. Data from this recording station, along with the NYDEP data were used to develop a realistic time series of salinity fluctuation to drive salt transport at the north and south ends of the model. The initial salinity field was also set according to measured data. A tidally varying signal was placed in the salinity record from measured records that show the phase relation between tide and salinity in the lower Hudson River.

Data required to guide DO simulations included a time series of DO values at the north boundary (Castle Point) and south boundary (the Battery) of the model derived from data provided by the New York Department of Environmental Protection (NYDEP). These boundary conditions were presented in the Phase 3 study report (Zarillo, 1998). Figure 3 shows the time series of suspended sediment concentrations dissolved oxygen values placed at the boundaries of the model, which are termed external loadings. The series of suspended sediment concentrations (SSC) were set according to occasional measurements collected in the Lower Hudson River by the NYCDEP. To produce realistic input for suspended loads, a variation in concentration was added at the dominant M2 tidal period (12.42 hours). Expected values of SSC are in the range of 40 mg/l in the surface layer of the river and up to 100 mg/l in the lower layers.

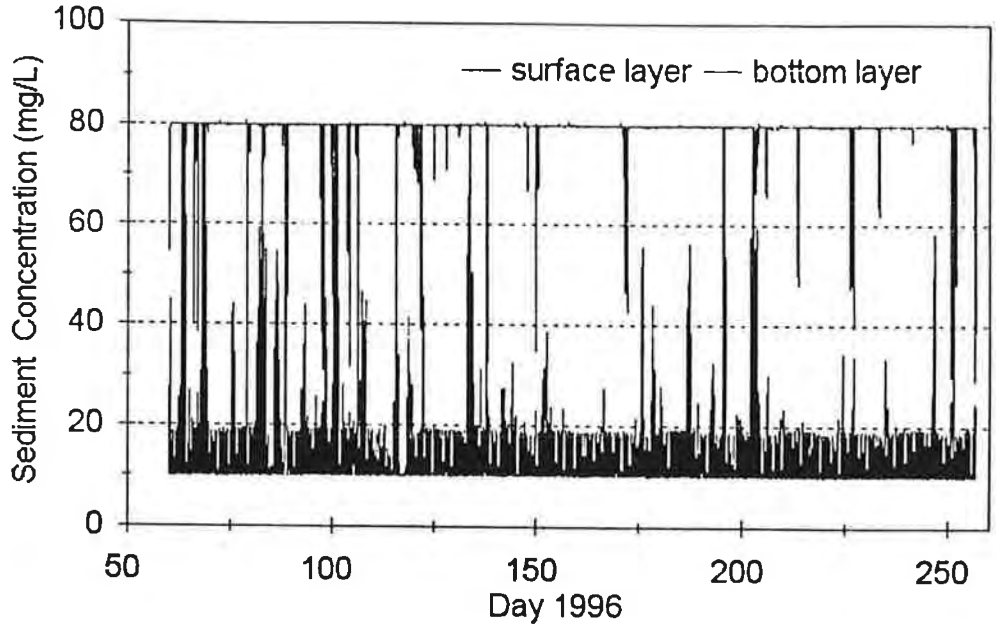


Figure 3. Time series of suspended sediment concentration data specified at the south boundary of the model.

Analysis of sediment samples form the entrance basin area indicate the dominant size distribution of surficial sediments are in the silt range (60 to 80%) and include lesser fractions of clay (20-30%) and sand-sized sediments (<10%). Silt and clay-sized sediments have the greatest potential cause of shoaling in the entrance basin area. One of the critical questions addressed in the Phase 4 study is sedimentation conditions in the entrance basin area. Thus, sediment transport predictions were confined to the finer sand size range and silt/clay sizes.

To setup the EFDC model for sediment transport the model was modified to initiate sediment motions over a range of size classes accordingly. Critical shear values were specified for each class, was well as a fall velocity typical for each class. A near bed reference concentration for each type of sediment is also specified. The largest reference concentration (mass of sediment available for transport) was set for the silt-sized faction in accordance with their dominance in surficial sediments. This scheme was modified for the Hudson River proper where the percentages of sand-sized sediment are higher due to strong tidal currents. Here, the bottom layer concentrations of sand, silt and clay-sized sediments were considered to be spatially variable. Higher concentrations of sand were specified at mid-channel positions where tidal and river discharges are largest. Higher concentrations of silt and clay-sized sediments were specified along margins of the river channel where discharge and velocity are lower. Thus, the possible sources of sediments to the entrance basin area contributed by the Hudson River are: 1) resuspension of bottom sediments; and 2) the suspended loads that are derived from time series specified at the north and south boundaries of the model (see Figure 4).

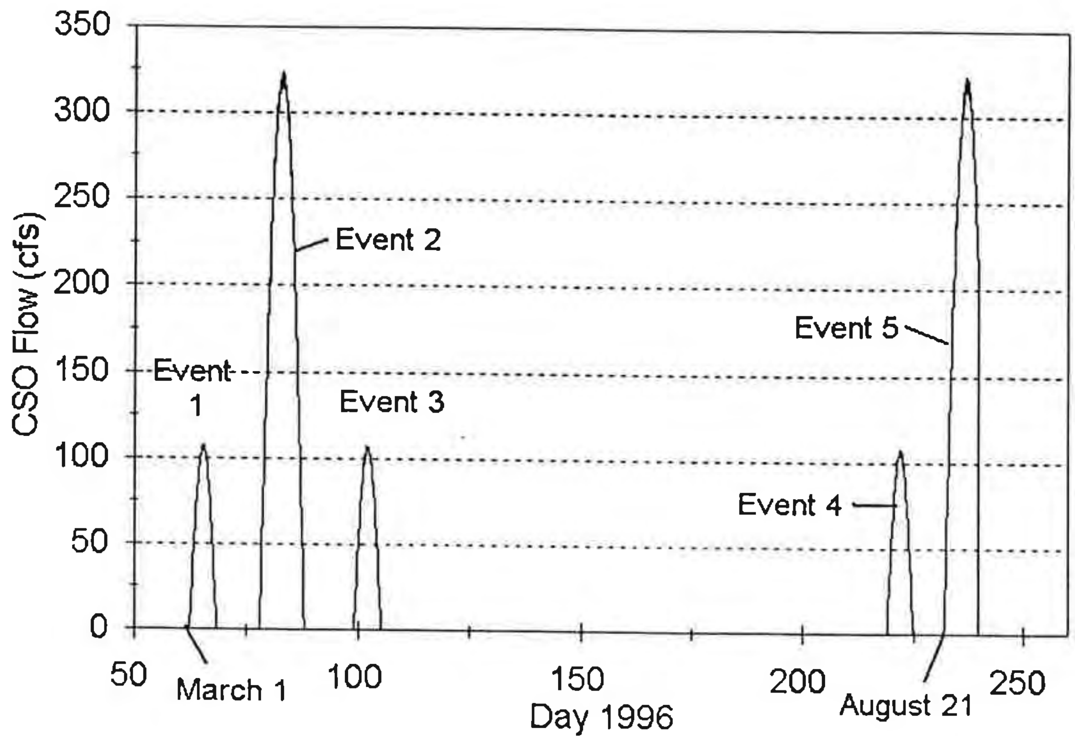


Figure 4. Flows specified at the CSO in the Entrance Basin area during the model test run.

The Jersey City CSO was specified in the entrance basin area as proposed in the final HBLRT design. The characteristic flows of the Jersey City CSO were set according to field measurements conducted in 1994-95 and the capacity of the CSO pipes (see Figure 4). During model tests, the CSO discharge was specified as episodic and within a certain discharge range. Suspended sediment concentrations of the flows was set in the range of

160 to 180 mg/L. The goal of these tests was to determine the impact of episodic CSO flows on the water quality in the entrance basin, specifically on levels of DO and suspended sediment concentration in the basin. Figure 4 shows the five events that were specified in the 7-month model run.

In addition to external loading from the Jersey City CSO and the Hudson River, other sources/sinks of DO included in the model runs were aeration in the surface layer of the model and sediment oxygen demand in the bottom layer of the model. Other possible impacts on DO concentrations include chemical oxygen demand and nitrification. Since no data is available to make realistic estimates of these two processes they were not explicitly used in the model simulation of DO. However, the overall trends of DO values in the dissolved oxygen data used to set up the boundary conditions of the model incorporate the impacts of these processes.

2.3 Model Application to predict Dissolved Oxygen and Suspended Sediment Concentrations.

The model test to simulate DO and suspended sediment was accomplished in a continuous 7-month run that included a range of impacts on the entrance basin area. Among the five storm, or runoff events included in the model test there were average events and three were specified as major events during which maximum flows from the Jersey City CSO exceeded 300 cfs. Table 1 summarizes the major parameters of the model test run. These events were specified between early March and mid April of 1996. These events were correlated with conditions of high winds and low atmospheric pressure typical of extratropical northeasters . The remaining two event were specified during the month of August to demonstrate the possible impacts of runoff from late summer tropical storms.

Table 1. Model test parameters

		Max CSO Discharge (cfs)	Max. sediment conc. (mg/L)
Duration	2/28-9/15/96	325	185
Basin Excavation	80,000 yd^2	NA	NA
Event 1	3/5-3/10/96	105	180
Event 2	3/18-4/1/96	325	170
Event 3	4/8- 4/14/96	104	180
Event 4	8/6-8/11/96	107	185
Event 5	8/19-8/27/96	323	180

2.4 Topographic Change Predictions

Predicted topographic change was closely related to sediment concentration predictions. The EFDC model was modified to keep a running account of bed elevation change in response to either sediment deposition or resuspension. This was accomplished by determining at each model time step (10-second interval), the flux of sediment either to or from the bed in the bottom layer of the model. This parameter was distributed over the bottom below each model cell and converted to elevation change (positive or negative) by assuming a bulk density for fine-grained sediments (silts and clays). At the end of the 7-month run, the total change in elevation was combined with the original topography of the model. The results of this analysis are presented as both a net elevation change and total elevation (bottom topography) after the 7-month run.

3.0 Results of Model Tests

The results of the DO, sediment transport and hydrodynamic simulations were analyzed as daily averages to eliminate the effects of strong tidal variations and the affects on DO concentrations due to daily heating and cooling of estuarine water. In addition to the still plots and graphs presented here to summarize results, a series of animation files was also produced. These are provided as a technical appendix on CD-ROM, and can be viewed with the TecPlot Framer software also provided on the CD-ROM. The animations include

DO concentration, suspended sediment concentration, and circulation patterns in both the entrance basin and for the entire lower Hudson River model. The computer animations are for selected time periods within the 7- month model run. Table 2 lists the animation files according to parameter and period. It is recommended that the readers of this report also review the animation files for a better visualization of model results.

Table 2. Basin area and Hudson River Animation Files (Electronic Appendix)

File Name	Parameter	Time Period	Location
DOB-120.rm	Bottom DO	2/29-4/30/96	Entrance Basin
DOB-120.rm	Surface DO	2/29-4/30/96	Entrance Basin
SEDB120.rm	Bottom Sed. Conc.	2/29-4/30/96	Entrance Basin
SEDB120.rm	Surface Sed. Conc.	2/29-4/30/96	Entrance Basin
DOB1257.rm	Bottom DO	5/1-9/15/96	Entrance Basin
DOS257.rm	Surface DO	5/1-9/15/96	Entrance Basin
SEDB257.rm	Bottom Sed. Conc.	5/1-9/15/96	Entrance Basin
SEDS257.rm	Surface Sed. Conc.	5/1-9/15/96	Entrance Basin

3.1 Results of Dissolved Oxygen Simulation

The model predictions indicated that under no-flow conditions DO concentrations remained above the 4-mg/L NJDEP minimum. Thus, for periods of zero flow from the CSO, DO concentrations are determined by the exchange of water with the Hudson River. However, similarly to previous model test cases, temporary low values of DO concentration in the entrance basin correlate with CSO discharges. Figure 5 shows a time series of predicted near-bottom concentration of DO in the entrance basin from the beginning of March (Day 60) to the beginning to April 10th (Day 100). The location of the time series is in a model cell approximately 100 feet east of the Jersey City CSO.

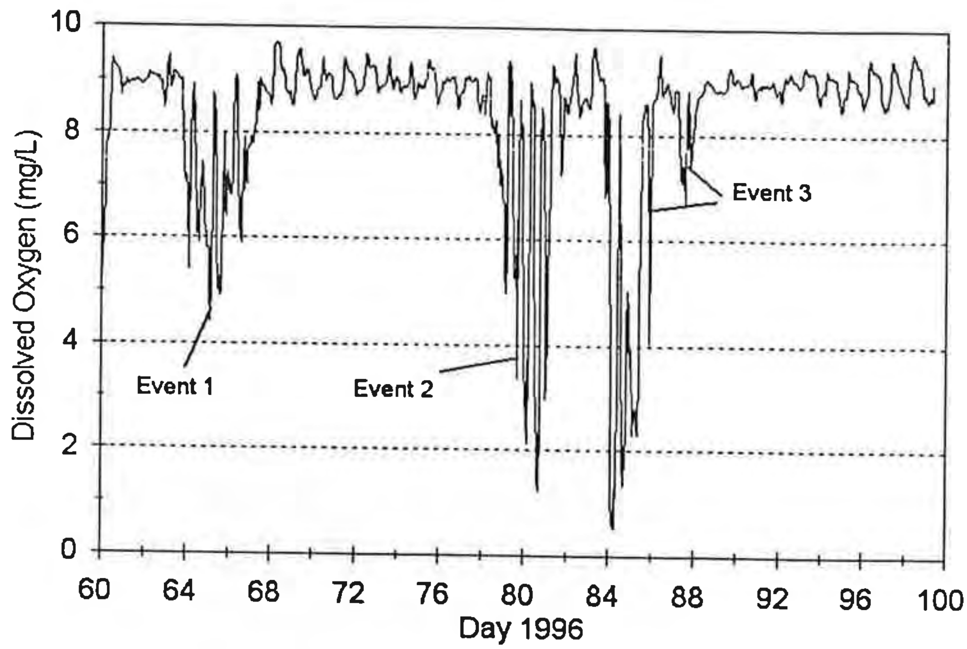


Figure 5. Predicted bottom dissolved oxygen concentration in the vicinity of the Jersey City CSO. Time period is March 1-April 10, 1996

The three episodes of low DO concentrations correlate with the CSO events depicted in Figure 5. The plot of the DO time series at this location also demonstrated the predicted recovery time from each event. In two of the events (Events 2 and 3), predicted DO concentrations dropped below the 4-mg/L threshold. Recovery occurred within two to three days for all three events. The magnitude of Event 3 in terms of CSO discharge was less then Event 2, which included flows of over 300 cfs. However, the DO minimum associated with Event 3 near the CSO was lower compared to the other events.

Figure 6 shows the maximum aerial extent of conditions below 4-mg/L for the Event 1, whereas Figure 7 shows the same relative condition for Event 2. At the peak of Event 2, approximately 40 percent of the entrance basin was subjected to conditions of less than 4-mg/l DO concentrations according to predictions from the bottom layer of the model. For Event 1, when the CSO flow rate did not exceed much more than 100 cfs, the maximum extend of DO concentration of the less than 4-mg/L was approximately 10% of the entrance basin area. Event 3 closely followed the impacts of Event 2. Therefore, DO concentrations in the entrance basin during Event 3 also included some accumulated impacts from Event 2. Figure 8 shows that maximum distribution of low DO conditions in the bottom layer exceed 40% of the basin area.

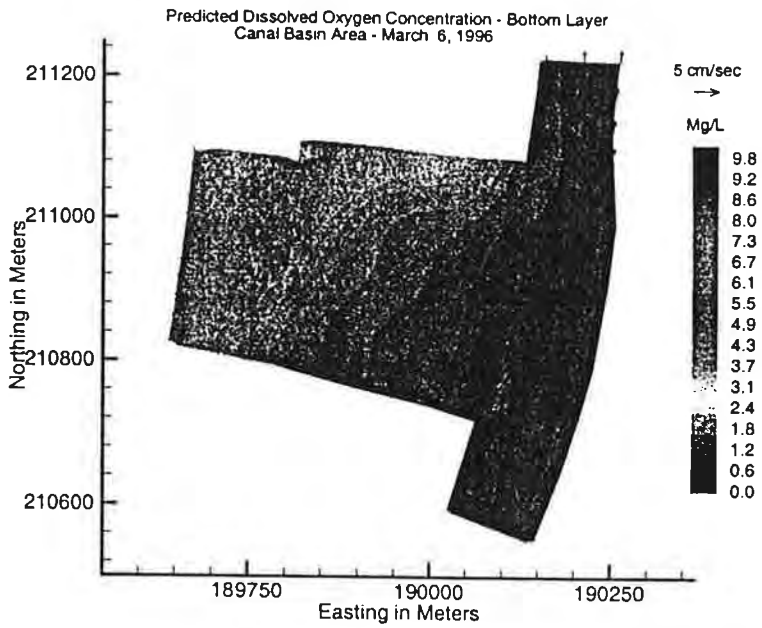


Figure 6. Dissolved oxygen concentration in the Entrance Basin during Event 1

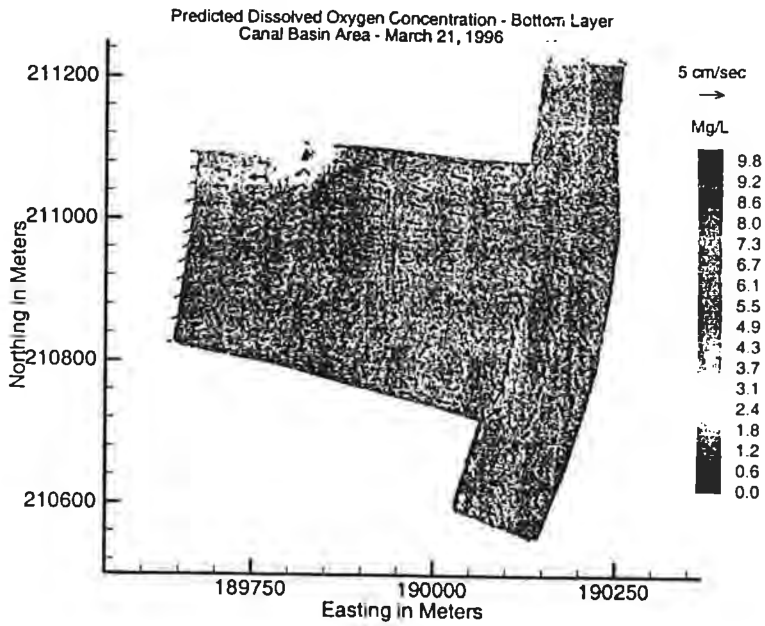


Figure 7. Dissolved oxygen concentration in the Entrance Basin during Event 2

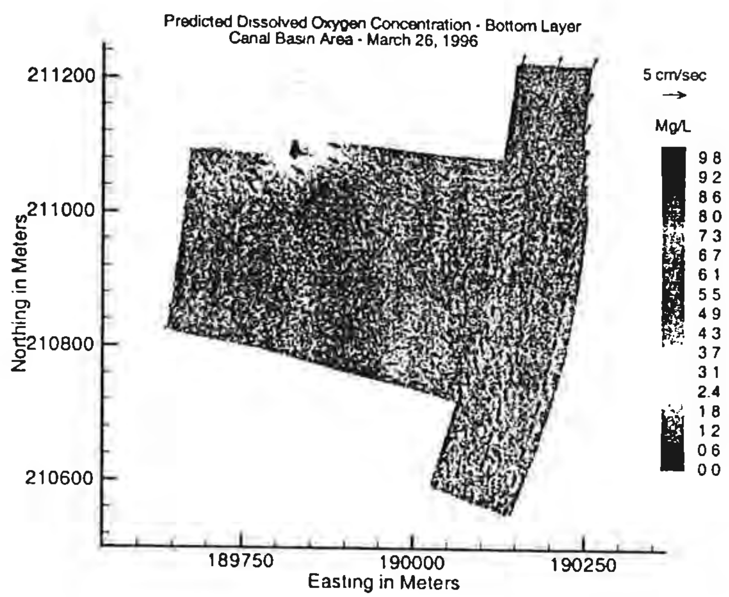


Figure 8. Dissolved oxygen concentration in the Entrance Basin during Event 3

Figure 9 shows a time series of predicted bottom concentration of DO in the entrance basin from July 18th (Day 200) to September 8, 1996 (Day 250). Similarly to the time series shown in Figure 5, the location of the prediction is in a model cell approximately 100 feet east of the Jersey City CSO. The recovery from low DO concentrations predicted under Event 4 was similar to that of Events 1 and 3, about 2 days. Likewise recovery from the immediate impacts of the larger Event 5 during this period required about 4 days. The day-to-day impacts on DO levels from each of the five events can be seen by running the appropriate animations files listed in Table 2.

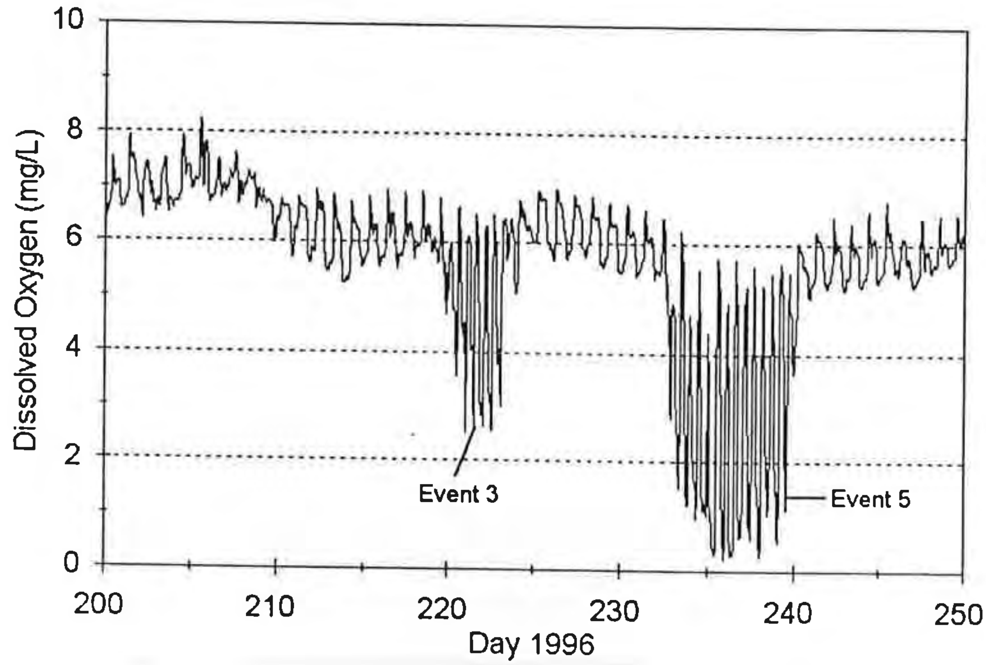


Figure 9. Predicted bottom dissolved oxygen concentration in the vicinity of the Jersey City CSO. Time period is August 18 - September 6, 1996.

3.1 Results of Sediment Transport Simulation

According to model predictions sediment concentrations in the entrance basin area were determined largely by ambient conditions in the Lower Hudson River. Figure 9 shows a time series of predicted near-bottom concentration of suspended sediment in the entrance basin area. The time series shown in this figure covers the entire 7-month period of the model test and also includes the near bottom DO concentration predicted for the same location, which is about 100 feet east of the CSO. Figure 9 shows that there was some detectable increase in sediment concentrations within the entrance basin during flow events. However, the overall impact of the flow events is not a spatially widespread compared with the distribution of low DO concentrations for the same events. Figure 10 shows the sediment concentration predicted in the bottom layer of the model during the maxima of Event 5, which occurred on August 23rd, when flows from the CSO exceeded 300 cfs.

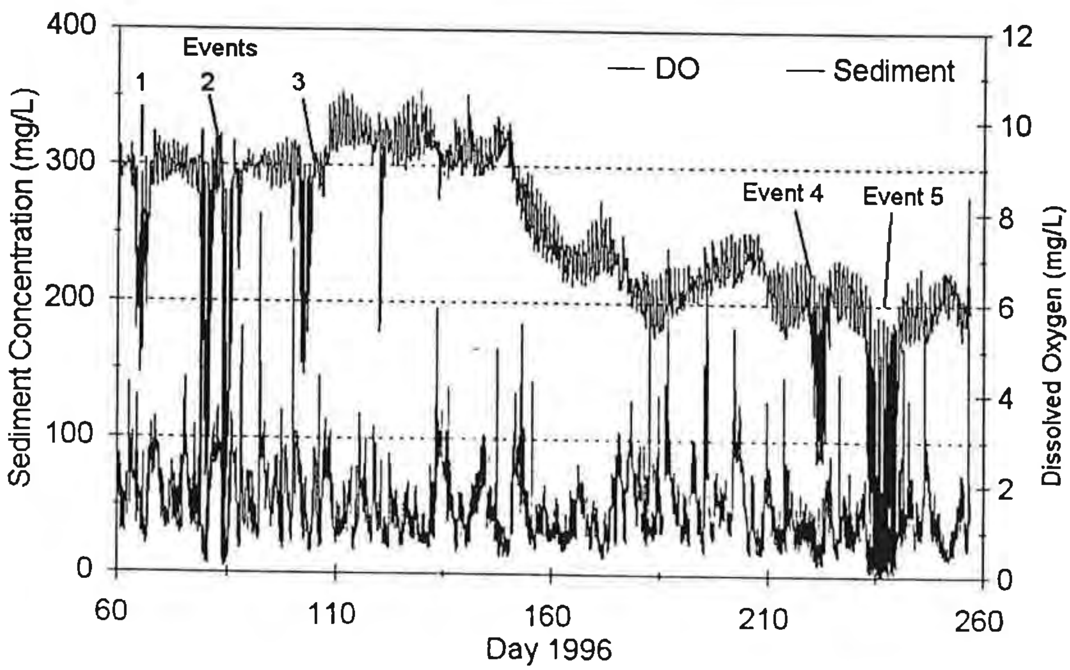


Figure10. Predicted near-bottom sediment and DO concentration in the vicinity of the Jersey City CSO. Time period is February 28 - September 14, 1996.

Maximum sediment concentrations reached about 180-mg/L over about 10% of the bottom layer. After the end of this event, suspended sediment concentrations dropped backed to the average of about 50-80 mg/L typical of zero CSO flow conditions (see

Figure 10). Within the time series of suspended sediment concentrations there are several short period in which concentrations exceed 200 mg/L. Most of these periods do not correlate with increase CSO flow in the entrance basin. Thus, it is concluded that variations in the magnitude of tidal resuspension can contribute to increased sediment concentrations in the entrance basin. Due to the short duration of CSO flows it is likely that tidal scour and contributions from the Hudson River are the major contributors to sediment dynamics in the canal basin.

3.2 Predicted Topographic Change

The predicted change in the elevation of the bed by the end of the 7-month due to sediment deposition in the entrance basin area is shown in Figure 11. Topographic change was predicted to be between 0.04 and 0.6 inches (0.1-1.5 cm) of elevation increase due to deposition of silt and clay-size sediments. The zone of maximum sedimentation was not confined to the excavation, but covered a large central section of the entrance basin area, including portions of the excavation and the pile field.

Figure 12 shows the prediction of topographic change for the lower Hudson River for the duration of the model test. It can be clearly seen that the deposition rate in the entrance basin area, although relatively low, is larger compared with predicted deposition rates in the River. This indicates that the restricted circulation entrance basin can trap fine-grained sediment from the water column, thus increasing deposition rates compared with the adjacent river section.

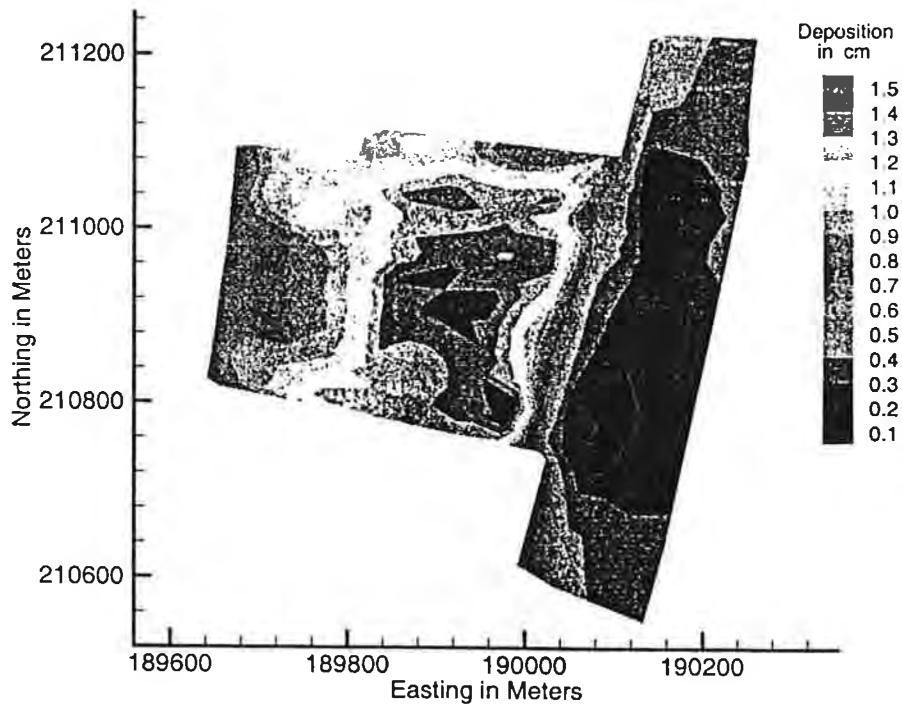


Figure 11. Predicted change in elevation of the Entrance Basin area between March and February of 1996.

4.0 Summary and Conclusions

The conclusion of the fourth phase of model testing in the Long Slip canal entrance basin and adjacent Hudson River confirmed earlier conclusions regarding flushing of CSO discharges to the entrance basin that DO will remain at favorable levels and predictions of sediment dynamics. The model test case was run for an approximate 7-month period beginning at the end of February 1996 and ending in mid-September, 1996, a period representative of average conditions based on a review of long term records. Five runoff events were specified to test the Jersey City CSO impacts on the Long Slip canal entrance basin area, as well as the impacts from conditions in the adjacent lower Hudson River.

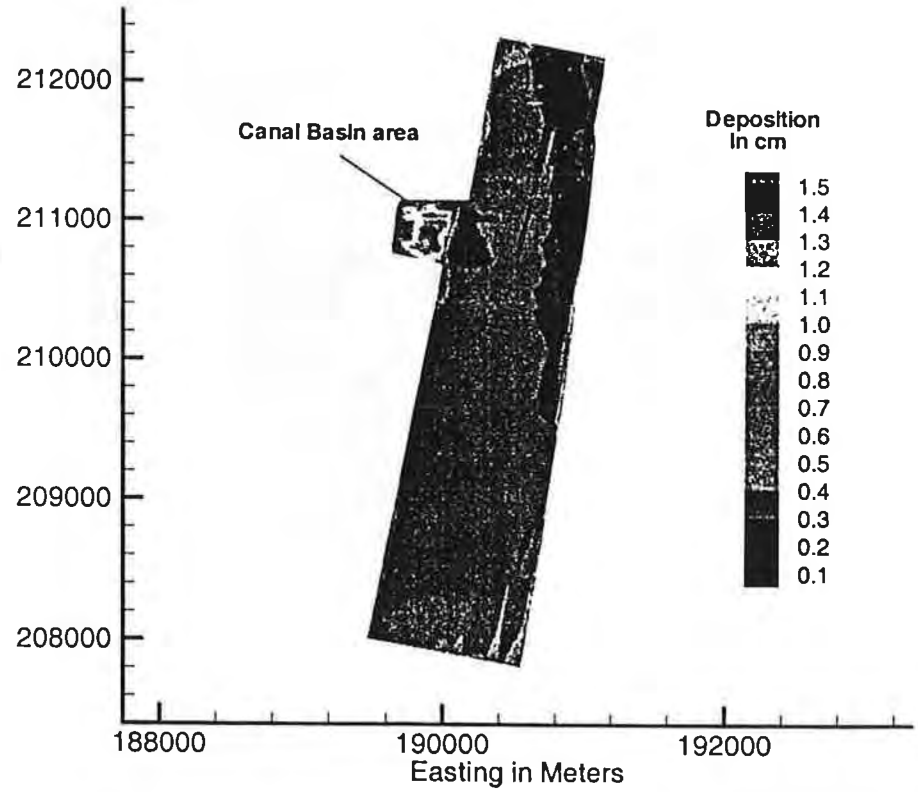


Figure 12. Predicted change in elevation of the Lower Hudson River between March and February of 1996.

Model setup for the 7-month test run included time series of water elevation, salinity, water temperature, dissolved oxygen concentrations, and suspended sediment concentrations. Time series of these parameters were specified at the south and north boundaries of the Environmental Fluid Dynamics Code hydrodynamic/water quality model. Model setup also includes specification of meteorological parameters for the model test period. These parameters, including wind velocity, atmospheric pressure, air temperature and rain fall were acquired from local weather stations and NOAA meteorological buoys in the nearby coastal ocean.

The water quality modeling found that with the improvements to the CSO discharge quality, the removal of dry weather flows, the isolation of oxygen-demanding sediments in the canal, and the entrance basin excavation to improve circulation and vertical mixing, DO levels in the interpier area approximate the ambient Hudson River. DO concentration in the entrance basin area will remain above the NJDEP 4-mg/L minimum during dry weather as long as DO concentrations remain above the minimum in the adjacent Hudson River and the CSO is not discharging. During events of low oxygen water discharges from the CSO, predicted DO concentrations temporarily dropped below 4 mg/L in portions of the entrance basin. The magnitude of impacts depended on the magnitude and duration of inflows from the CSO, as well as the any accumulated impacts remaining from previous runoff events. The model test included the excavation for the entire simulation. Recovery from high runoff events in the entrance basin area occurred within 2 to 3 days of event termination. Event 3, ending about April 14,1996, took about 1-day longer for recovery since it was combined with lingering impacts from the previous high flow event. The impacts of CSO discharges are expected to be significantly reduced over existing conditions due to the better flushing promoted by the excavation. Without the excavation, recovery of DO levels can take two to three times longer.

Predicted suspended sediment concentrations in the entrance basin area followed the ambient conditions in the lower Hudson River for periods of zero CSO discharge. Concentrations in the basin were predicted to be in the 40 to 100 mg/l range in the lower layer of the model. In the surface layer concentrations were consistently lower than about 20 mg/l under no-flow conditions. Sediment concentration values frequently exceeded 200 mg/L for short periods of time during both relatively dry conditions and high runoff conditions. This indicated that variations in the magnitude of tidal resuspension, as well as CSO flows, can contribute to increased sediment concentrations in the basin. With the elimination of dry weather flows, CSO - derived sediment is no longer a significant component of sediment deposited in the canal entrance basin.

The EFDC model compiled a running account of bottom elevation change in response to either sediment deposition or resuspension. The results predict that sedimentation within the basin over the 7-month prediction will be between 0.04 and 0.6 inches. Based on this result, the maximum rate of sedimentation within the excavation is expected to be about 1 foot in a 10-year period a rate consistent with open water areas. With this preliminary design, no maintenance will be required for 10 to 20 years; further modeling and refinement during the final design will likely extend the maintenance interval.

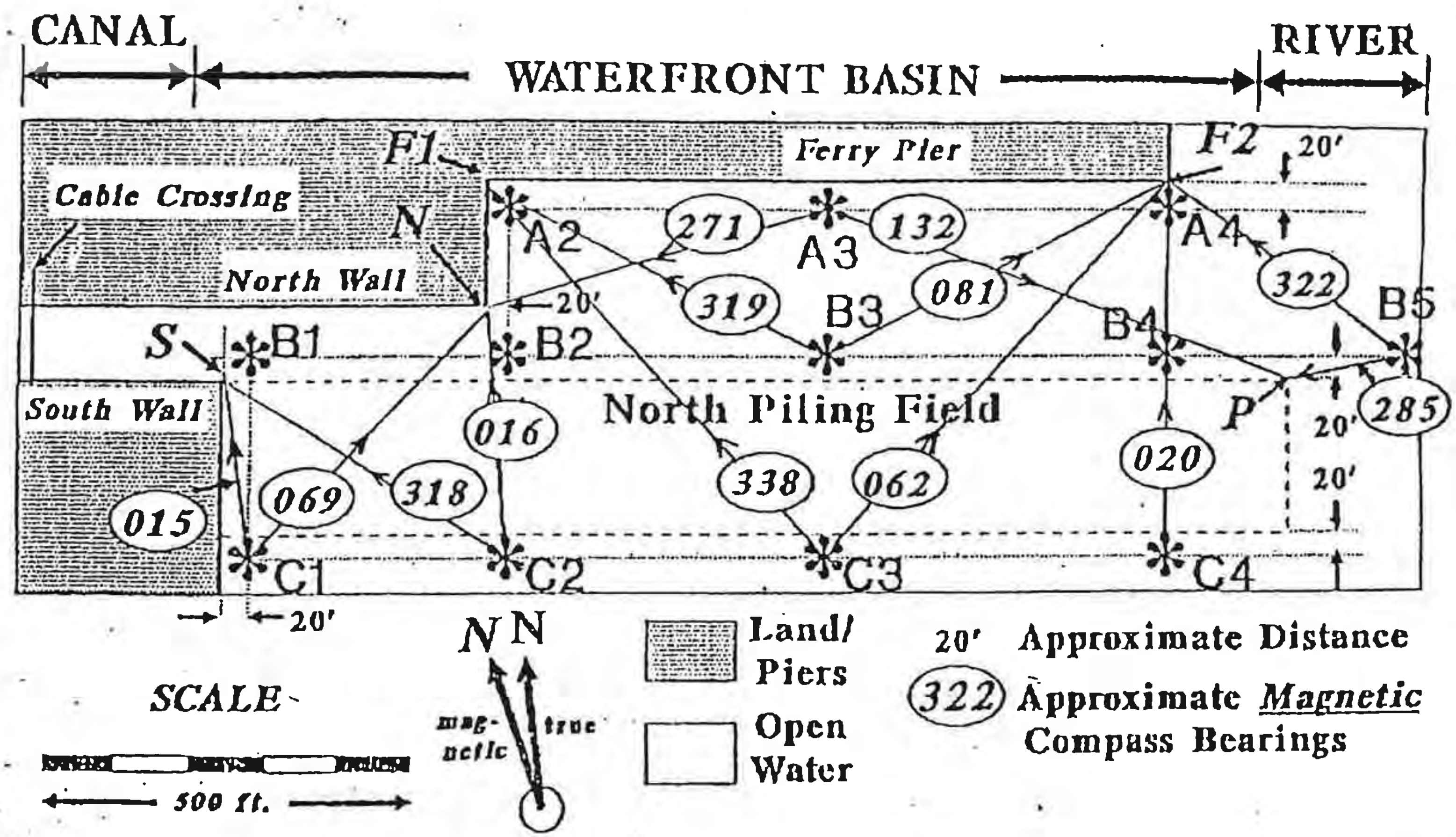
5.0 References

Zarillo, G.A., 1997. Application of a Three dimensional Numerical Model to Evaluate Water Quality Improvments in the Long Slip Canal Entrance Basin, Report to Dames & Moore, Inc. 58 p.

Zarillo, G.A, 1998 Application of a Three-Dimensional Numerical Model to Evaluate Water Quality Improvements in the Long Slip Canal Entrance Basin Dissolved Oxygen Predictions. Reports to Dames & Moore, Inc., 26 p.

Scale Diagram of
LONG SLIP CANAL APPROACH

Showing Monitoring Sites A2 - C4
with compass bearings and distances to fixed points
N, S, F1, F2, & P



LONG SLIP CANAL HABITAT CREATION PROJECT
Water Quality Recording Sheet
STATION DATA

DATE 4/20/97

START TIME 315 pm

Measurement	A-2	A-3	A-4	B-1	B-2	B-3	B-4	B-5	C-1	C-2	C-3	C-4
Max Depth (')	3	5	8	8	9	6	11	38	5	6	4	5
Secchi (ft)	2	2	2	2	2	2	1½	2	2	2	2	2
SURFACE												
pH (pH units)	7.7	7.8	7.8	7.8	7.7	7.8	7.8	7.4	7.8	7.8	7.8	7.9
Turb (NTU)	20	20	20	10	10	20	30	20	10	10	20	30
DO (mg/l)	9.8	10.2	10.8	9.9	10.2	10.4	10.8	11.7	10.4	10.4	11.3	10.7
TEMP (deg C)	9	9	9	10	10	9	9	10	9	10	9	9
Sal (%)	1.3	1.3	1.3	1.3	1.3	1.3	1.2	1.2	1.3	1.3	1.3	1.2
SHALLOW BOT												
pH (pH units)	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.0	7.8	7.8	7.8	7.8
Turb (NTU)	20	10	20	20	20	30	40	40	30	20	20	30
DO (mg/l)	10.3	10.5	10.6	10.3	10.4	10.7	10.5	11	10.4	10.3	10.2	10.5
TEMP (deg C)	10	10	10	10	10	10	10	10	10	10	10	10
Sal (%)	1.3	1.3	1.3	1.4	1.4	1.4	1.2	1.2	1.3	1.3	1.3	1.2

DEEP BOT B-5

	B-5
pH (pH units)	6.1
Turb (NTU)	40
DO (mg/l)	10.1
TEMP (deg C)	10
Sal (%)	1.4

3 FT ON SCALE
WINDY, OVERCAST
WATER CHOPPY

LONG SLIP CANAL HABITAT CREATION PROJECT
Water Quality Recording Sheet
STATION DATA

DATE 4/20/97 START TIME 1025

Measurement	A-2	A-3	A-4	B-1	B-2	B-3	B-4	B-5	C-1	C-2	C-3	C-4
Max Depth (')	8 FOOT	10	14	13	12	10	13	44	12 FEET	12 FT	8	9
Secchi (ft)	2 FEET	2 FEET	2 FEET	2	2 FOOT	2 FOOT	2 FOOT	2 FOOT	2 FOOT	2 FOOT	2 FOOT	2 FOOT
SURFACE												
pH (pH units)	7.8	7.8	7.9	7.9	7.8	7.7	[illegible]	7.9	6.1	7.8	7.8	7.9
Turb (NTU)	20	20	20	10	10	20	10	10	20	20	20	10
DO (mg/l)	10.4	10.8	10.6	10.9	10.7	10.8	10.9	10.9	10.8	10.6	10.7	10.6
TEMP (deg C)	9	9	9	9	9	9	9	9	10	9	9	9
Sal (%)	1.2	1.3	1.2	1.1	1.1	1.2	1.2	1.1	1.2	1.2	1.2	1.2
SHALLOW BOT												
pH (pH units)	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.3	7.7	7.7	7.9
Turb (NTU)	30	30	20	20	20	30	20	20	20	20	30	20
DO (mg/l)	10.4	10.3	10.7	10.4	10.5	10.7	10.8	11.2	10.1	10.2	10.4	10.4
TEMP (deg C)	9	9	9	10	9	9	9	10	10	10	9	9
Sal (%)	1.3	1.3	1.6	1.4	1.4	1.5	1.4	1.4	1.6	1.6	1.5	1.3

DEEP BOT B-5

pH (pH units)	7.8
Turb (NTU)	20
DO (mg/l)	10.9
TEMP (deg C)	9
Sal (%)	2.0

High TIDE 8 FT ON STICK

CLEAR, OVERCAST
NO WAVES

LONG SLIP CANAL HABITAT CREATION PROJECT
Water Quality Recording Sheet

DATE 4/17/97

STATION DATA

START TIME 4:15 pm

Measurement	A-2	A-3	A-4	B-1	B-2	B-3	B-4	B-5	C-1	C-2	C-3	C-4
Max Depth (')	7	9	11	16	13	10	14	46	14	13	8	9
Secchi (ft)	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT
SURFACE												
pH (pH units)	7.7	7.7	7.7	7.6	7.5	7.6	7.4	8.2	7.7	7.7	7.7	7.7
Turb (NTU)	16	14	20	15	11	18	16	20	20	20	20	20
DO (mg/l)	11.1	11.2	11.0	11.1	10.9	11.0	11.0	11.1	11.0	11.2	11.1	11.1
TEMP (deg C)	9.1	9.1	9.0	9.2	9.2	9.2	9.2	9.3	9.0	9.0	9.0	9.0
Sal (%)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
SHALLOW BOT												
pH (pH units)	7.6	7.7	7.7	7.7	7.7	7.6	7.0	7.0	7.7	7.7	7.7	7.7
Turb (NTU)	16	28	20	20	20	22	20	20	20	20	20	20
DO (mg/l)	10.6	10.5	10.5	10.7	10.9	10.9	12.0	12.0	11.0	10.9	10.9	10.9
TEMP (deg C)	9.4	9.5	9.0	9.7	9.5	9.5	9.5	9.5	10	9.0	9.0	9.0
Sal (%)	0.6	0.5	0.2	0.2	0.2	0.5	0.5	0.5	0.5	0.6	0.6	0.5
DEEP BOT B-5												
pH (pH units)								7.0				
Turb (NTU)								20				
DO (mg/l)								12.0				
TEMP (deg C)								9.5				
Sal (%)								0.5				

High TIDE
7FT on DEPTH STICK
RAINING, OVERCAST
WAVES 1FT

LONG SLIP CANAL HABITAT CREATION PROJECT
Water Quality Recording Sheet

DATE 4/16/97 STATION DATA START TIME 4:30 pm

Measurement	A-2	A-3	A-4	B-1	B-2	B-3	B-4	B-5	C-1	C-2	C-3	C-4
Max Depth (')	9	9	11	13	14	11	15	40 Feet	10	9	8	9
Secchi (ft)	1 Ft	1 FT	1 Ft		1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT	1 FT
SURFACE												
pH (pH units)	7.5	7.6	7.6	7.4	7.2	7.1	7.8	5.6	7.6	7.6	7.6	7.6
Turb (NTU)	22	20	21	18	19	19	30	46	20	20	20	22
DO (mg/l)	11	10.9	10.9	10.9	11	10.9	10.9	11.4	10.8	10.9	11.1	11.1
TEMP (deg C)	10.7	9.8	9.6	10.5	10.1	9.9	9.9	10.1	10.4	9.7	9.6	9.4
Sal (%)	.37	0.33	0.33	0.40	0.45	0.32	0.34	0.32	0.39	0.35	0.30	0.32
SHALLOW BOT												
pH (pH units)		BOTTOM		SAMPLES		NOT		TAKEN		BECAUSE		
Turb (NTU)		PUMP			WAS	NOT		AVAILABLE				
DO (mg/l)												
TEMP (deg C)												
Sal (%)												

DEEP BOT B-5

pH (pH units)	
Turb (NTU)	
DO (mg/l)	
TEMP (deg C)	
Sal (%)	

Clear,

IEA NEW JERSEY
628 Route 10 Whippany, N.J. 07981
(201) 428-8181

CHAIN OF CUSTODY

FIELD BOOK: ______ Pg 1 of 1

(1) Client: NJ TRANSIT RAIL OPS
(2) Project Name/no.: ~~Hoboken~~ JERSEY CITY 18th ST, C.S.O
(3) Client Contact: CHARLES HENTZ
(4) IEA Contact:
(5) TAT: 1wk, 2wk, 3wk, OTHER
(6) Proj. Type: NJPDES, NPDES, ISRA, CLP, CERCLA, RCRA, UST, ACO, MOA, OTHER Long Slip
(7) Protocol: CLP, SW846, EPA 600, DW, OTHER STORMWATER
(8) Reporting Type: NJ Reg Format, NJ Reduced Format, CLP, Level II, Level I (Data Sum), Other

(14) Bill To: NJ TRANSIT RAIL OPS, ENVIRONMENTAL SERVICE UNIT
PO#

For Lab Use Only: Job No. / Quote No. / # of Coolers: / Cooler Temp: / Custody Seal #(s) / Date Due:

PM NON-CONFORMANCE: Preserved: Temp: / Container: Volume: / Broken: Initials: / Holding Time: / Other: / Logged By:

(9) Client ID (10 CHAR)	(10) Date	(11) Time	(12) Mix	(13) # OF CONTAINERS	BOD5	TSS								LAB ID	DESCRIPTION
001	4/17/97	1600	ML	1	X										PH 5.1
002	4/17/97	1610	ML	1		X									TURB. 12
															D.O. 2.8
															TEMP. 11°C
															SAL. 0.71
															COND. 1217
										0600					HIGH TIDE
										0400					

(16) COMMENTS: (Please include hazards on site.)

(17)	Print Name and Company	Signature	Custody Seal # (s)	Date/Time
Sampled By:	MARTY DOBBINS	Marty Dobbins	# 20702	4/17/97/1600
Received By:	AL D'Achille	AD D'Achille		4/18/97/0930
Relinquished By:				/
Received By:				/
Relinquished By:				/
Received By:				/

Mix = Matrix of Sample. (AI=Air, AQ=Aqueous, LE=Leachate, ML=Misc Liquid, MS=Misc Solids, OIL, SE=Sediment, SL=Sludge, SO=Soil)

(Copies: White and yellow copies should accompany samples to IEA. The pink copy should be retained by the client.) See reverse for directions.

IEA OF NEW JERSEY
628 Route 10 Whippany, N.J. 07981
(201) 428-8181

CHAIN OF CUSTODY

FIELD BOOK: ______ Pg ____ of ____

(1) Client: NJ TRANSIT RAIL OPS
(2) Project Name/no.: JERSEY CITY 18TH ST CSO
(3) Client Contact: CHARLES HENTZ
(4) IEA Contact:
(5) TAT: 1wk, 2wk, 3wk, OTHER ______
(6) Proj. Type: NJPDES, NPDES, ISRA, CLP, CERCLA, RCRA, UST, ACO, MOA, OTHER LONG SLIP
(7) Protocol: CLP, SW846, EPA 600, DW, OTHER
(8) Reporting Type: NJ Reg Format, NJ Reduced Format, CLP, Level II, Level I (Data Sum), Other ______

(14) Bill To: NJ TRANSIT RAIL OPS ENVIRONMENTAL SERVICE UNIT
PO#

(15) ANALYSIS REQUIRED

(9) Client ID (10 CHAR)	(10) Date	(11) Time	(12) Mtx	(13) # OF CONTAINERS	BOD5	TSS
001	4/18/97	0600	ML	1	X	
002	4/18/97	0600	ML	1		X

For Lab Use Only
Job No.
Quote No.
# of Coolers
Custody Seal #(s)
Date Due:
PM NON-CONFORMANCE
A Preserved: Temp:
B Container: Volume:
C Broken: Initials:
D Holding Time:
Other:
Logged By:

DESCRIPTION
PH 6.7
COND 14
D.O. 3.7
TEMP 11°C
SAL 0.8
HIGH TIDE

(16) COMMENTS: (Please include hazards on site.)

(17)

	Print Name and Company	Signature	Custody Seal #(s)	Date/Time
Sampled By:	MARTY DOBBINS	Marty Dobbins		
Received By:	AL D'ACHILLE	[illegible]	#20702	4/18/97 / 1600
Relinquished By:				/
Received By:				/
Relinquished By:				/
Received By:				/

Mix = Matrix of Sample. (AI=Air, AQ=Aqueous, LE=Leachate, ML=Misc Liquid, MS=Misc Solids, OIL, SE=Sediment, SL=Sludge, SO=Soil)

(Copies: White and yellow copies should accompany samples to IEA. The pink copy should be retained by the client.) See reverse for directions.

Garden State Laboratories, Inc.

Bacteriological and Chemical Testing
410 Hillside Avenue
Hillside, New Jersey 07205

Toll Free 800-273-8901
Telephone 908-688-8900
Fax 908-688-8966

Mathew Klein, M.S., Director Emeritus
Harvey Klein, M.S., Laboratory Director

REPORT OF ANALYSIS

REPORT # 970320008.0
CLIENT # KIL13
DATE SUBMITTED: 3/20/97

TO: KILLAM -DOBBINS/KNOWLES
P.O. BOX 32

MILLBURN NJ 07041-0032
ATT: MARTY DOBBINS/DAVID KNOWLES

RECEIVED
APR 4 1997
KILLAM MANAGEMENT & OPERATIONAL SERVICES, INC.

SAMPLE TYPE: STORMWATER
SAMPLE ID: 001 & 002
SAMPLE LOCATION: @JERSEY CITY - 18TH STREET. CSO

DATE SAMPLED: 3/20/97 TIME SAMPLED: 13:30HRS.

ANALYSIS	RESULT	UNITS	DATE ANALYZED
Biochemical Oxygen Demand	103	mg/l	3/20/97-15:21
Total Suspended Solids	56	mg/l	3/26/97

< = less than, not detected.

NOTE: HIGH TIDE SAMPLES DUE TO TIME RESTRICTIONS
NV

IEA
An Aquarion Company

000001

APRIL 14, 1997

20970-71400
NJ TRANSIT
1 PENN PLAZA (NJ TRANSIT)
NEWARK , NJ 07105

ATTENTION: NICK VALENTE

The following samples were received for analysis by IEA-NJ (Cert.#14530).
These samples were received on and labeled as follows:

IEA Sample No.:	Client ID:	Date Received
71400001	HBCSO	04/02/97

DATA RELEASE AUTHORIZED BY: Brian W. Wood

Brian Wood
Laboratory Manager

Client: NJ TRANSIT

Job No: 20970-71400

WATER

Miscellaneous Parameters

mg/l

Lab I.D.	71400001				
Client I.D.	HBCSO				
Analyte					DL
TSS	22				1.0

DL - Detection Limit

LONG SLIP CANAL HABITAT CREATION PROJECT
Water Quality Recording Sheet
STATION DATA

DATE 4/25/97 START TIME 4 pm

Measurement	A-2	A-3	A-4	B-1	B-2	B-3	B-4	B-5	C-1	C-2	C-3	C-4
Max Depth (')	5	6	12	13	9	7	11	42	5	8	6	6
Secchi (ft)	2	2	2	2	2	2	2	2	2	2	2	2
SURFACE												
pH (pH units)	7.7	7.8	7.8	7.7	7.8	7.8	7.8	7.8	7.3	7.6	7.7	7.8
Turb (NTU)	1.0	3.0	2.0	2.0	2.0	2.0	3.0	2.0	3.0	2.0	3.0	2.0
DO (mg/l)	9.4	9.8	10.3	10.4	10.1	10.3	10.2	10.5	10.0	10.1	10.1	10.3
TEMP (deg C)	10	10	10	11	11	10	10	11	11	10	10	10
Sal (%)	1.3	1.5	1.5	1.5	1.5	1.5	1.5	1.4	1.5	1.6	1.5	1.5
SHALLOW BOT												
pH (pH units)	7.6	7.6	7.7	7.7	7.8	7.7	7.7	7.8	6.7	7.4	7.6	7.7
Turb (NTU)	2.0	4.0	3.0	2.0	3.0	4.0	4.0	2.0	3.0	2.0	3.0	3.0
DO (mg/l)	9.5	9.6	9.9	9.4	10.1	10.1	10.1	10.8	10.6	9.3	9.8	10.1
TEMP (deg C)	10	12	11	11	12	11	11	10	11	12	11	11
Sal (%)	1.5	1.6	1.7	1.6	1.6	1.6	1.7	1.5	1.5	1.6	1.5	1.5

DEEP BOT B-5	
pH (pH units)	7.7
Turb (NTU)	3.0
DO (mg/l)	10.[illegible]
TEMP (deg C)	11
Sal (%)	1.6

3 ft on staff
Windy,
overcast —

LONG SLIP CANAL HABITAT CREATION PROJECT
Water Quality Recording Sheet

DATE 4/25/97

STATION DATA

START TIME 10 AM

Measurement	A-2	A-3	A-4	B-1	B-2	B-3	B-4	B-5	C-1	C-2	C-3	C-4
Max Depth (')	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Secchi (ft)	9	11	12	19	14	11	13	49	11	11	9	9
SURFACE												
pH (pH units)	7.7	7.8	7.8	7.7	7.8	7.7	7.8	7.8	6.9	7.5	7.7	7.8
Turb (NTU)	20	20	20	2.0	20	20	20	20	30	30	20	30
DO (mg/l)	10.2	10.3	10.2	10.1	10.1	10.1	10.4	10.3	10.0	10.0	10.2	10.3
TEMP (deg C)	10°C	10°C	10°C	10°C	10°C	10°C	10°C	10°C	10°C	10°C	10°C	11°C
Sal (%)	1.3	1.4	1.4	1.4	1.4	1.3	1.4	1.2	1.4	1.4	1.2	1.4
SHALLOW BOT												
pH (pH units)	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.8	7.7	7.2	7.7	7.8
Turb (NTU)	20	40	30	20	30	30	40	30	20	40	20	20
DO (mg/l)	9.5	10.0	10.0	10.1	10.0	10.0	10.5	10.1	10.2	10.1	10.2	10.4
TEMP (deg C)	11°C	11°C	11°C	11°C	11°C	10°C	10°C	10°C	11°C	10°C	10°C	10°C
Sal (%)	1.5	1.3	1.4	1.4	1.4	1.6	1.4	1.5	1.4	1.4	1.2	1.4

DEEP BOT B-5

Measurement	B-5
pH (pH units)	7.8
Turb (NTU)	30
DO (mg/l)	10.1
TEMP (deg C)	10°C
Sal (%)	1.5

HIGH TIDE - 7FT
SUNNY, CLEAR
LIGHT WIND
NO WAVE ACTION

7461

LONG SLIP CANAL HABITAT CREATION PROJECT
Water Quality Recording Sheet

DATE 4-28-97

STATION DATA

START TIME 3:15

Measurement	A-2	A-3	A-4	B-1	B-2	B-3	B-4	B-5	C-1	C-2	C-3	C-4
Max Depth (')	14	10	~~7~~8	14	13	12	16	52	11	12	8	10
Secchi (ft)	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
SURFACE												
pH (pH units)	7.6	7.5	7.3	7.5	7.6	7.6	7.5	7.2	7.7	7.6	7.7	7.7
Turb (NTU)	30	20	20	20	20	20	20	20	20	20	20	20
DO (mg/l)	9.9	9.6	9.4	9.0	8.9	8.9	9.2	9.6	9.4	9.9	9.8	9.8
TEMP (deg C)	11	11	11	11	11	11	12	11	11	11	11	11
Sal (%)	1.4	1.3	1.2	1.2	1.2	1.2	1.3	1.3	1.3	1.3	1.3	1.3
SHALLOW BOT												
pH (pH units)	7.5	7.4	7.1	7.5	7.6	7.6	7.4	6.8	7.7	7.6	7.7	7.6
Turb (NTU)	30	40	40	30	30	20	20	20	20	20	20	40
DO (mg/l)	10.2	9.5	9.5	9.2	9.2	9.8	9.7	9.9	9.9	10.6	9.9	9.7
TEMP (deg C)	11	11	11	11	11	11	12	11	11	12	11	11
Sal (%)	1.6	1.4	1.3	1.4	1.4	1.4	1.2	1.6	1.5	1.6	1.6	1.7

DEEP BOT B-5	
pH (pH units)	5.5
Turb (NTU)	20
DO (mg/l)	10.1
TEMP (deg C)	11
Sal (%)	1.7

TO: NICK VALENTI

HEAVY RAINS DURING THE MORNING + AFTERNOON, LIGHT RAIN DURING SAMPLING
1 FT WAVES, OVERCAST
HIGH TIDE

SAMPLER: M. DOBBINS

LONG SLIP CANAL HABITAT CREATION PROJECT
Water Quality Recording Sheet

DATE 5/1/97

STATION DATA

START TIM... 10:30AM

Measurement	A-2	A-3	A-4	B-1	B-2	B-3	B-4	B-5	C-1	C-2	C-3	C-4
Max Depth (')	3	6	15	9	8	6	10	38	3	6	4	4
Secchi (ft)	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
SURFACE												
pH (pH units)	7.6	7.6	7.7	7.7	7.7	7.7	7.7	7.8	7.4	7.5	7.7	7.7
Turb (NTU)	1.0	2.0	3.0	1.0	3.0	4.0	4.0	4.0	3.0	2.0	3.0	4.0
DO (mg/l)	8.8	9.7	9.8	9.4	9.8	9.8	9.8	9.9	9.9	9.6	9.7	9.8
TEMP (deg C)	13	12	12	14	12	12	12	12	13	13	12	12
Sal (%)	1.2	1.2	1.1	1.1	1.2	1.2	1.2	1.1	1.3	1.3	1.3	1.2
SHALLOW BOT												
pH (pH units)	7.7	7.7	7.7	7.6	7.7	7.7	7.7	7.7	7.1	7.6	7.7	7.7
Turb (NTU)	2.0	3.0	4.0	2.0	2.0	4.0	5.0	5.0	4.0	2.0	3.0	4.0
DO (mg/l)	9.0	9.1	9.6	8.8	9.8	10.0	9.0	9.2	9.4	9.2	8.9	9.9
TEMP (deg C)	13	13	13	12	13	12	12	13	13	12	13	13
Sal (%)	1.3	1.3	1.2	1.5	1.4	1.3	1.2	1.2	1.2	1.5	1.4	1.2

DEEP BOT B-5	
pH (pH units)	7.7
Turb (NTU)	5.0
DO (mg/l)	[illegible]
TEMP (deg C)	12
Sal (%)	1.2

LOW TIDE
1FT WAVES
OVERCAST

LONG SLIP CANAL HABITAT CREATION PROJECT
Water Quality Recording Sheet
STATION DATA

DATE 5/1/97 START TIME 3 Pm

Measurement	A-2	A-3	A-4	B-1	B-2	B-3	B-4	B-5	C-1	C-2	C-3	C-4
Max Depth (')	7	9	10	14	13	11	14	48	15	14	9	9
Secchi (ft)	2	2	2	2	2	2	2	2	2	2	2	2
SURFACE												
pH (pH units)	7.7	7.7	7.7	7.6	7.6	7.6	7.5	7.7	7.7	7.7	7.7	7.7
Turb (NTU)	2.0	3.0	3.0	2.0	2.0	3.0	3.0	4.0	3.0	2.0	3.0	3.0
DO (mg/l)	9.1	9.1	9.0	9.2	9.2	9.2	9.2	9.3	9.1	9.1	9.1	9.1
TEMP (deg C)												
Sal (%)												
SHALLOW BOT												
pH (pH units)	7.6	7.7	7.7	7.7	7.6	7.6	7.3	7.7	7.7	7.7	7.7	7.7
Turb (NTU)	3.0	3.0	3.0	3.0	2.0	3.0	4.0	5.0	4.0	2.0	3.0	3.0
DO (mg/l)	9.3	9.2	9.3	9.7	9.3	9.3	9.6	10.1	9.8	9.3	9.3	9.3
TEMP (deg C)												
Sal (%)												

DEEP BOT B-5	
pH (pH units)	7.7
Turb (NTU)	5.0
DO (mg/l)	10.1
TEMP (deg C)	
Sal (%)	

HIGH TIDE
OVERCAST
LIGHT DRIZZLE
7 FT ON. SCALE
BENCHMARK

LONG SLIP CANAL HABITAT CREATION PROJECT
Water Quality Recording Sheet
STATION DATA

DATE 5/2/97 START TIME 4:30 AM

Measurement	A-2	A-3	A-4	B-1	B-2	B-3	B-4	B-5	C-1	C-2	C-3	C-4
Max Depth (')	9	10	12	15	12	10	13	43	11	12	8	10
Secchi (ft)	2	2	2	2	2	2	2	2	2	2	2	2
SURFACE												
pH (pH units)	7.7	7.7	7.7	7.8	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7
Turb (NTU)	2	2	2	2	2	2	2	2	2	2	2	2
DO (mg/l)	9.3	9.6	9.7	9.8	9.7	9.6	9.7	9.9	9.5	9.6	9.6	9.6
TEMP (deg C)	11	11	11	11	11	11	11	11	10	11	11	11
Sal (%)	1.0	1.0	1.0	1.0	1.1	1.1	1.1	1.0	1.1	1.1	1.1	1.1
SHALLOW BOT												
pH (pH units)	7.6	7.7	7.7	7.7	7.7	7.6	7.7	7.7	7.7	7.7	7.7	7.7
Turb (NTU)	2	3	3	2	2	2	2	3	2	3	2	2
DO (mg/l)	9.4	9.3	9.8	9.5	9.6	9.5	9.6	10.3	9.2	9.2	9.3	9.3
TEMP (deg C)	11	11	11	11	11	11	11	10	11	11	11	11
Sal (%)	1.0	1.0	1.2	1.2	1.2	1.2	1.1	1.1	1.2	1.2	1.2	1.2

DEEP BOT B-5

Measurement	B-5
pH (pH units)	7.7
Turb (NTU)	3
DO (mg/l)	10.3
TEMP (deg C)	10
Sal (%)	1.1

HIGH TIDE
2 FT WAVE SWELLS
WINDY,
DARK
7 FT ON SCALE BENCH MARK

LONG SLIP CANAL HABITAT CREATION PROJECT

Water Quality Recording Sheet

DATE 5/27/97

STATION DATA

START TIME 10:45

Measurement	A-2	A-3	A-4	B-1	B-2	B-3	B-4	B-5	C-1	C-2	C-3	C-4
Max Depth (')	8	10	9	14	13	11	14	46	11	13	8	9
Secchi (ft)	1	1	1	1	1	1	1	1	1	1	1	1
SURFACE												
pH (pH units)	7.1	7.4	7.5	7.4	7.4	7.4	7.7	8.2	7.6	7.5	7.5	7.5
Turb (NTU)	2.0	2.0	2.0	2.6	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
DO (mg/l)	9.0	9.2	9.1	8.9	9.0	9.2	9.2	10.5	9.0	9.2	9.4	9.4
TEMP (deg C)	15.0	15.1	15.0	14.9	15.1	14.9	15.1	16	15.2	15.1	15.1	15.1
Sal (%)	1.4	1.3	1.4	1.3	1.3	1.3	1.2	1.3	1.4	1.3	1.3	1.3
SHALLOW BOT												
pH (pH units)	7.1	7.6	7.5	7.5	7.4	7.4	7.2	7.6	7.6	7.5	7.5	7.5
Turb (NTU)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
DO (mg/l)	8.9	8.8	8.1	8.3	9.0	9.2	9.2	10.1	9.0	9.1	8.9	9.0
TEMP (deg C)	15.0	15.0	15.1	15.2	15.1	15.1	15.1	14.9	15.0	15.2	15.1	15.1
Sal (%)	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3

DEEP BOT B-5

Measurement	B-5
pH (pH units)	7.2
Turb (NTU)	2.0
DO (mg/l)	10.5
TEMP (deg C)	14.9
Sal (%)	1.3

HIGH TIDE - INCOMING
CLEAR SUNNY
1 FOOT SWELLS
[illegible]

IEA
An Aquarion Company

000001

3/31/97

TSS ONLY

APRIL 14, 1997

20970-71400
NJ TRANSIT
1 PENN PLAZA (NJ TRANSIT)
NEWARK , NJ 07105

ATTENTION: NICK VALENTE

The following samples were received for analysis by IEA-NJ (Cert.#14530).
These samples were received on and labeled as follows:

IEA Sample No.:	Client ID:	Date Received
71400001	HBCSO	04/02/97

DATA RELEASE AUTHORIZED BY. Brian Wood

Brian Wood
Laboratory Manager

Client: NJ TRANSIT

Job No: 20970-71400

WATER

Miscellaneous Parameters

mg/l

Lab I.D.	71400001				
Client I.D.	HBCSC				
Analyte					DL
TSS	22				1.0

DL - Detection Limit

№ 26000

IEA OF NEW JERSEY
628 Route 10 Whippany, N.J. 07981
(201) 428-8181

CHAIN OF CUSTODY

FIELD BOOK: ______ Pg 1 of 1

(1) Client: NJ TRANSIT RAIL OPERATION
(2) Project Name/No.: NJ 18th ST. CSO
(3) Client Contact: NICK VALENTE
(4) IEA Contact:
(5) TAT: 1wk, 2wk, 3wk, OTHER ______
(6) Proj. Type: NJPDES, NPDES, ISRA, CLP, CERCLA, RCRA, UST, ACO, MOA, OTHER ______
(7) Protocol: CLP, SW846, EPA 600, DW, OTHER ______
(8) Reporting Type: NJ Reg Format, NJ Reduced Format, CLP, Level II, Level I (Data Sum), Other ______

(14) Bill To: ______
PO#: ______

(9) Client ID (10 CHAR)	(10) Date	(11) Time	(12) Mtx	(13) # OF CONTAINERS	(15) ANALYSIS REQUIRED: BOD5	TSS								
	3/31/97	2PM	ML	2	1	1								

For Lab Use Only

Job No. 71400
Quote No.
# of Coolers
Cooler Temp. (s)
Custody Seal # (s)
Date Due

PM NON-CONFORMANCE
Preserved: Temp:
Container: Volume:
Broken: Initials:
Holding Time:
Other:
Logged By:

LAB ID	DESCRIPTION
01	No Sample ID on Chain

(16) COMMENTS: (Please include hazards on site.)

(17)	Print Name and Company	Signature	Custody Seal # (s)	Date/Time
Sampled By:	MARTY DORRANS	[signature]		
Received By:	Al DiAchille	[signature]		4/1/97 / 1110
Relinquished By:	E.D. REYNOLDS / IEA	[signature]		4/1/97 / 1650
Received By:	R. DROZ	[signature]		4-2-97 / 1050
Relinquished By:				/
Received By:				/

Mtx = Matrix of Sample. (AI=Air, AQ=Aqueous, LB=Leachate, ML=Misc Liquid, MS=Misc Solids, OIL, SE=Sediment, SL=Sludge, SO=Soil)

(Copies: White and yellow copies should accompany samples to IEA. The pink copy should be retained by the client.) See reverse for directions.

000003

IEA
An Aquarion Company

000001

MAY 01. 1997

4/17/97

20970-71672
NJ TRANSIT
1 PENN PLAZA (NJ TRANSIT)
NEWARK , NJ 07105

ATTENTION: NICK VALENTE

The following samples were received for analysis by IEA-NJ (Cert.#14530).
These samples were received on and labeled as follows:

IEA Sample No.:	Client ID:	Date Received
71672001	001	04/18/97
71672002	002	04/18/97

DATA RELEASE AUTHORIZED BY: Brian W. Wood

Brian Wood
Laboratory Manager

000011

Client: NJ TRANSIT

Job No: 20970-71672

WATER

Miscellaneous Parameters

mg/l

Lab I.D.	71672001	71672002	DL
Client I.D.	001	002	
Analyte			
BOD5 (mg/l O_2)	5	NR	2
TSS	NR	9	1

DL - Detection Limit

NR - Not Requested

IEA OF NEW JERSEY
628 Route 10 Whippany, N.J. 07981
(201) 428-8181

CHAIN OF CUSTODY

FIELD BOOK: Pg 1 of 1

(1) Client: NJ TRANSIT RAIL OPS

(2) Project Name/no.: ~~HOBOKEN~~ JERSEY CITY 18th ST. C.S.O

(3) Client Contact: CHARLES HENTZ

(4) IEA Contact:

(5) TAT: 1wk, 2wk, 3wk, OTHER

(6) Proj. Type: NJPDES, NPDES, ISRA, CLP, CERCLA, RCRA, UST, ACO, MOA, OTHER LONG SLIP

(7) Protocol: CLP, SW846, EPA 600, DW, OTHER STORMWATER

(8) Reporting Type: NJ Reg Format, NJ Reduced Format, CLP, Level II, Level I (Data Sum), Other

(14) Bill To: NJ TRANSIT RAIL OPS ENVIRONMENTAL SERVICE UNIT

PO#

(15) ANALYSIS REQUIRED

(9) Client ID (10 CHAR)	(10) Date	(11) Time	(12) Mix	(13) # OF CONTAINERS	BOD5	TSS
001	4/17/97	1600	AQ	1	X	-
002	4/17/97	1610	AQ	1		X

For Lab Use Only

Job No: 71672
Quote No:
Tot Coolers:
Cooler Temp (s):
Custody Seal # (s):
Date Due:

PM NON-CONFORMANCE

Preserved: Temp:
Container: Volume:
Broken: Initials:
Holding Time:
Other:
Logged By:

DESCRIPTION
001 PH 5.7
TURB. 12
002 DO 2.8
TEMP. 11°C
SAL 0.71
COND. 12.7
HIGH TIDE

(16) COMMENTS: (Please include hazards on site.)

(17)	Print Name and Company	Signature	Custody Seal # (s)	Date/Time
Sampled By:	MARTY DOBBINS	Marty Dobbins	20702	4/17/97 / 1600
Received By:	[illegible]	[illegible]		4/18/97 / 0830
Relinquished By:	AL DACHILLE	Al Dachille		4/18/97 / 1330
Received By:	SCHARTERS IEA	Shannon Charters	20702	4/18/97 / 13:30
Relinquished By:				/
Received By:				/

Mix = Matrix of Sample. (AI=Air, AQ=Aqueous, LE=Leachate, ML=Misc Liquid, MS=Misc Solids, OIL, SE=Sediment, SL=Sludge, SO=Soil)

(Copies: White and yellow copies should accompany samples to IEA. The pink copy should be retained by the client.) See reverse for directions.

000003

IEA OF NEW JERSEY
628 Route 10 Whippany, N.J. 07981
(201) 428 8181

CHAIN OF CUSTODY

FIELD BOOK: ______ Pg ____ of ____

(1) Client: NJ TRANSIT RAIL OPS
(2) Project Name/no.: JERSEY CITY 18TH ST SSD
(3) Client Contact: CHARIES HENTZ
(4) IEA Contact:
(5) TAT: 1wk, 2wk, 3wk, OTHER
(6) Proj. Type: NJPDES, NPDES, ISRA, CLP, CERCLA, RCRA, UST, ACO, MOA, OTHER LONG SLIP
(7) Protocol: CLP, SW846, EPA 600, DW, OTHER
(8) Reporting Type: NJ Reg Format, NJ Reduced Format, CLP, Level II, Level I (Data Sum), Other

(14) Bill To: NJ TRANSIT RAIL OPS ENVIRONMENTAL SERVICE UNIT
PO#

(15) ANALYSIS REQUIRED

(9) Client ID (10 CHAR)	(10) Date	(11) Time	(12) Mix	(13) # OF CONTAINERS	BOD5	TSS
001	4/18/97	—	ML	1	X	
002	4/18/97	—	ML	1		X

For Lab Use Only

Job No.: 71671
Quote No.:
# of Coolers:
Cooler Temp. (s):
Custody Seal # (s):
Date Due:

PM NON-CONFORMANCE
Preserved: Temp:
Container: Volume:
Broken: Initials:
Holding Time:
Other:

Logged By:

DESCRIPTION
001 PH 6.7
COND 4.7
002 D.O 3.7
TEMP 11°C
SAL 0.8

HIGH TIDE

(16) COMMENTS: (Please include hazards on site.)

(17)

	Print Name and Company	Signature	Custody Seal # (s)	Date/Time
Sampled By:	MARTY DOBBINS	Marty Dobbins		4/18/97 / 0600
Relinquished By:	AL D'ACHILLE	Al D'Achille	#20702	4/18/97 / 11:30
Received By:	S CHARTERS IEA	Sauandu Charters	20702	4/18/97 / 13:30
Relinquished By:				/
Received By:				/

Mix = Matrix of Sample. (AI=Air, AQ=Aqueous, LE=Leachate, ML=Misc Liquid, MS=Misc Solids, OIL, SB=Sediment, SL=Sludge, SO=Soil)

(Copies: White and yellow copies should accompany sample to IEA. Pink copy should be retained by the client.) See reverse for directions.

000003

IEA
An Aquanon Company

000001
4/25/97

MAY 07, 1997

20970-71778
NJ TRANSIT
1 PENN PLAZA (NJ TRANSIT)
NEWARK . NJ 07105

ATTENTION: NICK VALENTE

The following samples were received for analysis by IEA-NJ (Cert.#14530).
These samples were received on and labeled as follows:

IEA Sample No.:	Client ID:	Date Received
71778001	CSO 001	04/25/97
71778002	CSO 002	04/25/97

DATA RELEASE AUTHORIZED BY: Ken Herman for

Brian Wood
Laboratory Manager

Client: NJ TRANSIT

Job No: 20970-71778

WATER

Miscellaneous Parameters

mg/l

Lab I.D.	71778001	71778002	DL
Client I.D.	CSO 001	CSO 002	
Analyte			
BOD5 (mg/l O_2)	35	NR	2
TSS	NR	42	1

DL - Detection Limit

NR - Not Requested

IEA OF NEW JERSEY
628 Route 10 Whippany, N.J. 07981
(201) 428-8181

CHAIN OF CUSTODY

FIELD BOOK: Pg 1 of 1

(1) Client: NJ TRANSIT RAIL OPS
(2) Project Name/no.: JERSEY CITY 18TH ST CSO
(3) Client Contact: NICK VALENTE
(4) IEA Contact:
(5) TAT: 1wk, 2wk, 3wk, OTHER
(6) Proj. Type: NJPDES, NPDES, ISRA, CIP, CERCLA, RCRA, UST, ACO, MOA, OTHER Long Slip
(7) Protocol: CIP, SW846, EPA 600, DW, OTHER
(8) Reporting Type: NJ Reg Format, NJ Reduced Format, CLP, Level II, Level I (Data Sum), Other

(14) Bill To: NJ TRANSIT
PO#

(15) ANALYSIS REQUIRED

(9) Client ID (10 CHAR)	(10) Date	(11) Time	(12) Mix	(13) # OF CONTAINERS	BOD5	TSS
CSO 001	4/25/97	0630			X	
CSO 002	4/25/97	0630				X

For Lab Use Only
Job No. 71788
Quote No.
No. of Coolers
Cooler Temp(s)
Custody Seal # (s)
Date Due
PM NON CONFORMANCE
Preserved / Temp
Container / Volume
Broken / Initials
Holding Time
Other
Logged By
DESCRIPTION
01 High TIDE
02
pH 6.1
COND 380 mS/cm
TURB [illegible]
DO [illegible] mg/L
Temp 12°C
SAL 14 %

(16) COMMENTS: (Please include hazards on site.)
High TIDE - ~~[illegible]~~ INCOMING

	Print Name and Company	Signature	Custody Seal # (s)	Date/Time
(17) Sampled By:	MARTY DOBBINS - NJT	Marty Dobbins		4/25/97 / 0630
Received By:	[illegible]	[illegible]		4/25/97 / 1830
Relinquished By:				/
Received By:				/
Relinquished By:				/
Received By:				/

Mix = Matrix of Sample. (AI=Air, AQ=Aqueous, LE=Leachate, ML=Misc Liquid, MS=Misc Solids, OIL, SE=Sediment, SL=Sludge, SO=Soil)

000003

(Copies: White and yellow copies should accompany samples to IEA. The pink copy should be retained by the client.) See reverse for directions.

IEA
An Aquarion Company

000001

4/25/97

MAY 07, 1997

20970-71777
NJ TRANSIT
1 PENN PLAZA (NJ TRANSIT)
NEWARK , NJ 07105

ATTENTION: NICK VALENTE

The following samples were received for analysis by IEA-NJ (Cert.#14530).
These samples were received on and labeled as follows:

IEA Sample No.:	Client ID:	Date Received
71777001	CSO 003	04/25/97
71777002	CSO 004	04/25/97

DATA RELEASE AUTHORIZED BY:

Brian Wood
Laboratory Manager

printed on recycled paper

TSS	NR	38		

DL - Detection Limit

NR - Not Requested

000012

Client: NJ TRANSIT

Job No: 20970-71811

WATER

Miscellaneous Parameters

mg/l

IEA
An Aquarion Company

)00001
4/25/97

MAY 07, 1997

20970-71777
NJ TRANSIT
I PENN PLAZA (NJ TRANSIT)
NEWARK , NJ 07105

ATTENTION: NICK VALENTE

The following samples were received for analysis by IEA-NJ (Cert.#14530).
These samples were received on and labeled as follows:

IEA Sample No.:	Client ID:	Date Received
71777001	CSO 003	04/25/97
71777002	CSO 004	04/25/97

DATA RELEASE AUTHORIZED BY: Ken J. Kinman for

Brian Wood
Laboratory Manager

Client: NJ TRANSIT

Job No: 21970-71777

WATER

Miscellaneous Parameters

mg/l

Lab I.D.	71777001	71777002	DL
Client I.D.	CSO 003	CSO 004	
Analyte			
BOD5 (mg/l O_2)	63	NR	2
TSS	NR	36	1

DL - Detection Limit

NR - Not Requested

IEA OF NEW JERSEY
628 Route 10 Whippany, N.J. 07981
(201) 428-8181

CHAIN OF CUSTODY

No. 53747

FIELD BOOK: ______ Pg ____ of ____

(1) Client: NJ TRANSIT RAIL
(2) Project Name/no. 18TH ST CSO JERSEY CITY
(3) Client Contact: MCK VALENTE
(4) IEA Contact:
(5) TAT: 1wk, 2wk, 3wk, OTHER
(6) Proj. Type: NJPDES, NPDES, ISRA, CIP, CERCLA, RCRA, UST, ACO, MOA, OTHER Long Slip
(7) Protocol: CLP, SW846, EPA 600, DW, OTHER
(8) Reporting Type: NJ Reg Format, NJ Reduced Format, CLP, Level II, Level I (Data Sum), Other

(14) Bill To: NJ TRANSIT
PO#

(15) ANALYSIS REQUIRED

(9) Client ID (10 CHAR)	(10) Date	(11) Time	(12) Mix	(13) # OF CONTAINERS	BOD5	TSS
CSO 003	4/25/97	1630	ML		X	
CSO 004	4/25/97	1630	ML			X

For Lab Use Only:
Job No.: 71227
Quote No.:
# of Coolers:
Cooler Temp.(s):
Custody Seal # (s):
Date Due:

PM NON-CONFORMANCE
Preserved: Temp:
Container: Volume:
Broken: Initials:
Holding Time:
Other:
Logged By:

DESCRIPTION
LOW TIDE
pH 6.5
Cond. 830 ms/cm
Turb 330
DO 11.8 mg/l
Temp 10°C
Sal. 1.4 %

(16) COMMENTS: (Please include hazards on site.)
LOW TIDE

	Print Name and Company	Signature	Custody Seal # (s)	Date/Time
Sampled By:	[illegible]	[illegible]		4/25/97 1830
Received By:	Greg Smith IEA	Greg Smith		4/25/97 1830
Relinquished By:				/
Received By:				/
Relinquished By:				/
Received By:				/

000003

Mix = Matrix of Sample. (AI=Air, AQ=Aqueous, LE=Leachate, ML=Misc Liquid, MS=Misc Solids, OIL, SE=Sediment, SL=Sludge, SO=Soil)

(Copies: White and yellow copies should accompany samples to IEA. The pink copy should be retained by the client.) See reverse for directions

IEA
An Aquarion Company

000001

4/28/97

MAY 09. 1997

20970-71811
NJ TRANSIT
1 PENN PLAZA (NJ TRANSIT)
NEWARK . NJ 07105

ATTENTION: NICK VALENTE

The following samples were received for analysis by IEA-NJ (Cert.#14530).
These samples were received on and labeled as follows:

IEA Sample No.:	Client ID:	Date Received
71811001	CSO 001	04/29/97
71811002	CSO 002	04/29/97

DATA RELEASE AUTHORIZED BY: Brian W. Wood

Brian Wood
Laboratory Manager

Client: NJ TRANSIT

Job No: 20970-71811

WATER

Miscellaneous Parameters

mg/l

Lab I.D.	71811001	71811002	DL
Client I.D.	CSC 001	CSC 002	
Analyte			
BOD5 (mg/l O_2)	21	NR	2
TSS	NR	39	1

DL - Detection Limit

NR - Not Requested

IEA OF NEW JERSEY
628 Route 10 Whippany, N.J. 07981
(201) 428 8181

CHAIN OF CUSTODY

FIELD BOOK: ______ Pg ___ of ___

1) Client: N.J. TRANSIT RAIL OPS
2) Project Name/no.: JERSEY CITY ST-C90
3) Client Contact: NICK VALENTE
4) IEA Contact:
5) TAT: 1wk, 2wk, 3wk, OTHER
6) Proj. Type: NJPDES, NPDES, ISRA, CIP, CERCLA, RCRA, UST, ACO, MOA, OTHER LOWE SLIP
7) Protocol. CLP, SW846, EPA 600 DW, OTHER
8) Reporting Type: NJ Reg Format, NJ Reduced Format, CLP, Level II, Level I (Data Sum) Other

(14) Bill To: N.J. TRANSIT

PO#

(15) ANALYSIS REQUIRED: 1 BODS; 1 TSS

9) Client ID (10 CHAR)	(10) Date	(11) Time	(12) Mtx	(13) # OF CONTAINERS	Lab ID
CSO 001	4-29-97	0600			001
CSO 002	4-29-97	0620			002

For Lab Use Only
Job No.: 71811
Quote No.:
# of Coolers:
Coolers Temp.(s):
Custody Seal(s):
Field ID:
SPM NON-CONFORMANCE
Preserved: Temp:
Container: Volume:
Broken: Initials:
Holding Time:
Other:
Logged By:
DESCRIPTION

6) COMMENTS: (Please include hazards on site.)
LOW TIDE INCOMING

	Print Name and Company	Signature	Custody Seal # (s)	Date/Time
Sampled By:	[illegible]	[illegible]		4-29-97 1020
Received By:	SCHARTERS IEA	[illegible] Charters		4/29/97 10[illegible]
Relinquished By:				/
Received By:				/
Relinquished By:				/
Received By:				/

Mtx = Matrix of Sample. (AI=Air, AQ=Aqueous, LE=Leachate, ML=Misc Liquid, MS=Misc Solids, OIL, SE=Sediment, SL=Sludge, SO=Soil)

(Copies: White and yellow copies should accompany samples to IEA The pink copy should be retained by the client) See reverse for directions

00003

IEA
An Aquarion Company

000001

5/6/97

MAY 15, 1997

20970-71956
NJ TRANSIT
1 PENN PLAZA (NJ TRANSIT)
NEWARK , NJ 07105

ATTENTION: NICK VALENTE

The following samples were received for analysis by IEA-NJ (Cert.#14530).
These samples were received on and labeled as follows:

IEA Sample No	Client ID	Date Received
71956001	CSO 001	05/06/97
71956002	CSO 002	05/06/97

DATA RELEASE AUTHORIZED BY

Brian W. Wood

Brian Wood
Laboratory Manager

IEA OF N...

Lab Name: IEA - NJ

Job No: 20970-71956

Client: NJ Transit

Matrix: Water

Miscellaneous Parameters

mg/l

Lab I.D.	Method	71956001	71956002	DL
Client I.D.		CSO 001	CSO 002	
Biochemical Oxygen Demand (mg/l O2)	405.1	170	NR	2
Total Suspended Solids	160.2	NR	36	1

DL - Detection Limit

NR - Not Requested

Reviewed by: Brian W. Wood Date: 5/15/97

IEA OF NEW JERSEY
628 Route 10 Whippany, N.J. 07981
(201) 428 8181

CHAIN OF CUSTODY

FIELD BOOK:

Pg 1 of 1

(1) Client: NJ TRANSIT RAIL

(2) Project Name/no: JC 18th ST CSO

(3) Client Contact: NICK VALENTE

(4) IEA Contact:

(5) TAT: 1wk, 2wk, 3wk, OTHER

(6) Proj. Type: NJPDES, NPDES, ISRA, CLP, CERCLA, RCRA, UST, ACO, MOA, OTHER LONGSLIP

(7) Protocol: CLP, SW846, EPA 600, DW, OTHER

(8) Reporting Type: NJ Reg Format, NJ Reduced Format, CLP, Level II, Level I (Data Sum), Other

(14) Bill To: NJ TRANSIT RAIL CORP

PO#

(15) ANALYSIS REQUIRED

(9) Client ID (10 CHAR)	(10) Date	(11) Time	(12) Mix	(13) # OF CONTAINERS	BOD5	TSS								For Lab Use Only: DESCRIPTION
CSO 001	5/6/97	2:45PM	AQ	7	X									001
CSO 002	5/6/97	2:45pm	AQ	1		X								002

For Lab Use Only
Job No: 71956
Quote No:
# of Coolers:
Cooler Temp(s):
Custody Seal #(s):
Date Due:

RPM NON-CONFORMANCE
Preserved: Temp:
Container: Volume:
Broken: Initials:
Holding Time:
Other:
Logged By:

(16) COMMENTS: (Please include hazards on site.)
STORMWATER JERSEY CITY 18th ST C.S.O

	Print Name and Company	Signature	Custody Seal # (s)	Date/Time
(17) Sampled By:	MARTY DOBBINS	Marty Dobbins		5/6/97 12:45Pm
Received By:	[illegible]	[illegible]		5/6/97 [illegible]
Relinquished By:				/
Received By:				/
Relinquished By:				/
Received By:				

Mix = Matrix of Sample. (AI=Air, AQ=Aqueous, LE=Leachate, ML=Misc Liquid, MS=Misc Solids, OIL, SE=Sediment, SL=Sludge, SO=Soil)

000003

(Copies: White and yellow copies should accompany samples to IEA. The pink copy should be retained by the client.) See reverse for directions.

Appendix 5

Biological Resources

Contents:

NJ TRANSIT

Long Slip Canal Habitat Creation Project

Hoboken Terminal, Hoboken, Jersey City, NJ

BIOLOGICAL BASELINE STUDY OF LONG SLIP CANAL

March 14, 1995

DAMES & MOORE

A DAMES & MOORE GROUP COMPANY

Prepared by: Vincent Guida

Reviewed by: Eugene Peck

Approved by: Joseph Porrovecchio

One Blue Hill Plaza • Suite 530 • Pearl River, New York 10965

C O N F I D E N T I A L

FINAL REPORT

BIOLOGICAL BASELINE STUDY OF LONG SLIP CANAL

Performed by

Vincent G. Guida, Ph.D.

Assisted by

Daniel Zeroka, M.S. *and* Arpita Choudry, Student Intern
Environmental Studies Center
Lehigh University
Bethlehem, Pennsylvania

under subcontract to

Frederic R. Harris, Inc.
(project 10-2758-03)

March 14, 1995

EXECUTIVE SUMMARY

* A biological survey of Long Slip Canal was conducted in anticipation of acquiring permits for modification of that waterway. Aquatic flora and fauna were assessed from benthic grab samples, epibenthic sled and otter trawl tows, and fouling samples taken during early summer, early fall and late fall sampling episodes. Grain size and organic content analyses of sediments and bottom contour mapping were also performed to provide supporting information for the biological survey.

* An assessment was made of the nature and rate of biogas production by microbiota in bottom sediments of the Canal.

* Sampling by all methods on all dates yielded 126 separable taxa (species) of macro-organisms, including blue-green bacterial filaments, seaweeds, invertebrates and fish, from the Canal and its vicinity.

* The kinds of benthic and fouling communities found suggest a polluted, brackish environment that suffers from severe anoxia in summer, then is progressively colonized during fall as improvements in water quality and the nature of the sediments permit. The Canal's flora and fauna do not directly provide much in the way of food resources for fish and crabs, though they may do so indirectly, via small forage fish.

* The western end of the Canal was so polluted in summer that no live organisms were found on the bottom and few were found on the walls. This condition gradually abated toward the east, but even just outside the canal benthic and fouling communities were impoverished as compared with other estuarine locations at the same time of year. Sewer discharge into the western end of the Canal was a major cause of this impoverishment; water quality was visibly degraded and bottom sediments near the sewer outfalls were completely anaerobic and full of terrestrial organic debris.

CONTENTS

LIST OF TABLES

I. BACKGROUND

Long Slip Canal (formerly Erie-Lackawana Canal) is a man-made barge canal located along New Jersey's Hudson River waterfront. It is located in a rail yard owned by the New Jersey Transit Corporation (NJT). Under a contract with Killam Associates, Frederic R. Harris, Inc. (FRH) is exploring the environmental aspects of plans by property owner NJT to either fill or deck over Long Slip Canal in order to increase the utilizeable space in the rail yard. Requirements for state and federal permits to perform such alterations will require a biological monitoring program to assess the impact of the alteration on the Hudson River Estuary. Such a monitoring program requires a biological baseline inventory to be performed before construction is undertaken. This inventory will provide a rational basis deciding upon mitigation requirements prior to alteration and for judging impact assessment afterwards. Such baseline sampling has been a regulatory requirement for permits for other Hudson River waterfront development schemes (Liberty Park Marina, Harborside Financial Center).

In fulfillment of this need, the Environmental Studies Center of Lehigh University, under sub-contract to FRH, has conducted a baseline biological study in Long Slip Canal to include benthic, epibenthic, fouling and nektonic sampling of flora and fauna. This goes beyond the usual minimum requirements for a benthic faunal investigation. It was felt that this was necessary for the following reasons:

1. Based on a 1982-83 survey by the NJDEP Division of Fish, Game and Wildlife (FGW), there was the possibility that this canal serves as a at least a temporary habitat for migratory fish (nekton), hence the need for a nekton survey,

2. In many New Jersey estuaries the epibenthic community (primarily highly mobile, shrimp and shrimp-like crustaceans) serve as the chief food of migratory fish. Normal benthic sampling can not adequately assess this resource, hence the need for epibenthic sampling, and

3. Given the geometry of this canal, its concrete walls provide about one fifth of the surface area available for colonization by estuarine organisms, and should therefore not be overlooked as providing habitat space, hence the need for a fouling investigation.

Some additional types sampling/analysis were undertaken by the Environmental Studies Center for the purpose of understanding the peculiarities of the distribution of organisms observed in the course of biological sampling. These included rough mapping of the bottom contours of the canal and environs, grain size and organic analyses of sediment from the canal and environs, and analyses of the composition and production rates of gases produced by those sediments. While some information was already available on bottom contours and sediment character as a result of previous efforts, it was not sufficiently detailed for interpretation with respect to the distribution of biota. Only a small effort was expended on such extra-biological investigation.

FIG. 1 LONG SLIP CANAL OVERVIEW

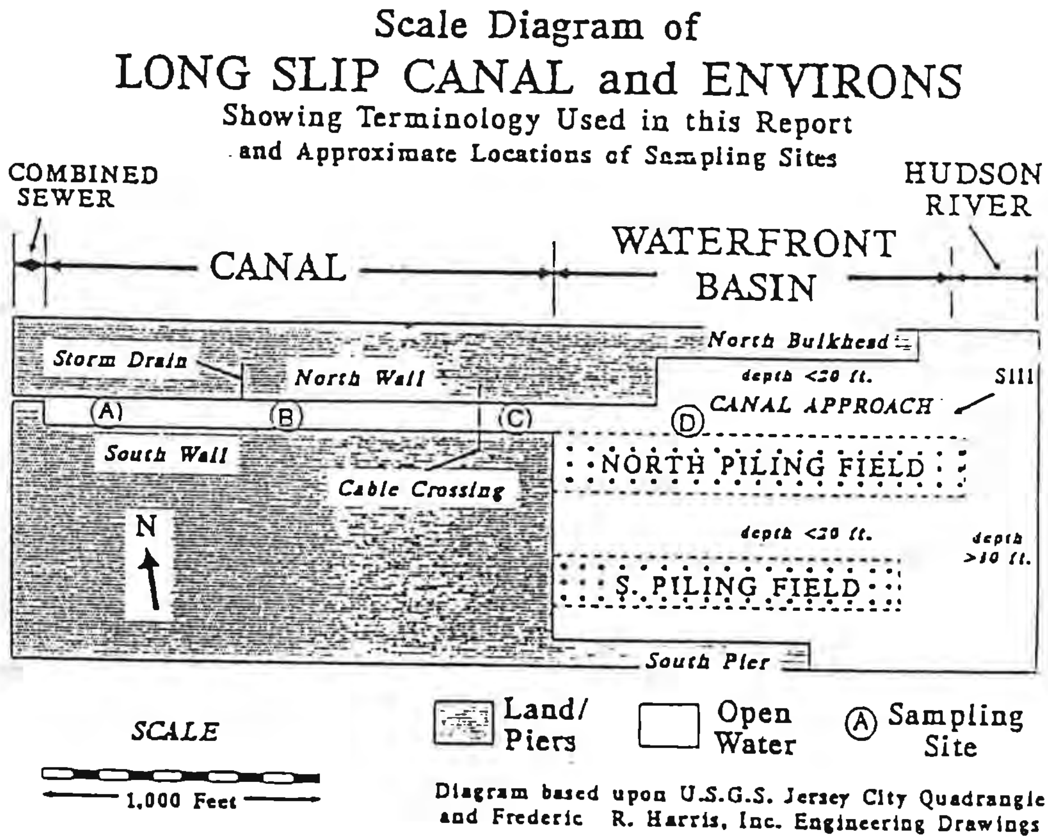
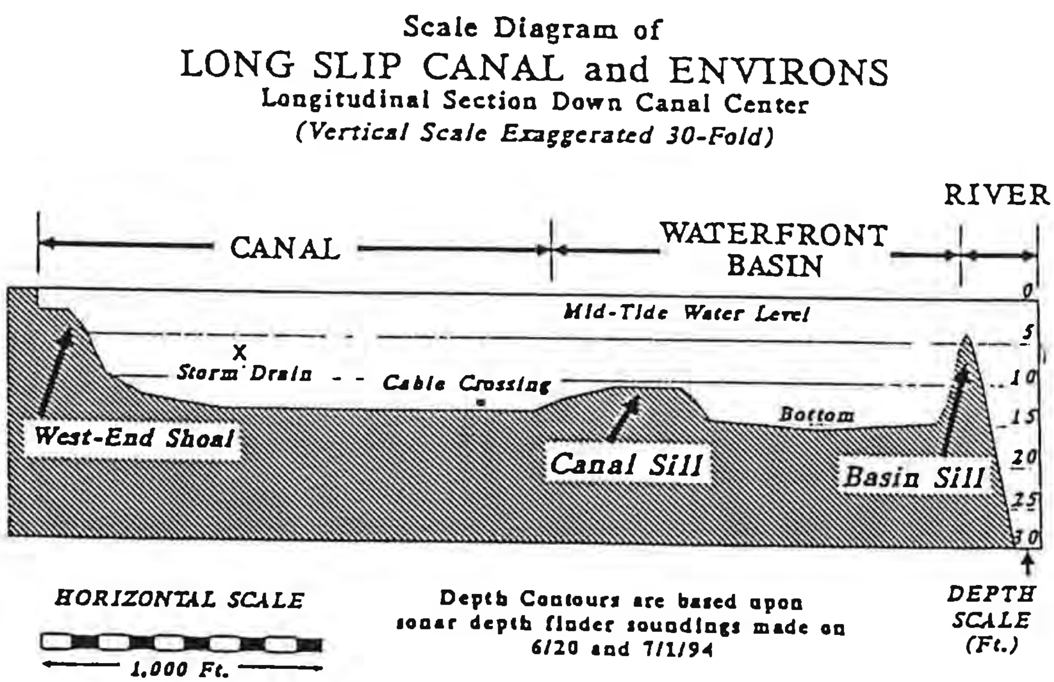


FIG. 2 LONG SLIP CANAL DEPTH CONTOURS



Four means of sampling were employed:

I. Benthic Sampling: using an 8" X 8" Ekman grab sampler: efficient for capture of slow-moving, infaunal (burrowing in the bottom) invertebrates: samples are considered fully quantitative: 2 samples in mid-canal/mid-basin taken per site per sampling episode,

II. Epibenthic Sampling: using an epibenthic sled (steel frame with runners) with a 1 mm mesh plankton net with 9" X 20" mouth, towed by boat for 2 min. at 1.0 to 1.2 kt.: efficient for capture of faster-moving, epifaunal (swimming above the bottom) invertebrates plus small, slow fish plus bottom drift community: samples are semi-quantitative: 1 sample taken in mid-canal/mid-basin per station per sampling episode,

III. Nektonic Sampling: using a 2 m otter trawl with 3/4" mesh, towed by boat for 2 min. at 1.0 to 1.2 kt.: efficient for capture of bottom fish and fastest-moving epifaunal invertebrates: samples are semi-quantitative: 1 sample taken in mid-canal/mid-basin per station per sampling episode, and

IV. Fouling Sampling: using approx. 10"-long strokes with a 3"-wide paint scraper during low tide: efficient for capture of algae and sessile (attached) invertebrates and associated mobile invertebrates from shear walls: samples are semi-quantitative: 3 samples taken per station per sampling episode at various heights along north canal wall.

Sampling was performed in three episodes: #1 early summer, #2 early fall and #3 late fall. All four sampling methods were during early summer and early fall and at all four sites, except as noted below. Epibenthic and Nektonic sampling were not performed in late fall. The object of this sampling schedule was to observe the effects of anticipated seasonal anoxia in the canal and catch fish when they were most likely to be residing or migrating through this region (Table 2):

TABLE 2
Biological Sampling Schedule (1994)

Sampling Method	Episode #1	Episode #2	Episode #3
I. Benthic	Jun. 20	Oct. 14	Nov. 30
II. Epibenthic	Jul. 1[1]	Sep. 30	not done
III. Nektonic	Jul. 1	Sep. 30	not done
IV. Fouling	Jun. 20[2]	Sep. 30	Nov. 30

notes: [1] Damage to epibenthic net prevented sample from being taken from site "A"

[2] Rapidly rising tide prevented fouling sample from being taken from site "B"

Unfixed sediment samples for grain size analysis were stored wet at 5° C for no more than 7 days before analysis. Thoroughly mixed sub-samples of approximately 250 ml were washed serially through 2000, 500, 250, 125, 105 and 63 micrometer sieves and a known fraction of the thoroughly mixed final washings (passing 63 um) was vacuum filtered through a 1 micrometer glass fiber filter to allow gravimetric analyses of total and volatile solids for each fraction.

Gas generating capacity of sediments from site "A" was also assessed using an unfixed sediment sample. Within one day of collection, sub-samples of 350 ml. volume were transferred to four 1 liter flasks, which were then filled with canal water. A steel wool plug was added to remove any corrosive hydrogen sulfide (H_2S) gas produced, and flasks were fitted with gas production manometer and sealed gas-tight (Fig. 3). Two flasks were kept at room temperature (21° C or 70° F), and two in a 35° C (95° F) temperature controlled room. Gas production was assessed twice daily at first, later daily as the production rate declined. Samples for gas composition analysis were drawn monthly using a gas-tight syringe.

These samples and the gas sample collected at site "A" were analyzed using a Fisher Gas Partitioner with a thermal conductivity detector and using helium as a carrier gas. The site "A" sample was sub-sampled and analyzed three times one day after collection. Single analyses were done for gas samples from the lab generating units within ten minutes of collection.

FIG. 3 LABORATORY GAS GENERATING UNIT

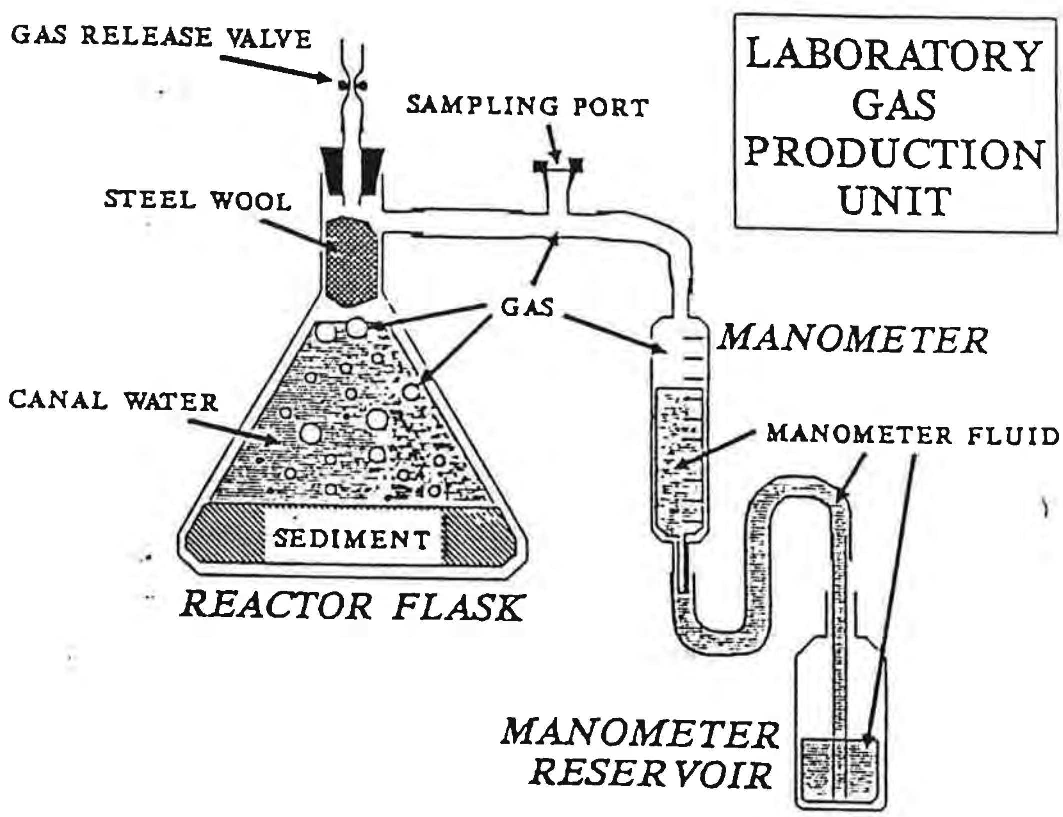


TABLE 4
Sedimenc Appearance On Site: June 30, 1994

Character	Site "A"	Site "B"	Site "C"	Site "D"
Color at Surface	black	black	gray	gray
Color at Depth	black	black	black	black
Texture	lumpy	lumpy to gooey	gooey	gooey
Obvious Constituents	leaves & trash[1]	leaves & trash[1] or none	none	none
Odor	sewage	sewage & oil	sulfurous	sulfurous

[1] note: "trash" is defined here as anthropogenic artifacts: rags, paper, plastic, aluminum foil and cigarette filters were common.

Black color of sediments is caused by the accumulation of ferrous sulfide (FeS) resulting from anaerobic bacterial metabolism of sulfate (SO_4^{-2}) from seawater. Black color at the sediment surface (sediment-water interface) here indicates anaerobic conditions at that interface, i.e. little or no oxygen in bottom water. Leaves and trash plus sewage and oil odors at "A" and "B" are indicative of polluted discharge from combined storm/sanitary sewers. The lumpy texture of these sediments, likewise, was a consequence of inclusion of a lot of foreign material in the sediment.

Lighter color at the sediment surface (gray) at "C" and "D" indicated the presence of oxygen in bottom water. Oxygen rapidly oxidizes black FeS to pale $FeSO_4$. The sulfurous odor of sediments from these locations resulted from other products of marine bacterial sulfate reduction: hydrogen sulfide (H_2S) and organic sulfides. This odor, which is normal for marine/estuarine sediments, is probably eliminated at "A" and "B" via reactions of H_2S with discharge constituents, e.g. with excess iron to form odorless FeS. The smooth, gooey texture of sediments at "C" and "D" indicated a deposit of nearly pure silt and clay, lacking large, foreign material.

These differences in sedimentary character suggests that the combined overflow sewer and storm drain are causing severe impacts on sediments and water quality in western Long Slip Canal, but that most of the solid material settles out before reaching the eastern end of the canal, lessening the impacts on sediment and water quality at that end of the canal and in the adjacent Waterfront Basin. The fact that some "B" samples have lumpy and some have gooey textures indicates a boundary around the middle of the canal beyond which little large material is carried. The correspondence between the distribution of leaves, trash and lumpy texture in sediments and the high intensity of bubbling suggest that these materials are the source of sedimentary gas production in the canal.

The appearance of sediments in the field differed from the pattern presented in Table 4 on only one date: November 30. On this date, the bottom at site "A" was seen to have a light-colored (oxidized) surface, suggesting an abundance of oxygen in the water column, even at this westernmost site.

"A" samples. Lumpy samples from "B" taken for benthic faunal analysis contained less botanical material than "A" samples, but contained large balls of fibers (lint) and had a strong petroleum odor. Samples from "A" were less oily and contained only a little lint. Clearly, the character of the discharge from the Storm Drain at "B" and the Combined Sewer at "A" are quite different. The low abundance of sand at "B" also suggests that storm-induced high flows through the Storm Drain are not as severe as those through the Combined Sewer. Barring the possibility of toxic contamination from the Storm Drain, "B" presents a less altered biotic habitat than "A".

That both lumpy and gooey samples were taken from "B" is important. This indicates a sharp transition in sediment type within a small area around the middle of the canal's length. This is important because it means that the peculiar habitat conditions of site "A" represent half or less of Long Slip Canal.

While site "D" sediment had an organic content higher than that of most other stations, that feature does not set it apart from the rest of the area, as does the high organic content of "A" sediment. The high organic content at "D" (23.6%) is not comparable to that at "A" (39.3%). Analysis of particle size (Table 5) showed that most of the material at "D" is fine, detrital organic matter. Its source is probably a combination of suspended material from upstream in the Hudson River and settling plankton. It is likely in a very degraded state, i.e. only capable of slow microbial degradation, and is settling preferentially in that location as a result of slowing of water movements in proximity to the western wall of the Waterfront Basin and the entrance to Long Slip Canal. Preferential deposition of silt/clay and the fine organic fraction at "D" have created the Canal Sill. Sills are depositional features typically resulting from reversing tidal hydrology. By contrast, organic material at "A" is coarse, and fresh and degrades fairly rapidly, resulting in intense bubbling of gaseous decay products.

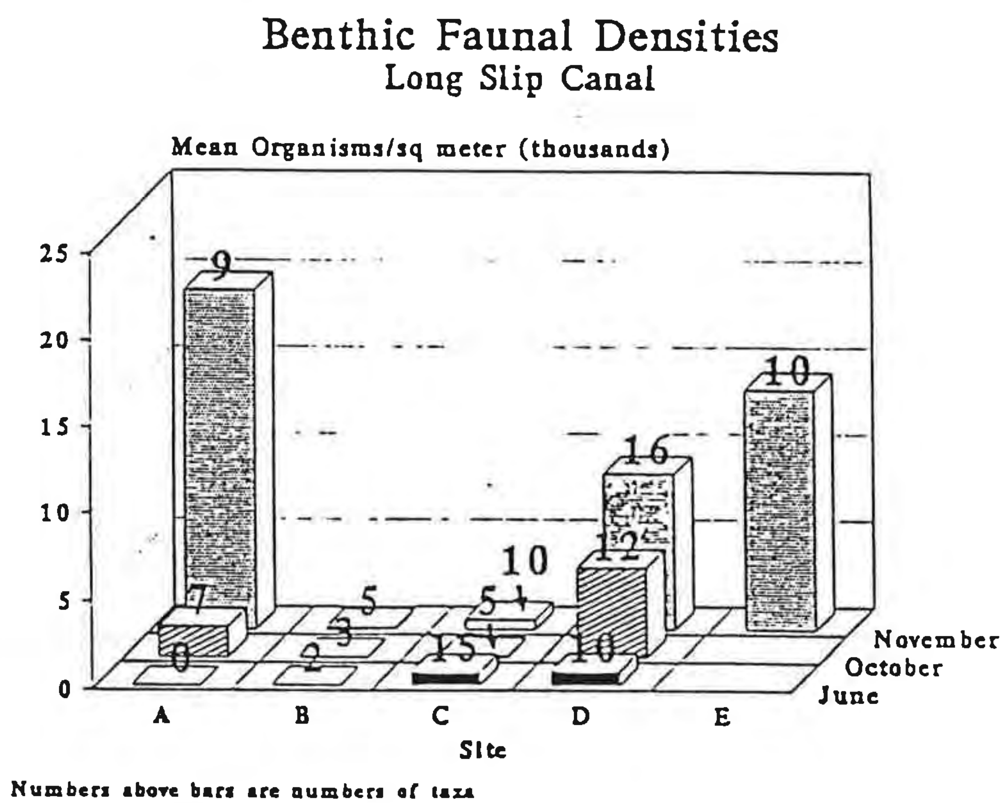
<u>Macroflora and Macrofauna of Long Slip Canal: General Aspects</u>

Sampling by all methods at all sites in and around Long Slip Canal yielded a total of 126 seperable taxa, including members of the Cyanobacteria (blue-green "algae": 3 taxa), four algal Divisions (19 taxa) and eleven animal Phyla (104 taxa). Within the limits of the Canal itself, 97 taxa were found: 3 cyanobacterial, 17 algal and 77 animal. "Taxa" here means identifiably different organisms. In most cases, this means "species", but in some cases the exact identity of the species could not be determined, nor whether more than one species was represented. Thus "taxa" is the more correct term. All are listed according to major taxon in Appendix I, with a common name, where one could be found. Note that "Major Taxon" is not synonymous with "Phylum" for animals. Some animal phyla have been subdivided into two or more major taxa for greater clarity. "Snails" and "Bivalves" both belong to Phylum Mollusca, "Aquatic Earthworms" and "Marine Worms" both belong to Phylum Annelida, "Copepods" through "Terrestrial Insects/Arachnids" all belong to Phylum Arthropoda. As no typical epibenthic community elements were encountered, organisms are hereafter identified as belonging to "Benthic" (bottom), "Fouling" (attached) or "Planktonic" or "Nektonic" (swimming) biological communities. Lists of organisms belonging to these communities are not mutually exclusive: some taxa, even those clearly identifiable as a single species, were found participating in more than one community.

Given the large differences in the nature of sediments and the obvious gradient in water quality from west to east observed during every visit to Long Slip Canal, it was not surprising that the benthic fauna also demonstrated strong west to east distribution patterns. General improvement in water quality through time also resulted in a seasonal biological trends.

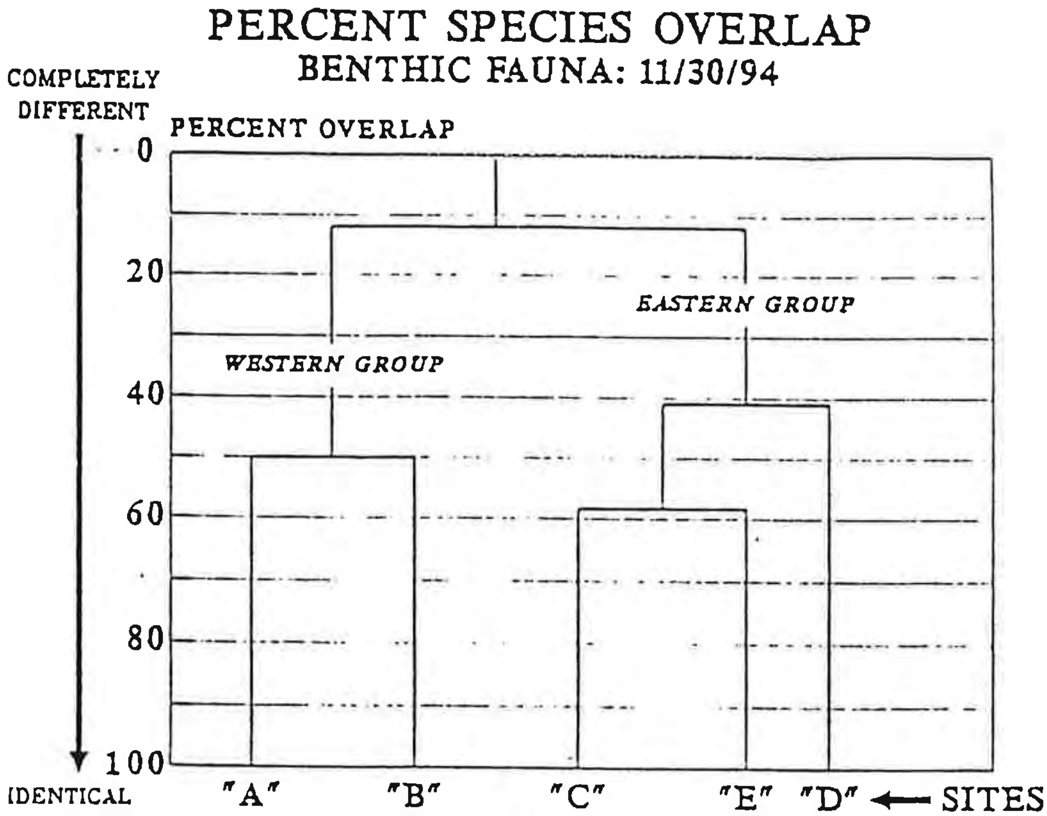
Ekman grab samples obtained a combined total of 43 animal taxa in the thirteen samples taken during three sampling episodes (Appendix II). Of these 43, seven were terrestrial insects that had accidentally fallen into the water (and drowned), six were accidentally captured planktonic animals and two were fouling-associated organisms that had somehow made their way to the bottom. Thus, the number of truly benthic taxa captured was actually 27, including 11 species of marine worms (Polychaete Annelids), 6 taxa of aquatic earthworms (Oligochaete Annelids), 4 snail species (Gastropod Mollusks), 3 clam species (Pelecypod Mollusks), 2 shrimp-like species (Crustaceans) and 1 flatworm (Turbellarian). Numbers of taxa per site ranged from 0 to 16, and mean densities of animals ranged 0 to over 19,000 per square meter (Fig. 4). Each site exhibited a somewhat different pattern with time.

FIG. 4. BENTHIC FAUNAL DENSITIES



Site "A" was devoid of benthic animals on June 20. Neither of the two Ekman grab samples had any animals in them whatsoever. Faunal densities elsewhere on that date were low (<1,000 per square meter), but there were

FIG. 5 SPECIES OVERLAP DENDROGRAM FOR BENTHIC COMMUNITIES, 11/30/94



Use of a formal species diversity index again demonstrates the west-to-east gradient in the biota, but also supports some less obvious conclusions about the nature of the benthos at "B" and "C" as opposed to "A" and "B". Calculation of Shannon-Weaver diversity indices was made using numbers of organisms pooled from both samples taken at each site during each episode. Pooling was necessary because of the exceedingly small numbers encountered in each grab sample from "B" and "C".

TABLE 6
Species Diversity among Benthic Fauna
Shannon-Weaver Index ($\log_{10}$)

Sampling Date	Sampling Sites A	B	C	D
6/20	no fauna	0.301	0.869	0.761
10/14	0.278	0.579	0.728	0.206
11/30	0.386	0.563	0.743	0.649

plankton and "drift" organisms from nearby fouling communities. Although larger, but even less efficient at catching eubenthic and drift organisms than the epibenthic sled, the otter trawl net also provides additional qualitative information on the benthic biota.

Eight sled tows plus eight otter trawl between 7/01 and 9/30 yielded a total of 83 taxa, more than half of which were not found by other means of sampling employed (Appendix III). Of the 83 total taxa, 26 were eubenthic, of which 10 were not encountered in Ekman samples. Of the same 83 total, 26 were fouling (drift) organisms, 14 of which were not encountered in fouling samples. The rest were nekton (fish and swimming crabs discussed in a succeeding section), plankton and terrestrial arthropods (insects and spiders).

Epibenthic and otter trawl samples taken on 7/01 were dominated by eubenthic organisms, especially marine worms, cumacean shrimp and clams, and by planktonic fish eggs (discussed later). Not surprisingly, marine worms Haploscoloplos fragilis and Streblospio benedicti and cumacean shrimp Leucon americanus dominated the "D" sample on that date. These three species made up 79% of the 484 organisms in that sample, exclusive of fish eggs. These are the same species found dominating Ekman samples at "D" and "E" on 11/30, although only H. fragilis was yet abundant enough to be seen in 6/20 Ekman samples. Macoma tenta, a deposit-feeding clam, was also abundant in the "D" epibenthic sample of 7/01. A similar assemblage of eubenthic organisms was obtained at "C" on that date, although far fewer in number than at "D" (120 total organisms, exclusive of fish eggs). At "B" there were few eubenthic organisms (35 total). The most numerous were two taxa of sewage flies (Psychoda and Pericoma) and a few Haploscoloplos, neither of which was detected by Ekman sampling on 6/20 or subsequently. There was no "A" epibenthic sample taken on 7/01. The only organisms collected from otter trawl tows at all four sites on 7/01 were two species of benthic snails (Illyanassa obsoleta and Nassarius trivittatus), found at "D".

On 9/30, both epibenthic and otter trawl samples contained large planktonic and fouling (drift) components in addition to the eubenthic organisms. The chief planktonic organisms collected was the comb jelly Mnemiopsis leidyi. These transparent, globular jellies of up to 4" long were so abundant as to clog the epibenthic plankton net and otter trawl net at stations "C" and "D", probably interfering with efficient capture of other organisms. Mnemiopsis was absent from sites "A" and "B", probably as a result of hydrographic conditions rather than avoidance of poor water quality; comb jellies are very weak swimmers and are readily carried by tidal currents wherever those currents take them. The abundance of drift algae and comb jellies is a common phenomenon in estuaries in late summer and early fall.

Eight taxa of algae dominated the drift component of the epibenthic sled and otter trawl catches. These and a number of species of fouling community animals, e.g. snails Littorina littorea, Crepidula fornicata and Eubranchus exiguus, mussel Mytilus edulis, colonial hydrozoans Ectopleura sp., Obelia oxydentata, Garveia sp. and Opercularella pumila, and barnacle Balanus eburneus, are organisms that require a hard surface on which to settle and grow or move about. No such surfaces were available on the bottom of Long Slip Canal or the Waterfront Basin.

found were of a size that they had to have been produced by adult mussels (two years old or more). Yet only tiny young-of-the-year mussels were found along the canal's north wall and associated with drift algae in this study. As with the exotic drift seaweeds and colonial hydrozoans, it is suspected that persistent mussel populations that include multi-year adults are fouling the pilings among the old piling fields in the Waterfront Basin.

Fouling Biological Community: Field Observations

The appearance of the concrete walls of the canal was also noted during each sampling episode.

TABLE 7
Fouling of Canal Walls

Episode:Date	Site "A"	Site "B"	Site "C"	Site "D"
#1 : 6/20	gray-green mat	no observation	sparse brown filaments	brown filaments, green seaweed
#2 : 9/30	sparse green seaweed, dense brown filaments	sparse green seaweed, dense brown filaments	dense green seaweed, sparse brown filaments	dense green seaweed, brown filaments
#3 : 11/30	same	same	dense green seaweed & brown filaments	dense green seaweed & brown filaments

The brown filaments above were at first thought to be a filamentous brown seaweed (Phaeophyte), but microscopic examination proved this algae to be almost exclusively the filamentous diatom (Bacillariophyte) Melosira moniliformis. It was generally found growing in the lower intertidal and subtidal zones (near and below the low water mark). The green seaweed growing higher on walls at "D" on 6/20 was largely intestine weed Enteromorpha intestinalis. The gray-green that dominated all zones at "A" on 6/20 proved to be a filamentous cyanobacterium (blue-green alga) Oscillatoria lutea, the most pollution-tolerant of all local fouling organisms. This organism almost completely disappeared from "A" by fall. Both fall sampling episodes showed the progressive invasion of the western canal by Enteromorpha (green seaweed) and Melosira (brown filaments), and the increasing dominance of Melosira in the eastern canal and Waterfront Basin. At least at this level of examination, the most obvious elements of the fouling community appeared to start off very differently in June, and through the fall, become progressively more similar. This apparent homogenization of the fouling community is taken as yet another indication of the improvement of water quality in the western canal during fall.

Remarkably few typical fouling animals (hydrozoans, barnacles, mussels, tunicates) were evident in the field. In part this was due to the brightly-illuminated southern exposure of the north canal wall, from which all samples were taken. Strong sunlight favors algae over animals. However, this was clearly not the only factor involved. No live barnacles were seen on 6/20, The dominant at "C" was the filamentous diatom Melosira moniliformis ("sparse brown filaments" in Table 7), and at "D" was intestine weed (Enteromorpha intestinalis: "green seaweed" in Table 7). By 9/30, O. lutea had nearly disappeared from "A", and was replaced by 8 species, dominated by blue-greens Lyngbya semiplena and Lyngbya confervoides. Green intestine weed had invaded all the way to "A" and had become dominant at "B" and "C", while sea lettuce (Ulva lactuca) and a red seaweed, Polysiphonia subtilissima, had become dominant at "D". November 30 found the appearance of 7 new algal taxa not previously seen, with marked increases of algal taxa at all sites (Table 8). The taxa present at site "A" broadly overlapped the lists for other sites by this date, but some seaweeds were still absent, e.g. Ulva and Polysiphonia.

TABLE 8
Numbers of Cyanobacterial and Algal Taxa in Fouling Samples

Sample Date	Numbers of Taxa at Sites "A"	"B"	"C"	"D"
6/20	1	no sample	6	6
9/30	8	5	3	5
11/30	10	12	12	13

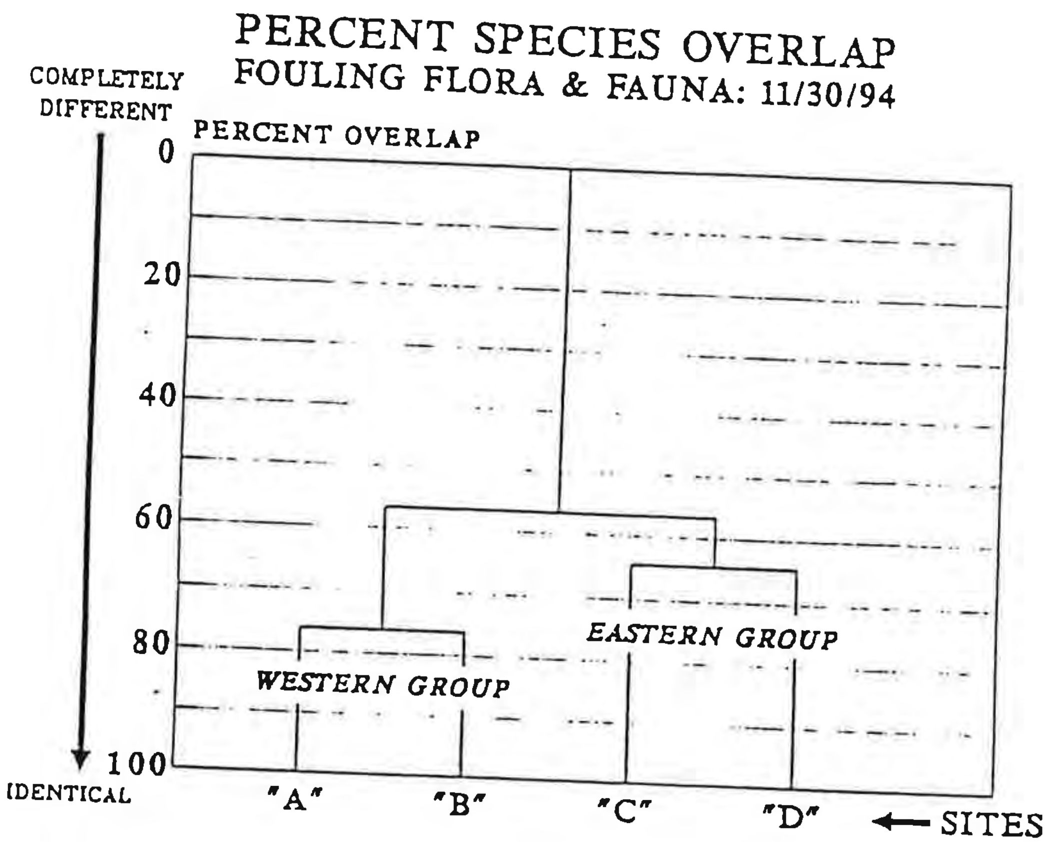
All animals found in the fouling community on 6/20 were mobile types, e.g. worms, amphipod crustaceans and insect larvae, that commonly associate with seaweeds, rather than the sessile (immovable) filter feeders like barnacles, mussels, tunicates, hydrozoans and bryozoans that are more typical of most estuarine fouling. The latter type of fouling animals first appeared on 9/30, becoming more common and extending their ranges westward on 11/30, but never became dominant, even at "D".

Seemingly paradoxically, the most numerous animals inhabiting the fouling community at eastern sites "C" and "D" were the same worms that dominated the benthic community at western sites "A" and "B" on that same date: Paranais litoralis, enchytraeid oligochaetes and Polydora ligni. These same animals were far less numerous in fouling at "A" and almost entirely absent from the benthos at "C" and "D". The connection appears to be an abundance of plant material: the leaves on the bottom at "A" and the luxuriant seaweed growth in fouling at "D". These organisms are not so much "pollution-loving" as they are "organic debris-loving".

The data show a general trend toward increasing numbers of individuals and taxa of fouling animals from June to November, with the most dramatic increases between 9/30 and 11/30 (Fig. 6). As with the benthos, the normal spring-summer development of the fouling community at all sites studied was probably delayed by poor water quality.

the intertidal fouling community showed smaller differences from site to site than its benthic counterpart (Fig. 5). However, there is still a tendency for separate grouping of western ("A" and "B") versus eastern ("C" and "D") sites (Fig. 7), suggesting that a water quality gradient is still present and still influential in fall.

FIG. 7 SPECIES OVERLAP DENDROGRAM FOR FOULING COMMUNITIES, 11/30/94



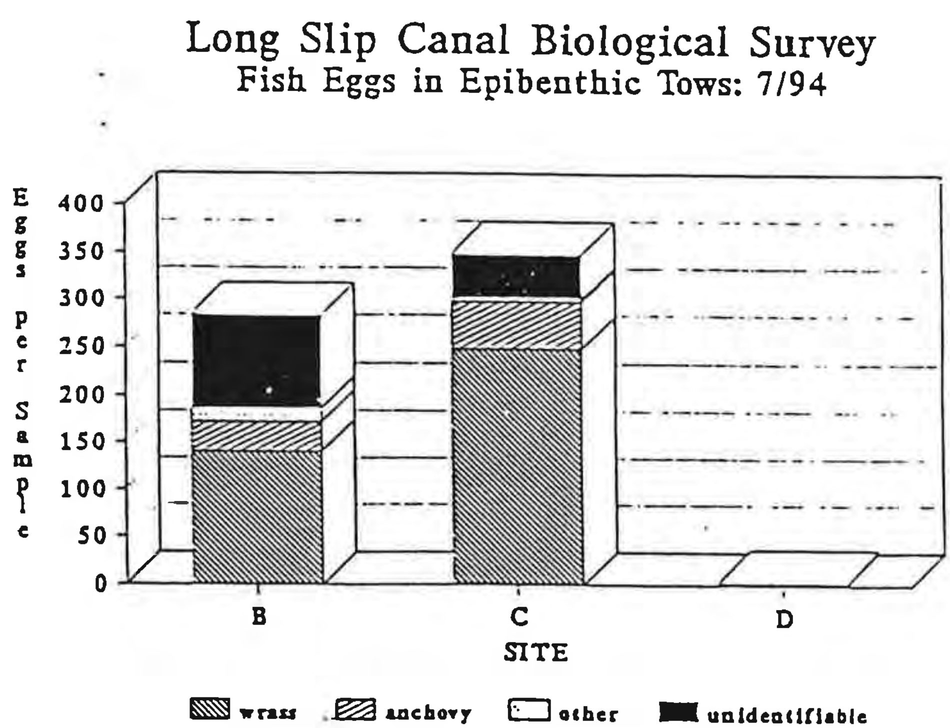
robins), sparids and/or scaenids (porgies and/or drums), and <u>Bairdiella chrysura</u> (white "perch"...actually a drum). Many eggs were unidentifiable because they were in deteriorating condition. These latter were unlikely to hatch.

TABLE 10
Total Numbers of Fish Eggs Caught by Episode and Sample

Sampling Episode	Epibenthic Samples				Benthic Samples			
	A	B	C	D	A	B	C	D
#1	--[1]	284	349	4	0	0	23	27
#2	0	13	2	1	0	0	0	4
#3	--[1]	--[1]	--[1]	--[1]	0	0	3	0

note: [1]"--" indicates no sample taken

FIG. 8 IDENTITIES OF FISH EGGS FROM EPIBENTHIC SAMPLES OF 7/01/94



Bay Anchovy, Menhaden, Gizzard Shad, Common Killifish (Mummichog), Crevalle Jack, Spotted Hake, Tautog, Cunner, White Perch, Atlantic Croaker, Porgy, Hogchoaker, Black-cheeked Tonguefish

Two types of small scales (<5 mm) were found. One small type (2 scales found) definitely belonged to a killifish (Fundulus sp.), the other small type (14 found) was similar to the first and probably came from silversides (Menidia sp.), which belong to a closely-related family. Of the larger scales (mostly ≥10 mm) at least six different types (species?) were recognized. One of these large types matched fresh scales from the white perch (Bairdiella chrysura: 11 scales found), the other five did not clearly match any of the fresh scales used for comparison. Most were ctenoid types (basses, wrasses, drums, snappers, porgies, flatfish, etc.), a few were cycloid (hakes, jacks, eels). Many scales were unidentifiable due to deteriorated condition. Their age was unknown. No recognizable scales of tautogs, cunners, anchovies or members of the herring family (e.g. menhaden, shad) were found.

While the evidence suggests that large fish may enter the canal, it is likely that this is not a prime habitat space for them. The fact that no large fish were ever caught in the otter trawl suggests that forays by fish into the canal may be brief and irregular. What larger fish might be doing in Long Slip Canal is an open question. Food resource in the form of benthic and fouling flora/fauna would appear very skimpy: far poorer than in the Waterfront Basin. Aquatic earthworms (oligochaetes), although extremely numerous at "A" by November, were also extremely small: Paranais litoralis did not exceed 5 mm (1/5th inch) in length. Large numbers of these might attract small forage fish like killifish and silversides, but not likely larger fish. Perhaps the smaller fish attracted the larger. The fact that the concentration of scales was much greater at "A" (57 found, including 56 large ones) than at "B" (7 found, including only 1 large one) does suggest that the richer bottom community at "A" late in the season may result in more extended fish presence at the western end of the canal than elsewhere. Another interpretation of the presence of fish scales is that dead fish carcasses are brought into the canal by tidal currents and tend to be deposited more heavily at "A" than at "B" due to the hydrology. The fish scale evidence can thus only suggest that various fish species enter Long Slip Canal.

Microbial Gas Production

The high content of big, largely undegraded botanical material in sediment at "A" results in a very conspicuous phenomenon that was observed in the western end of the canal during the four days of sampling episodes #1 and #2: microbial biogas production. Gas obtained in situ from site "A" contained a high percentage of flammable methane gas along with minor amounts of carbon dioxide, nitrogen and oxygen (Table 11). Methane and carbon dioxide are the gases actually produced by microbial degradation of the botanical debris;

Eq. 1
$$\underset{\text{carbohydrate}}{C_6H_{12}O_6} \xrightarrow[\text{fermentation}]{\text{microbial}} \underset{\text{methane}}{3CH_4} + \underset{\text{carbon dioxide}}{3CO_2}$$

Nitrogen and oxygen are "contaminants" from the water column and air, probably obtained during sampling.

The methane content of the gas generated in these flasks remained high despite the declining total production rate. The composition of gas produced from sediments at 21° C in the flask experiment was similar to that of the <u>in situ</u> gas sample from "A", with methane:carbon dioxide ratios increasing from 14:1 and 17:1 over a 3-month period. At the higher temperature (35° C) the increase in methane content with time is magnified, starting from 7:1 and 8:1 in units 1 and 2, respectively, on 11/15/94, increasing to 22:1 and 67:1 by 1/15/95. In other words, this sediment produces less total gas with time, but that gas *increases* in methane content, particularly at warm temperatures. Peak production rate (first month) was about 0.047 cu. ft. of gas per cu. ft. of sediment per day at 21° C (70° F) and 0.130 cu. ft. of gas per cu. ft. of sediment per day at 35° C (95° F). Using the rate:temperature relationship $r = ae^{-kT}$, the predicted rate of gas production for the canal at a reasonable peak summer water temperature (25° C - 77° F) is 0.055 cu. ft. of gas per cu. ft. of sediment per day.

Using a conservative estimate that about one quarter of the canal's sediment to a depth of 6" is capable of producing gas at this rate, a total production estimate of approximately 1000 cu. ft. of pure methane per day for the entire canal at peak summer water temperature was obtained (Appendix V).

As long as the present discharge from the Combined Overflow Sewer enters Long Slip Canal, there is not likely to be any abatement of gas production aside from seasonal cessation due to low water temperatures in winter. The peak rate of production (1000 cu. ft. per day) could be sustained for one month at summer temperatures, after which equally rich if not richer gas would be produced at lesser rates for up to 5 months at moderate temperatures (longer if the water cools) without replenishment of botanical materials from the Combined Overflow Sewer. If drainage from that sewer were to replenish the supply of botanicals during that five-month period (highly probably), the rate of production would again increase and the duration of gas production would be extended for several more months as a result of the addition of new material.

Even if discharge were to cease, gas production would probably continue for several months to a year until all the labile organic substrates in the botanicals already on the bottom were consumed. Any plan to modify the canal should take biogas production into consideration, as it would present a fire/explosion hazard if confined either by burial with fill or by decking over the canal.

IV. DISCUSSION

Comparison of the results of this investigation with those of similar studies in northeastern estuaries is instructive. While the species composition of the benthic fauna of Long Slip Canal and environs resembles that of the fauna of similar muddy bottom canals in southern New Jersey (1), the numbers of species are much lower and there are some important species missing or in very low abundance in the canal, e.g. four-eyed amphipods, capitellid worms and several bivalve mollusk species. This is probably the result of two combined factors: low salinity and pollution. The benthic

In the absence of such organisms, the marine worms (e.g. Haploscoloplos fragilis), eubenthic crustaceans (e.g. Leucon americanus) and the drift species from the fouling community would appear to be the primary resources for bottom-feeding fishes in the area (3). None of these potential food resources are very abundant in Long Slip Canal.

Likewise, the fouling community provides little potential food for fish. Its vast bulk is composed of algae, which are of little use to estuarine fish, which are mainly carnivores. The combination of low salinity and poor water quality appear to exclude most filter-feeding fouling animals except for small numbers of the exceedingly tolerant ivory barnacle Balanus eburneus. Even this animal is excluded during spring and summer. Most animals associated with the fouling community in and near the canal are small deposit-feeders that live among the seaweeds. These would not appear to be a very lucrative food source for large predators like most fish.

The only hint found of a richer invertebrate assemblages with larger potential prey animals nearby was the drift community, especially in the Waterfront Basin. The pilings fields in that basin are suspected to be the source of this material, and it is suspected that most fish in the area gravitate to this food resource, not to the impoverished canal habitats.

The evidence suggest that the canal may attract small forage fishes like killifish and silversides, and probably the small juveniles of larger species as water quality permits to take advantage of the small deposit-feeding worms that the degraded bottom conditions foster. Water quality probably does not permit such activity in summer, when the newly-hatched fish of many species could take advantage of such a habitat (4). Water quality was so poor at this time that even hardy oligochaete populations were suppressed in the canal. Only as water quality improved in autumn with falling water temperatures and presumably higher dissolved oxygen concentrations did the canal habitats likely favor the entry of forage fish and their larger fish predators. We were unable to detect such activity, except indirectly through the collection of fish scales and possible sonar contact with fish. The pattern of distribution of those scales and sonar contacts, as well as the pattern of distribution of benthic animals, suggest that the westernmost third of the canal (i.e. Site "A"), where the bottom is most heavily altered by pollution, is the most favorable fish habitat in autumn.

Herein lies a paradox. The organic sewage discharges that so degrade the quality of water and sediments and suppress the biota of the canal during spring and summer also provide the principle food resource, fueling the late-season benthic bloom that may result in at least limited value as fish habitat. Cease sewer discharge and clean up the bottom of the western end of the canal to eliminate bad water quality, odors and dangerous biogas production, and you also change the habitat irrevocably. Since canals in general provide poor benthic habitats because of the way that their shape limits water circulation (1), Long Slip Canal will probably never support a substantial fish community. Whatever value it presently holds for fish may actually be worsened by "cleaning it up" as a result of removing its largest food resource. On the other hand, the biota of the adjacent Waterfront Basin can only benefit from a cessation of discharges from the canal's sewers, which will probably be necessary no matter what kind of modification is undertaken.

Gosner, K. L. 1979. A Field Guide to the Atlantic Seashore. Houghton Mifflin Co., Boston, MA. 329 pp.

Hildebrand, S. F. & W. C. Schroeder. 1928. Fishes of the Chesapeake Bay. TFH Publications Inc., Neptune, NJ. 388 pp.

Kaston, B. J. 1953. How to know the Spiders. 1st ed. W. C. Brown, Co., Dubuque, IO. 220 pp.

Merritt, R. W. & K. W. Cummins. 1978. An Introduction to the Aquatic Insects of North America. Kendall/Hunt Publishing Co., Dubuque, IO. 441 pp.

Miner, R. W. 1950. Field Book of Seashore Life. G. P. Putnam's Sons, New York, NY 888 pp.

Round, F. E. 1990. The Diatoms: Biology and Morphology of the Genera. Cambridge University Press, Campbridge, England, UK. 747 pp.

Sars, G. O. 1895-1928. An account of the Crustacea of Norway. A. Cammermeyer, Christiana, Norway and Copenhagen, Denmark. 9 Vols.

Taylor, W. R. 1959. Marine Algae of the Northeast Coast of North America. University of Michigan Press, Ann Arbor, MI. 509 pp.

Vinyard, W. C. 1974. Key to the Genera of Diatoms of the Inland Waters of Temperate North America. Mad River Press, Eureka, CA.

Wiederholm, T. 1983. Chironomidae of the Holarctic Region, Keys and Diagnoses. Borgströms Tryckeri AB, Motala, Sweden.

APPENDIX I.

COMPLETE TAXONOMIC LIST FOR LONG SLIP CANAL STUDY: 6/20-11/30/94

Complete Taxonomic List for Long Slip Canal Study: 6/20-11/30/94

Major Taxon		Common Name	Scientific Name
Bluegreen "Algae"	*		Lyngbya confervoides
	*		Lyngbya semiplena
	*		Oscillatoria lutea
Green Algae	*	intestine weed	Enteromorpha intestinalis
	*		Enteromorpha linza
	*		Enteromorpha minima
	*		Monostroma oxyspermum
	*	filamentous seaweed	Ulothrix flacca
	*	sea lettuce	Ulva lactuca
	*	filamentous seaweed	Cladophora gracilis
Red Algae	*	graceful red weed	Gracilaria folifera
		false Agardhiellla	Gracilaria verrucosa
	*	red epiphyte	Audouinella efflorescens
	*	banded weed	Ceramium deslongchampii
	*	tubed weed	Polysiphonia subtilissima
Brown Algae	*	filamentous seaweed	Ectocarpus sp.
Diatoms	*	filamentous diatoms	Melosira moniliformis
	*	filamentous diatoms	Nitzschia sp.
		filamentous diatoms	Biddulphia sp.
	*	filamentous diatoms	unident. filament. diatom
	*	epiphytic diatoms	Rhoikoneis sp.
	*	epiphytic diatoms	Synedra sp.
Coelenterates		colonial hydroid	Ectopleura sp.
		colonial hydroid	Garveia sp.
		colonial hydroid	Obelia oxydentata
		colonial hydroid	Obelia bicuspidata
		colonial hydroid	Opercularella pumila
	*	comb jelly parasite	Edwardsia leidyi
Comb Jellies	*	Leidy's comb jelly	Mnemiopsis leidyi
Flatworms		slender flatworm	Euplana gracilis
	*	marine planarian	Fovia affinis
	*	alloeocoel	Monocelis sp.
	*		unident. flatworm
Nemerteans		ribbon worm	unident. nemertean
Entoprocts	*		Barentsia sp.
Bryozoa	*	creeping byozoan	Bowerbankia gracilis
		lacy crust	Membranipora lacroixii
Snails	*	common slipper shell	Crepidula fornicata
		New England dog whelk	Nassarius trivittatus
	*	mud dog whelk	Illyanassa egg cases
	*	mud dog whelk	Illyanassa obsoleta
	*	common periwinkle	Littorina littorea
		rice bubble shell	Cylichna oryza
		channel barrel bubble	Retusa canaliculata
		pyramid shell	Odostomia sp.
		club-gilled nudibranch	Eubranchus exiguus
Bivalves	*	narrowed macoma	Macoma tenta
	*	baltic macoma	Macoma balthica
		little surf clam	Mulinia lateralis
		arctic boring clam	Hiatella arctica
	*	blue mussel	Mytilus edulis

Complete Taxonomic List for Long Slip Canal Study: 6/20-11/30/94

Major Taxon	Common Name	Scientific Name
Terrestrial Insects/Arachnids	* springtail	collembolan
	* thrips	thysanopteran
	* ant	formicid
	* caterpillar	lepidopteran
	* moth	lepidopteran
	* aphid	aphid
	* shore fly	ephydrid fly
	* small wasp	eulophid wasp
	* aphid-like insect	psyllid
	* fly	unident. dipteran
	* fishing spider	pisaurid spider
	* mite	acarid
Tunicates	* sea grape	Molgula manhattensis
Fish	winter flounder	Pseudopleuronectes amer.
	northern pipefish	Syngnathus fuscus
	* wrass	Labrid eggs
	* sea robin	Triglid eggs
	* porgies & scup, drum	Sparid/Scaenid eggs
	* white perch	Bairdiella eggs
	* anchovy	Engraulid eggs
	anchovy	Engraulid larva
	killifish	Cyprinodontid
	*	unident. fish eggs

TOTAL TAXA: 126

"*" denotes taxa found inside Long Slip Canal

APPENDIX II.

EKMAN GRAB BENTHIC SAMPLE RESULTS: 6/20, 10/14 & 11/30/94

Benthic Samples: 6/20/94

Organism	A1	A2	B1	B2	C1	C2	D1	D2
Fovia affinis						2		
Illyanassa egg case					2		3	
Paranais littoralis			1			16	7	1
naiad sp. #2							1	
enchytraeid oligochaete				1				2
tubificid oligochaete #1						1		2
unident. oligochaetes					2			
Haploscoloplos fragilis					3	4	6	10
Nereis succinea						1		
Temora sp.					9	8	14	7
Tortanus sp.						2	1	1
Neomysis americana						1		
ant						1		
moth					1			
springtail					1			
thrips					1			
fish eggs					14	9	15	12
postlarval killifish							1	
total organisms	0	0	1	1	33	45	48	35
organisms/sq. m	0	0	24	24	799	1090	1163	848
no. of species	0	0	1	1	8	10	8	7

Benthic Samples: 11/30/94

Organism	A1	A2	B1	B2	C1	C2	D1	D2	E1
Cylichna oryza							1	2	
Retusa canaliculata								1	
Odostomia sp.								4	1
Illyanassa egg case								1	
Macoma balthica						1			
Macoma tenta						1		3	1
Mulinia lateralis								1	3
Paranais littoralis	603	623	6						
enchytraeid oligochaete	30	40	5						
tubificid oligochaete #1						1	16	258	12
tubificid oligochaete #2	20								
Haploscoloplos fragilis					2		4	252	56
Nereis succinea	5	2	1						
Eteone heteropoda	57	39			1	2	2	11	11
Nephthys bucera					1	3			1
Ophiodromus obscurus								6	
Polydora ligni	39	144	1			1			
Streblospio benedicti		1			7	11	17	89	5
Capitella capitata	6	5			1	13			24
Glycera americana								1	
Hypaniola grayi							1		
Leucon americanus							12	72	29
calanoid copepods	2	1							
cyclopoid copepods								1	
aphid			1						
unident. fish eggs						2	1		
total organisms	762	855	14	0	12	35	53	699	143
organisms/sq. m	18455	20707	339	0	291	848	1284	16929	13853
no. of species	8	8	5	0	5	9	7	12	10

APPENDIX III.

EPIBENTHIC SLED AND OTTER TRAWL CATCHES: 7/01 & 9/30/94

Otter Trawl (Nekton) Samples: 9/30/94

Organism	A	B	C	D
Ulva lactuca			X	
Melosira moniliformis			X	
Nitzschia sp.			X	
Polysiphonia subtilissima			X	X
Gracilaria verrucosa				X
Gracilaria folifera			X	
Audouinella efflorescens			X	X
Obelia oxydentata				X
Garveia sp.				X
Opercularella pumila				X
Euplana gracilis				1
unident. nemertean				1
Crepidula fornicata				1
Eubranchus exiguus				2
Mytilus edulis				1
Hapoloscoloplos fragilis				1
Nereis pelagica				6
Poydora ligni				14
Balanus eburneus				1
Melita nitida				6
Pluesymtes glaber				18
Caprella linearis				1
Callinectes sapidus				3
Molgula mahattensis				6
Pseudopleuronectes amer.				1
Syngnathus fuscus				1
total	0	0	--	64
number of species	0	0	6	22

APPENDIX IV.

FOULING SAMPLE CONTENTS: 6/20, 9/30 & 11/30/94

Fouling Samples: 6/20/94

Organism	A1	A2	A3	B1	B2	B3
				no samples taken		
Oscillatoria lutea	XX	XX	XX			
Lyngbya semiplena						
Entermorpha intestinalis						
Enteromorpha linza						
Ulva lactuca						
Polysiphonia subtilissima						
Melosira moniliformis						
Nitzschia sp.						
Paranais littoralis						
enchytraeid oligochaete		7	19			
tubificid oligochaete #3		5	101			
Polydora ligni						
Ampithoe valida						
Corophium acutum						
Gammarus mucronatus						
Thalassosmittia sp.						
total (animals only)	0	12	120			
number of taxa	1	3	3			

Fouling Samples: 6/20/94

Organism	C1	C2	C3	D1	D2	D3
Oscillatoria lutea						
Lyngbya semiplena		X				X
Entermorpha intestinalis		X	X	XX	XX	XX
Enteromorpha linza					X	X
Ulva lactuca		X		X	X	X
Polysiphonia subtilissima			X			
Melosira moniliformis	XX		X			X
Nitzschia sp.		XX	XX			X
Paranais littoralis			3			
enchytraeid oligochaete		1	1			
tubificid oligochaete #3		7	1			
Polydora ligni	4					
Ampithoe valida				1		
Corophium acutum	2					
Gammarus mucronatus		3	3			2
Thalassosmittia sp.	1				2	
total (animals only)	7	11	8	1	2	2
number of taxa	4	7	8	3	4	7

Fouling Samples: 9/30/94

Organism	C1	C2	C3	D1	D2	D3
				sample lost		
Oscillatoria lutea						
Lyngbya semiplena						
Lyngbya confervoides						
Ulothrix flacca						
Entermorpha intestinalis	XX	XX	XX			X
Enteromorpha linza		X				
Ulva lactuca					XX	
Polysiphonia sp.					XX	XX
Melosira moniliformis	X	X	X		X	X
Nitzschia sp.						
Rhoikoneis sp.						
Synedra sp.					X	X
unident. flatworm		1			1	
Bowerbankia gracilis						
Mytilus edulis					1	5
Paranais littoralis		2	1			8
enchytraeid oligochaete						
Nereis pelagica						
Eteone heteropoda					2	4
Polydora ligni	3	8	1		4	33
Streblospio benedicti						1
Fabricia sabella						16
unident. polychaete					1	
Balanus eburneus	6	3				
Gammarus mucronatus					2	2
Ampithoe valida			1			
Corophium acutum	1	1				
unident. megalopa larva						
Thalassosmittia sp.		1			1	
total (animals only)	0	3	1		2	64
number of taxa	2	4	2		5	11

Fouling Samples: 11/30/94

Organism	C1	C2	C3	D1	D2	D3
Oscillatoria lutea						
Lyngbya semiplena			X			
Lyngbya confervoides						
Ulothrix flacca			X			X
Entermorpha intestinalis	X	X	XXX	X	X	XXX
Enteromorpha linza						X
Enteromorpha minima						
Cladophora gracilis			X	X	XXX	X
Monostroma oxyspermum	X		XXX	X	X	X
Ulva lactuca					X	X
Polysiphonia subtilissima	XXX	X	X	X	X	
Ceramium deslongchampii					X	
Ectocarpus sp.			X			
Melosira moniliformis	XXX	XXX	X	XXX	XXX	X
unid. filam. diatom	X	X			X	
Biddulphia sp.						X
Nitzschia sp.	X		X			
Rhoikoneis sp.		X	X			X
Synedra sp.	X	X	X	X		X
Obelia bicuspidata					X	
Euplana gracilis					2	
Monocelis sp.	8	2	13	9	10	4
unident. flatworm	2		1	2	2	
Bowerbankia gracilis					X	
Membranipora lacroixii						X
Barentsia sp.				X	X	
Littorina littorea						1
Mytilus edulis				5	2	
Hiatella arctica					1	
Paranais litoralis	503	28	25	114	129	1
naiad oligochaete sp. 2	1					
enchytraeid oligochaete		1	44	1	1	47
Eteone heteropoda				4	2	
Polydora ligni	18		37	38	122	2
Streblospio benedicti						
Fabricia sabella	241	62	1	31	9	
Balanus eburneus		2	1	11	4	1
Gammarus mucronatus	2			4	2	
Gammarus palustris		1		2		
Ampithoe valida				4	6	
Corophium acutum					1	
Microdeutopus gryllotalpa				16	69	
unident. amphipod						1
Thalassosmittia sp.	2	3	58	4	17	109
canaceid fly larva	1		26	1	2	29
mites						7
Molgula manhattensis					10	
total noncolonial animals	778	99	206	246	389	202
number of taxa	16	13	20	22	29	21

APPENDIX V.

CALCULATIONS FOR BIOGAS PRODUCTION IN LONG SLIP CANAL

CALCULATIONS FOR BIOGAS PRODUCTION IN LONG SLIP CANAL

First Month's Mean Gas Production Rates (± Standard Deviation):

35° C 1.55 ± 0.303 cc gas @STP per 350 ml sediment/hr.

21° C 0.62 ± 0.054 cc gas @STP per 350 ml sediment/hr.

Calculation of Rate at 25° C:

$r_T = a \cdot e^{-KT}$ where: r_T = rate at temperature T
a = a constant
e = 2.718281828...
K = a constant
T = Kelvin temperature (°C + 273)

Solving for "a" and "K", using first month's mean rates:

$$\log r_T = \log a - KT \log e$$

for 35° C:

$$\log 1.55 = \log a - K \cdot 308° \cdot 0.43294$$
$$0.190331 = \log a - 133.76 \cdot K \qquad \text{(eq. 1)}$$

for 21° C:

$$\log 0.62 = \log a - K \cdot 294° \cdot 0.43294$$
$$0.207608 = \log a - 127.68 \cdot K \qquad \text{(eq. 2)}$$

subtracting eq. 2 from eq. 1 and solving for "K"....

$$K = -0.06544$$

substituting "K" back into eq. 1 and solving for "a"...

$$a = 2.72679 \times 10^{-9}$$

using values of "a" and "K" for 25° C (= 298° Kelvin)...

$$r_{298} = 2.72679 \times 10^{-9} \cdot e^{-[(298)(-0.06544)]}$$
= 0.80554 cc gas @STP per 350 ml. sediment/hr.
= 0.055 cu. ft. gas/cu. ft. sediment/day

Extrapolation of Gas Production Rate @25° C to Entire Canal:

Canal Area: 1820 ft. (l) X 100 ft. (w)

Assumed Gas-Producing Sediment Volume is 1/4 of the area X 0.5 ft. depth:

V = 1820 ft. · 100 ft. · 1/4 · 0.5 ft. = 22,750 cu. ft.

Gas Production is volume-specific rate times sediment volume:

$Pr_{gas} = V \cdot r_{298}$ = 22,750 cu. ft. sed. · 0.055 cu. ft. gas/cu. ft. sed./day
= 1,257 cu. ft. gas

* Assuming "gas" is 80% methane...

$Pr_{methane} = Pr_{gas} \cdot 0.80$ = 1,005 cu. ft. CH_4 per day

APPENDIX D

ORGANISMS IDENTIFIED IN LONG SLIP CANAL DURING SAMPLING PROGRAM

TABLE D.1

Organisms Identified in Long Slip Canal During Sampling Program

MAJOR TAXON	COMMON NAME	SCIENTIFIC NAME
Cyanobacteria	(blue-green algae)	Lyngbya confervoides
		Lyngbya semiplena
		Oscillatoria lutea
Green Algae	Intestine Weed	Entermorpha intestinalis
		Enteromorpha minima
		Enteromorpha linza
		Monostroma oxyspermum
	Filamentous Seaweed	Ulothrix flacca
	Sea Lettuce	Ulva lactuca
	Filamentous Seaweed	Cladophora gracilis
Red Algae	Graceful Red Weed	Gracilaria folifera
	False Agardhiellla	Gracilaria verrucosa
	Red Epiphyte	Audouinella efflorascens
	Banded Weed	Ceramium deslongchampii
	Tubed Weed	Polysiphonia subtilissima
Brown Algae	Filamentous Seaweed	Ectocarpus sp.
Diatoms	Filamentous Diatoms	Melosira moniliformis
	Filamentous Diatoms	Nitzschia sp.
	Filamentous Diatoms	Biddulphia sp.
	Epiphytic Diatoms	Rhoikoneis sp.
	Epiphytic Diatoms	Synedra sp.
Coelenterates	Colonial Hydroid	Ectopleura sp.
	Colonial Hydroid	Garveia sp.
	Colonial Hydroid	Obelia oxydentata
	Colonial Hydroid	Obelia bicuspidata
	Colonial Hydroid	Opercularella pumila
	Comb Jelly Parasite	Edwardsia leidyi
Comb Jellies	Leidy's Comb Jelly	Mnemiopsis leidyi
Flatworms	Slender Flatworm	Euplana gracilis
		Monocelis sp.
		Fovia affinis
Nemerteans	Ribbon Worm	unidentified nemertean
Entoprocts		Barentsia sp.
Bryozoa	Creeping Bryozoan	Bowerbankia gracilis
	Lacy Crust	Membranipora lacroixii
Snails	Common Slipper Shell	Crepidula fornicata
	New England Dog Whelk	Nassarius travittatus
	Mud Dog Whelk	Illyanassa egg cases

MAJOR TAXON	COMMON NAME	SCIENTIFIC NAME
	Mud Dog Whelk	Ilyanassa obsoleta
	Common Periwinkle	Littorina littorea
	Rice Bubble Shell	Cylichna oryza
	Channeled Barrel Bubble	Retusa canaliculata
	Pyramid Shell	Odostomia sp.
	Clud-Gilled Nudibranchs	Eubranchus exiguus
Bivalves	Narrowed Macoma	Macoma tenta
	Baltic Macoma	Macoma balthica
	Arctic Boring Clam	Hiatella arctica
	Little Surf Clam	Mulinia lateralis
	Blue Mussel	Mytilus edulis
Aquatic Earthworms		Paranais littoralis
		naiad oligochaete #2
		enchytraeid oligochaete
		enchytraeid oligochaete
		enchytraeid oligochaete
		tubificid oligochaete
		unidentified oligochaetes
Marine Worms	Paddle Worm	Eteone heteropoda
	Paddle Worm	Eteone flava
	Paddle Worm	Eulalia sanguinea
	Clam Worm	Nereis succinea
	Orbiniid Worm	Haploscoloplos fragilis
	Red-Lined Worm	Nepthys bucera
	Clam Worm	Nereis pelagica
	Swift-Footed Worm	Ophiodromus obscurus
	Thread Worm	Capitella capitata
	Mud Worm	Polydora ligni
	Mud Worm	Streblospio benedicti
	Bristle Worm	Hypaniola gravi
	Fan Worm	Fabricia sabella
	Trumpet Worm	Pectinaria gouldi
	Blood Worm	Glycera americana
		unidentified polychaete
Copepods	Tunicate Parasite	lichomolgid copepods
	Calanoid Copepod	Temora sp.
	Calanoid Copepod	Tortanus sp.
	Calanoid Copepod	unidentified Calanoids
	Cyclopoid Copepod	unidentified Cyclopoids
Barnacles	Ivory Barnacle	Balanus eburneus
Seed shrimp	Seed Shrimp	cyatherid ostracod

Lehigh University

FINAL REPORT
to
NEW JERSEY TRANSIT

LONG SLIP CANAL
HABITAT RESTORATION PROJECT

HYDROGRAPHIC DATA REPORT and *IMPLICATIONS FOR PROJECTED HABITAT RESTORATION*

Vincent G. Guida, Ph.D.
Research Scientist

February, 1997

esc

Environmental Studies Center

printed on
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FINAL REPORT

LONG SLIP CANAL HABITAT RESTORATION PROJECT

HYDROGRAPHIC DATA REPORT
and
IMPLICATIONS FOR PROJECTED HABITAT RESTORATION

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EXECUTIVE SUMMARY

- This study was conducted in order to document present hydrographic and water quality conditions in the shallow waterfront basin east of Long Slip Canal, along the Hudson River waterfronts of Jersey City and Hoboken, NJ and to examine the consequences of habitat restoration at this site.

- Proposed modifications of the site include the closure of the canal by an armored dike, re-routing of existing CSOs, the dredging of an east-west channel across the basin to improve tidal circulation, and provisions for public access to the waterfront, which is now inaccessible.

- Present conditions in the canal itself include chronic, continuous low dissolved oxygen (0 to 2.5 ppm) throughout the water column during summer as a result of poor circulation and intense bacterial oxygen consumption resulting from the deposition of organic matter on the canal bottom by two active CSOs. Plants and animal life are virtually absent from the canal during summer and extremely depauperate in other seasons.

- Present conditions in the adjoining waterfront basin are strongly influenced by the presence of the canal, basin bottom topography, tidal hydrology and changing river salinity. High salinity-high density tidewater enters Long Slip Canal at high tide, sinks to the bottom, and is stripped of oxygen by bacterial respiration, then spreads back out into the bottom of the waterfront basin. A shallow north-south hump on the bottom of the outer (eastern) end of the basin blocks tidal flushing of this stagnant bottom water. Low D.O. on the basin bottom (usually below NJ minimum of 4.0, often below 2.0 mg/l) results in an impoverished biota there.

- The level of contamination of sediments in the waterfront basin with toxic hydrocarbons, pesticides and heavy metals is not known, but lower Hudson River sediments, in general, are among the least toxic in the entire harbor-estuarine complex. Sediment toxicity is not likely to impede habitat restoration success at this site.

- Nearby, comparable waterfront basin areas are major nursery habitats for young-of-the-year striped bass, Atlantic tomcod, and black sea bass, juvenile winter flounder, white perch, American eels, and cunner. They also provide good habitat for tautog. Increasing young-of-the year survival is considered key to expanding local fisheries stocks. The Long Slip waterfront area could provide similar habitat value if bottom D.O. was adequate. Striped bass, in particular, would benefit, since their young-of-the-year migrate into waterfront habitats about the time that D.O. now becomes severely depressed in the Long Slip vicinity. Tomcod would experience somewhat less benefit, since they appear to leave the shallows to escape warm temperatures before the D.O. becomes too severely depressed.

- Proposed canal closure would cut off the major source of bottom water de-oxygenation, while a channel through the outer basin hump would allow increased tidal flushing to prevent even marginal stagnation. With proper design, D.O. could remain above 4.0 mg/l, as it is in some better-flushed Hudson waterfront areas, thus promoting summer nursery use by fish.

- The irregular surface of the armored dike that will close off the canal mouth may provide good habitat for cunner, tautog and black sea bass, plus a large attachment area for blue mussels, upon which tautog depend for food.

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FIGURES

HYDROGRAPHIC DATA REPORT
and
IMPLICATIONS FOR PROJECTED HABITAT RESTORATION

Introduction

The study reported upon here was conducted as part of an ongoing project to close Long Slip Canal and restore the adjacent Hudson River waterfront basin as a biological habitat and a recreational area accessible to the public. Previous reports (1, 2) demonstrated severe impacts of poor water quality in the canal on the biota of the canal and the adjacent waterfront basin, especially during summer. However, few actual measurements of water quality were made in the course of these studies, making it difficult to define goals and demonstrate habitat improvement in a measurable way. Continuous water quality monitoring data from a fixed, automatic recorder in the same waterfront basin in 1994 is available (3), but this provides no information on spatial variations. To rectify this situation, a program of water quality monitoring was organized for the following two purposes:

1. To provide detailed information on water quality in the vicinity of Long Slip Canal in its present configuration for comparison with conditions following completion of the canal closure/habitat restoration project,

2. To provide a baseline for the planned employment of computer simulation models for the development of beneficial modifications to the existing water circulation patterns.

This program supplemented a more ambitious hydrographic data collection regime conducted at about the same time by Lawler, Matusky and Skelly (LMS:4).

Poor circulation and density stratification leading to stagnation (low oxygen) in bottom waters is suspected to be the principle water quality problem in Long Slip Canal and its waterfront basin. The contours of the basin's bottom are thought impede circulation. Therefore, the monitoring program was designed primarily to measure dissolved oxygen, those factors affecting water density (temperature and salinity), and bottom contours along a grid of twelve stations in the area outside the canal under various conditions of tide and weather. Water quality measurements were planned both at surface and bottom in order to detect stratification.

Proposed habitat improvements include the modification of existing bottom contours so as to improve circulation and eliminate stagnation of bottom water. Fish populations to be affected include three of particular concern: striped bass because of its fisheries value, Atlantic tomcod because of its official "threatened" status, and tautog because of its fisheries value and recent unexplained decline. Seven other species of fisheries or ecological value are also abundant (winter flounder, bay anchovy, American shad, black sea bass, American eel, cunner, white perch), and several others are present in lesser numbers. The juvenile stages of most fish species are particularly vulnerable to effects of environmental degradation. Therefore, the discussion of habitat restoration design should focus particularly, but not exclusively, upon those species of greatest concern, and on their juvenile stages in particular. Habitat restoration based upon the needs of juveniles is likely to be the most beneficial to local fish stocks (3).

Study Site and Monitoring Program

Long Slip Canal is located along the New Jersey bank of the Hudson River at mile 2.0 (the Battery at the southern tip of Manhattan is the mile 0.0 point), immediately south of the Hoboken-Jersey City municipal boundary and surrounded by a New Jersey Transit Corporation railroad facility (Fig. 1). At its eastern end, the 1800 X 100 foot canal opens into a shallow (depths of 15 feet or less at mean low tide) waterfront basin that is about 1400 feet wide and extends north and south along the Hudson River waterfront. Within 600' to the south of the canal's mouth, the broad waterfront basin is traversed by two linear fields of wooden pilings representing piers whose superstructures are gone. To the north of the canal's mouth, the waterfront basin is delimited by a concrete ferry pier and the NJT terminal. East of the waterfront basin is the main channel of the river, with depths of 30 to 50 feet. Previous investigations (2) revealed a shallow sill separating the inner portion of the waterfront basin from the deeper river basin.

A grid of twelve monitoring stations was established to cover the northern part of the waterfront basin, the area most influenced by the canal (Fig. 2). The stations were arranged in three lines (A, B, C) lying about 235 ft. apart, with 450 ft. separating the stations (1 through 5) within each line. Station A-1 (not on diagram) was not designated because its location (aligned with stations B-1 and C-1) lies on land. The rest of the "A" stations lie along a line 20' from and parallel to the ferry pier. Their purpose was to provide insight into the effect on circulation and water quality of the ferry pier and the Hoboken combined sewer overflow (CSO) located at A-2. The "B" line of stations was located parallel to and 20' from the northern boundary of the north piling field. B-1 was actually in the mouth of Long Slip Canal and was most influenced by that waterway with its two additional CSOs (Jersey City and Hoboken) and PATH sump outlets. At the opposite end of the "B" line was B-5, which lay beyond the end of the piling field and the waterfront basin, in the deep water of the river's main channel. It was the only deep water station used in the study. The "C" stations, located parallel to and 20' from the southern boundary of the north piling field provided information on whether or not the canal's influence was crossing that piling field. Pilings and bulkhead walls were marked with paint so that stations could be found easily in all tide and weather conditions.

Temperature, salinity and dissolved oxygen of surface and bottom water were determined using a Horiba U-10 Water Quality Checker. The same instrument was used to make measurements of pH and turbidity as well. The instrument was calibrated a few days prior to the first sampling date. Surface turbidity was also independently determined with a Secchi disk. Surface measurements with the U-10 were made by immersing the probe in the water to a depth of about 20 cm (8"). However, the cable on this instrument was too short to reach the bottom, so bottom water was pumped up into 4 liter jar containing the probe using a portable peristaltic pump with a long, weighted suction tube. The jar was continuously flushed from bottom to top with bottom water as measurements were taken to avoid contact of sample water with air prior to dissolved oxygen determination. At B-5, a midwater sample (~15 ft. depth) was taken in addition to surface and bottom (~30 ft. depth) samples. Depths were determined with the sampling vessel's depth finder (sonar). All sampling was accomplished from New Jersey Transit's 16' outboard motor boat.

Fig. 1

Scale Diagram of LONG SLIP CANAL and ENVIRONS

Showing Terminology Used in this Report

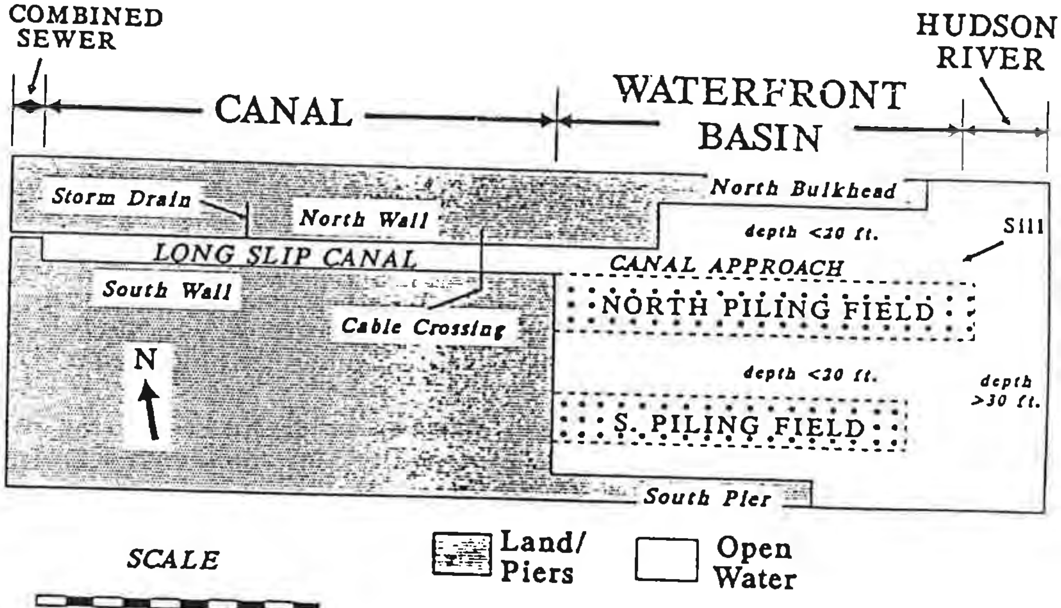
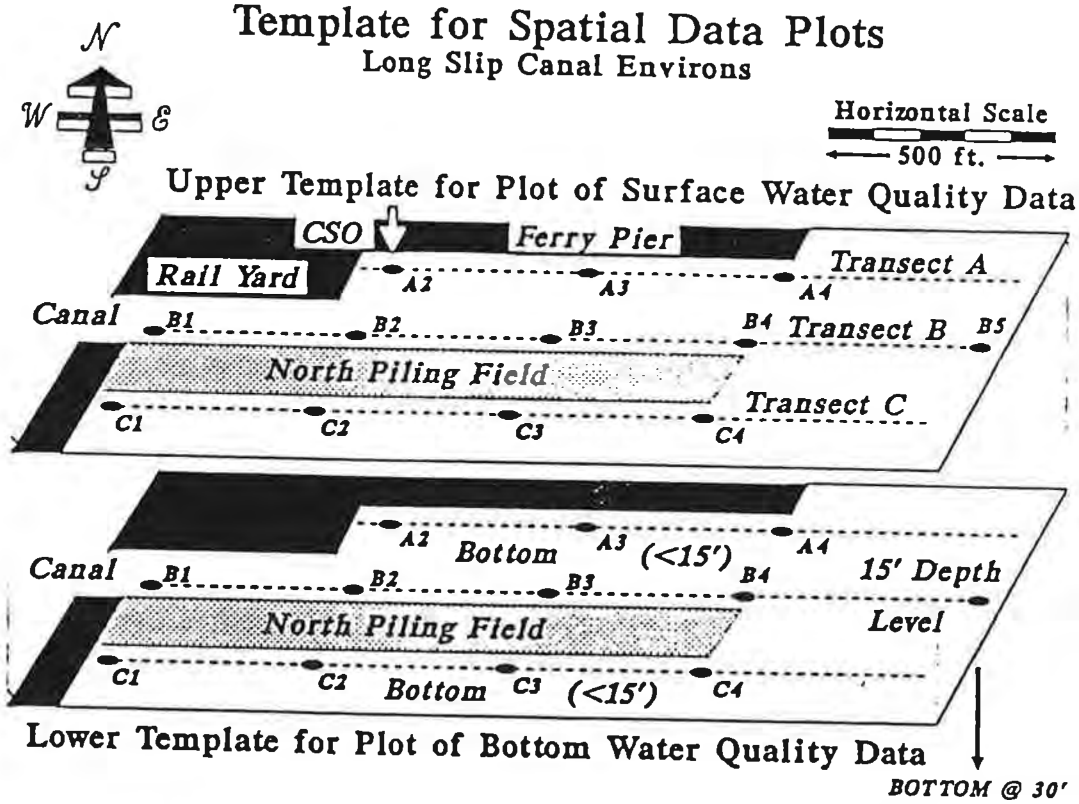


Diagram based upon U.S.G.S. Jersey City Quadrangle and Frederick R. Harris, Inc. Engineering Drawings

Fig. 2

Template for Spatial Data Plots

Long Slip Canal Environs



As water quality was known to show strong tidal periodicity (3), measurements of all stations were planned around both the times of high and low tides. As time of day was also a likely variable, dates of measurement were made about a week apart, when the times of high and low tides would be approximately reversed. Single (high tide) measurements were made on July 24 and 30, 1996, and both high and low measurements were made on August 8, 14 and 20, 1996:

Table 1. Sampling Schedule

Day & Date of Sampling	Period of Sampling	Time of Nearest Predicted Tide[1]	Predicted Height (ft.[1]) and (type of Tide)[1]
Th 07/24	1513-1650	1513	4.7' (high)
Tu 07/30	0900-1030	0838	5.2' (high)
Th 08/08	1100-?	1029	0.7' (low)
Th 08/08	1620-?	1643	4.7' (high)
W 08/14	1007-1134	0906	4.6' (high)
W 08/14	1523-1630	1507	0.3' (low)
Tu 08/20	0700-0806	0627	0.5' (low)
Tu 08/20	1315-1455	1256	4.6' (high)

[1] Based on predicted tides for Hoboken

As freshwater flows from adjoining CSOs were also likely immediate influences on water quality, precipitation data for the period of sampling was obtained for Newark International Airport (approx. 6 mi. SW) was obtained from the National Weather Service. The only moderately heavy rainfall during the course of the study was on August 1, which we unfortunately missed sampling by one day. July 24 and August 14 were days of light rain, and July 30, August 8 and August 20 were days of dry weather preceded by dry periods of 2, 1 and 5 days, respectively (Fig. 3).

Results: Depth Contours

A diagrammatic view of the bottom contours in the waterfront basin (Fig. 4) was constructed from repeated depth measurements at the twelve sampling sites. Actual depths of the lettered contours at mean tide levels are as follows:

Table 2. Water Depths for Lettered Contours in Fig. 4

Contour	Water Depth at Mean High Tide	Water Depth at Mean Low Tide
A	9'	4'
B	10'	5'
C	11'	6'
D	12'	7'
E	13'	8'
F	14'	9'
G	15'	10'
H	16'	11'
J	18'	13'

Fig. 3 Precipitation Data

Newark International Airport: 1996

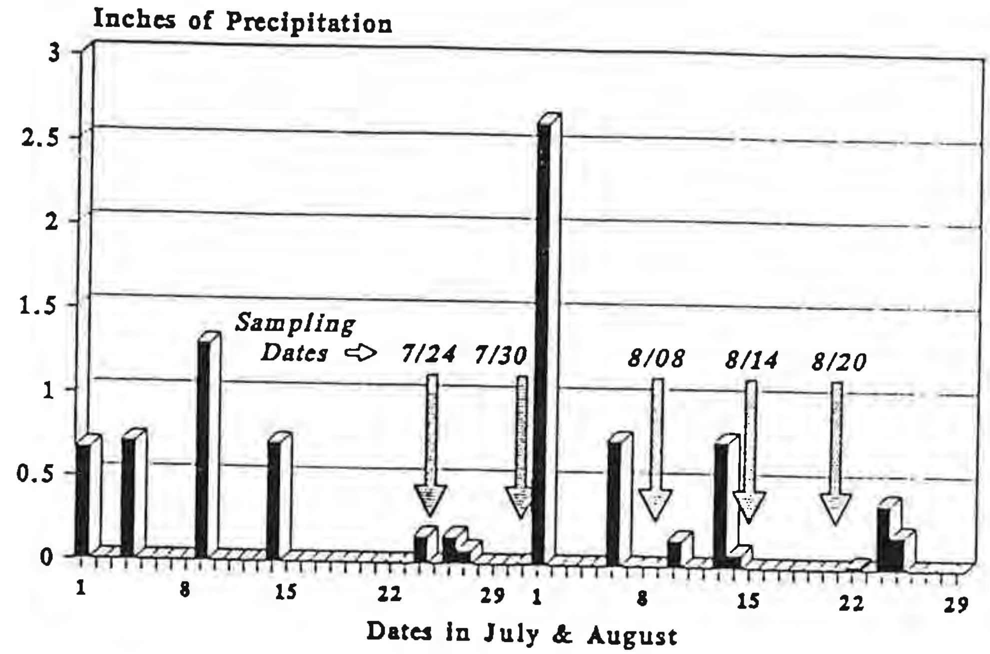
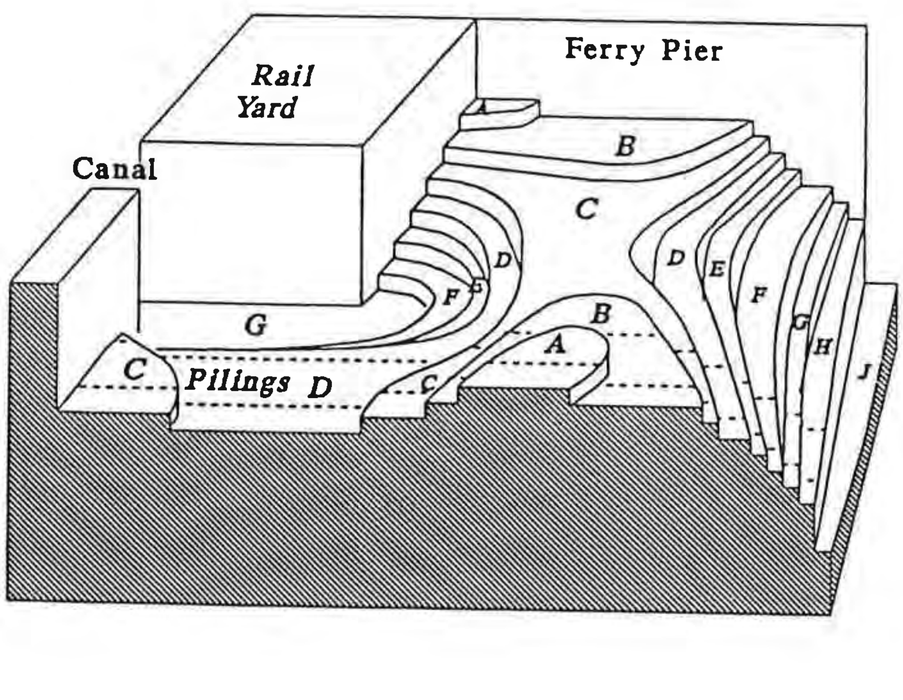


Fig. 4 Waterfront Basin

Bottom Contours in 1-foot Intervals

(not to scale)



It is clear from this figure that the existing saddle-shaped bottom contours in the middle of the waterfront basin isolate the deeper portion of the basin outside the mouth of Long Slip Canal (level "G") from similar depths along the slope of the river basin. Most of the canal itself is 1-2' deeper than G (equivalent to level "H")(2). Hence the bottoms of the canal and adjacent waterfront form a deep, semi-isolated basin. The clearest route of egress for water from this basin is southward, across the western end of the north piling field (level "D"), since the saddle's 4-foot-high crest blocks bottom exchange with the river basin. A more detailed precise bathymetric survey of the waterfront basin made at about the same time (4) demonstrates the bottom features. That the saddle's crest does indeed block exchange between the inner waterfront basin and the river channel will be made evident from the an analysis of the water quality data.

Results: Water Quality

Water temperature, salinity and dissolved oxygen concentrations for 7/24, 7/30, 8/14 and 8/20 sampling excursions are plotted on 2-dimensional spatial diagrams in Figs. 5-10. Data from 8/08 was too incomplete to be plotted in this manner, although it demonstrates patterns similar to those of the data from the other dates.

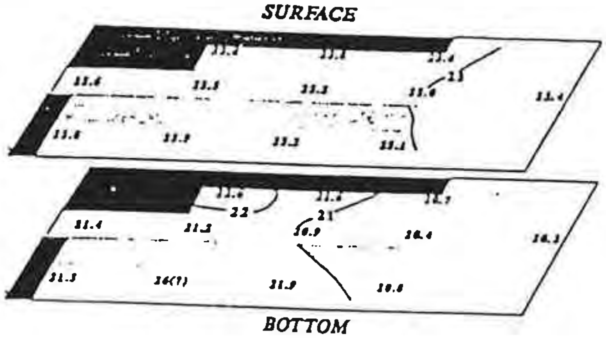
Water temperatures for the entire period ranged between 19° and 26°C. Temperatures in the waterfront basin were typically 0.5° to 1°C warmer than those in the river at the same depth, and the surface of the basin was typically 1° to 2°C warmer than the bottom. On dates when two sets of data were available for the same day, there was a 1° to 2°C rise in temperature throughout the water column at nearly all locations between morning and afternoon readings, regardless of tidal stage. This solar heating pattern is typical for large bodies of water and in this case makes only a minor contribution to water density differences that create stratified conditions. Similar patterns of temperature distribution were noted by LMS (4).

Measured salinities ranged 7 to 24 parts per thousand (ppt) during this study. Bottom salinities were generally 1 to 6 ppt higher than those at the surface, contributing the bulk of the density differences leading to stratification. Similar vertical gradients appear in the LMS data, bringing its authors to a similar conclusion regarding stratification (4). A 1 ppt salinity difference results in a density difference about three times that of a 1°C temperature difference for water at around 20°C and 20 ppt. Short term changes in salinity were associated with tidal rather than diurnal cycles; river salinities were about 2 ppt higher during high tides than they were during low tides on both 8/14 and 8/20, despite the fact that the times of high and low tides were approximately reversed on those two dates. Tidal salinity oscillations are expected in an estuary with both substantial tides and river flows. Salinities inside the waterfront basin were generally higher than those in the river during low tide, when the river salinity was at its minimum, and lower than the river during high tide, when the river salinity was maximal. This pattern suggests that exchange between the waterfront basin and river is sufficiently impeded by topography that water quality changes in the basin lag behind those of the river by several hours.

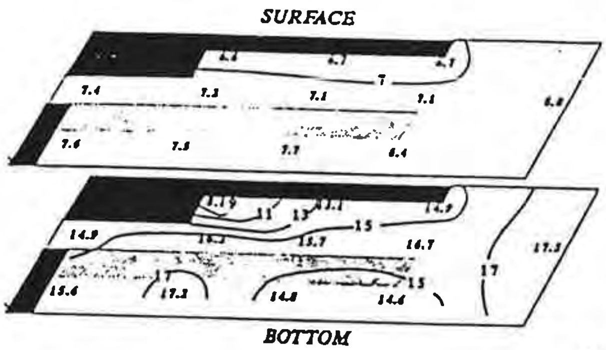
Bottom salinities in the basin demonstrated some peculiar features that suggest local water quality influences. Figs. 5, 6, 7, 8 and 10 show a focus

Fig. 5

Temperature Profile
High Tide: 1513, 7/24/96



Salinity Profile
High Tide: 1513, 7/24/96



Dissolved Oxygen Profile
High Tide: 1513, 7/24/96

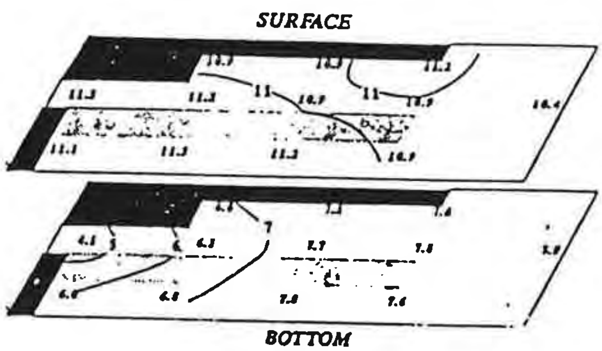
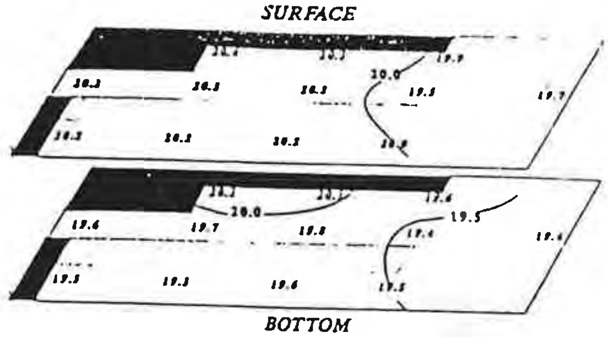
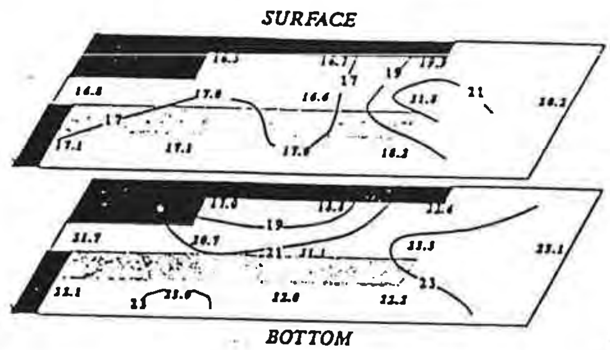


Fig. 6

Temperature Profile
High Tide: 0900, 7/30/96



Salinity Profile
High Tide: 0900, 7/30/96



Dissolved Oxygen Profile
High Tide: 0900, 7/30/96

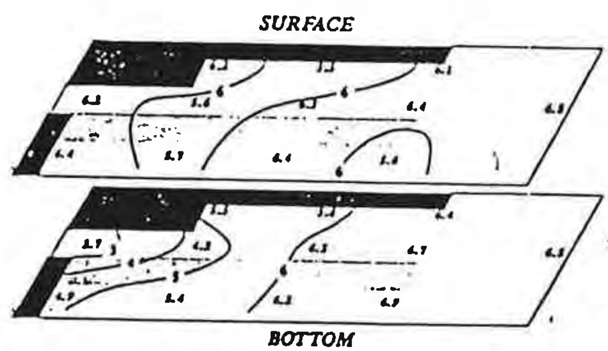
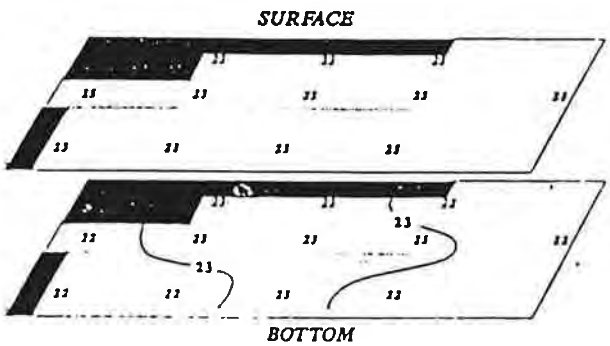
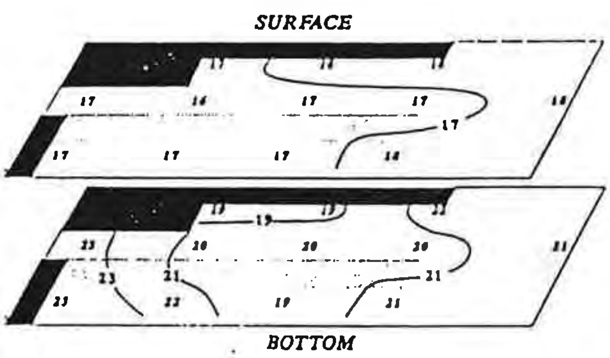


Fig. 7

Temperature Profile
High Tide: 1007, 8/14/96



Salinity Profile
High Tide: 1007, 8/14/96



Dissolved Oxygen Profile
High Tide: 1007, 8/14/96

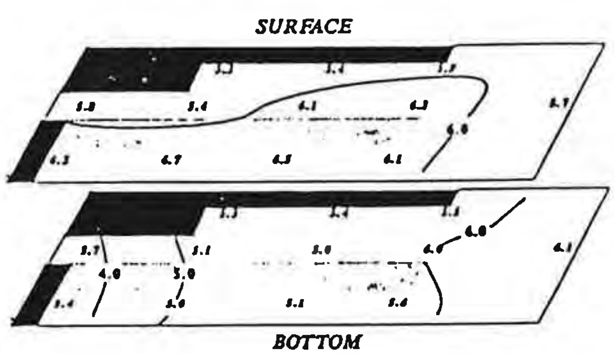
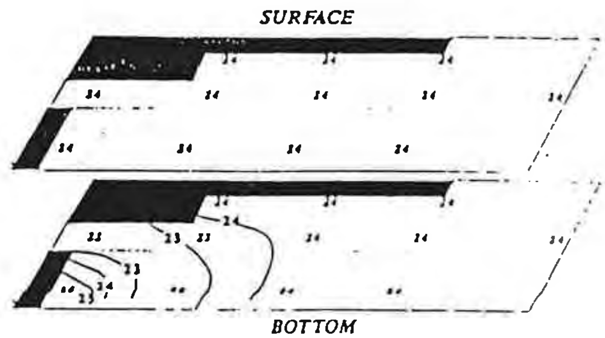
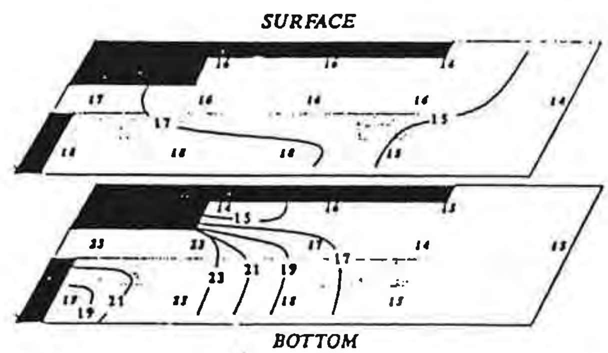


Fig. 8

Temperature Profile
Low Tide: 1523, 8/14/96



Salinity Profile
Low Tide: 1523, 8/14/96



Dissolved Oxygen Profile
Low Tide: 1523, 8/14/96

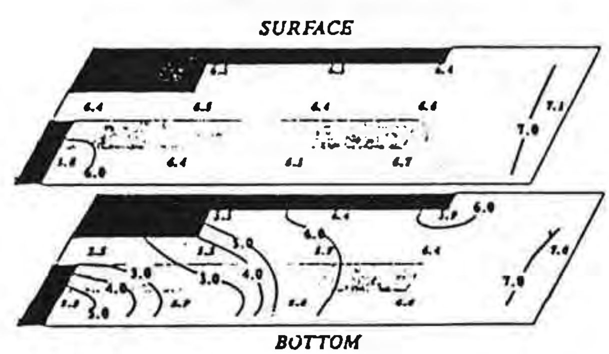
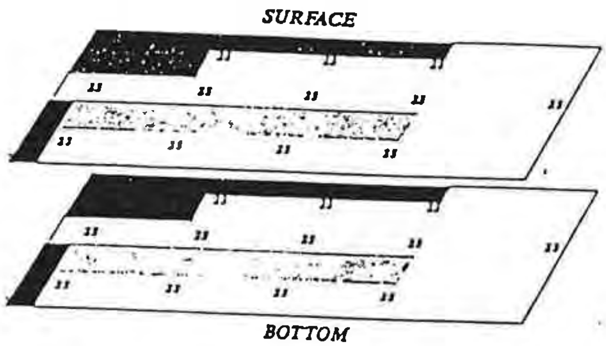
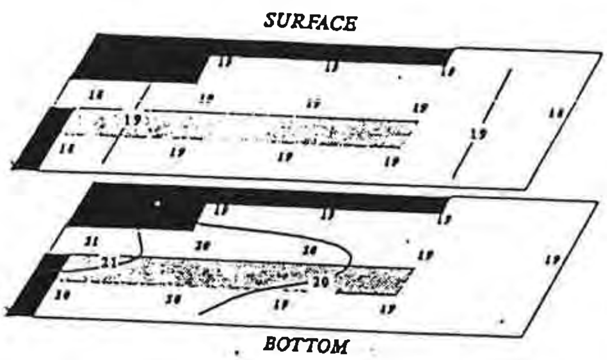


Fig. 9

Temperature Profile
Low Tide: 0700, 8/20/96



Salinity Profile
Low Tide: 0700, 8/20/96



Dissolved Oxygen Profile
Low Tide: 0700, 8/20/96

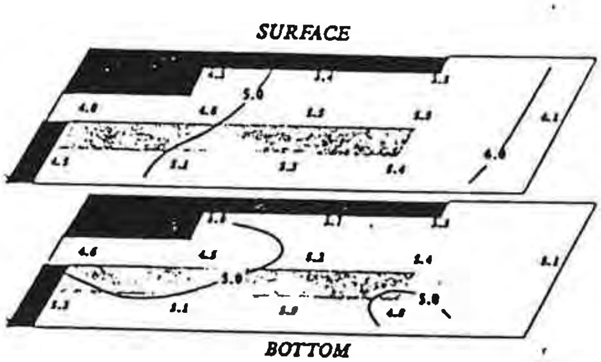
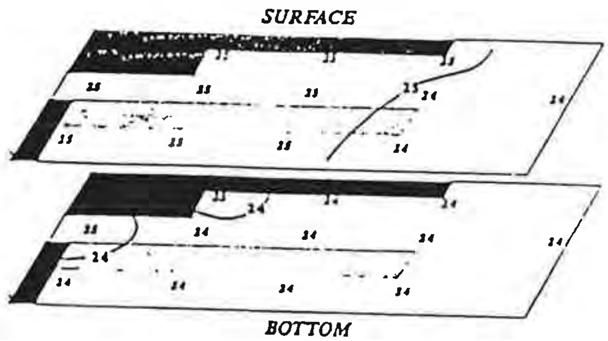
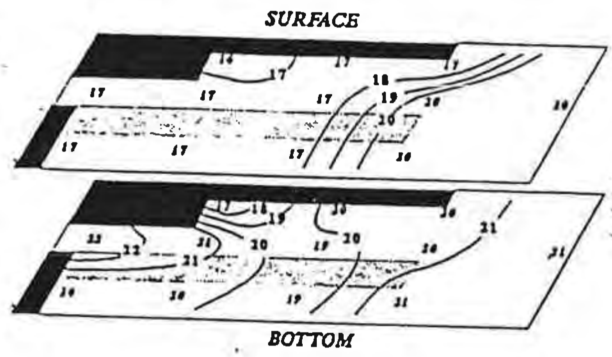


Fig. 10

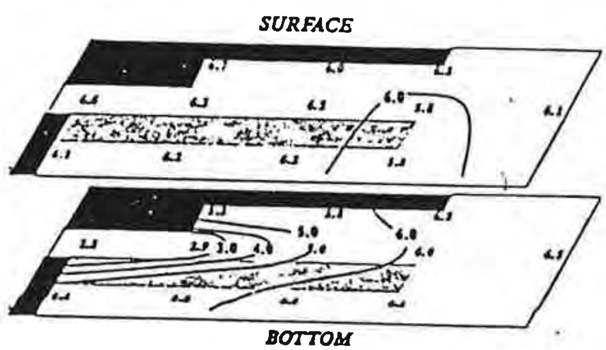
Temperature Profile
High Tide: 1315, 8/20/96



Salinity Profile
High Tide: 1315, 8/20/96



Dissolved Oxygen Profile
High Tide: 1315, 8/20/96



of lower bottom salinities centering around sampling site A-2, the location of a Hoboken municipal CSO outlet. This pattern indicates frequent if not continuous freshwater discharge from that outlet even on 8/20, following a period of 5 days of dry weather. Although the authors of the LMS study did not conclude that there is dry weather flow from this CSO (4), this author sees evidence of it in their data on at least some of their dry weather survey dates.

Another peculiarity is that the highest salinities measured on 8/14 and 8/20 were at the canal mouth (B-1), the deepest station in the basin, and these salinities remained at the nearly the same values during the tidal cycle while values in the river and outer basin were changing. This suggests the lag times in water turnover in the bottom of the canal and the adjacent deep inner basin area are even longer than for the basin in general, showing no substantial change after six hours. However, there was a change in the extent of the high salinity bottom region with tidal cycles on both days. The region appeared to expand and contract. On 8/14, in particular, it extended southward across the north piling field to station C-2 during low tide (Fig. 8). The same thing happened during low tide on 8/08 (no figure available), and is evident in LMS data, as well (4).

Dissolved oxygen concentrations in this high salinity water that characterized stations around the mouth of Long Slip Canal (B-1 to B-3, C-1, C-2) were generally lower than for surface water or for other bottom stations sampled (Fig. 11). Oxygen gas is less soluble in saltier water than in fresher water, so concentrations might be expected to be lower in this water. However, Figure 11 takes this difference into account by being plotted in terms of percent saturation rather than concentration in mg/l or ppm. The low values of D.O. for the Long Slip mouth stations plotted in Figs. 5-10 therefore represent water that is <u>oxygen depleted</u>, not simply low in oxygen due to low solubility. LMS data (4) shows even lower D.O. values than those obtained in this study for the same stations around the mouth of the canal. No oxygen depletion was associated with the Hoboken CSO at station A-2.

Vertical profiles of water density for each sampling excursion (minus the incomplete data of 8/08) are presented in Figs. 12 through 17. Densities in these figures are presented as "sigma T" values for convenience of representation:

sigma T = 1000 X (density in kg/l - 1.000)

These clearly demonstrate how pockets of high density water accumulate in the deep portions of the inner waterfront basin and remain there despite tidal exchange of overlying water. In several cases this inner basin water is the densest in the entire sampling...even denser than water at the bottom of the river. This is a strong indication that it is either the relic of a past high tide or the result of evaporation after. Either scenario requires long residence in the canal and basin environment.

These same vertical profiles also clearly show a lens of low density water that extends from surface to bottom around station A2 in many profiles, but becomes shallower and more spread out as it moves south (from Transect A toward Transect C). This is the influence of the Hoboken CSO at A2, which was apparently discharging continuously or nearly so during the period of the study.

Fig. 11 Distribution of D.O. Saturation Values
Waterfront Basin

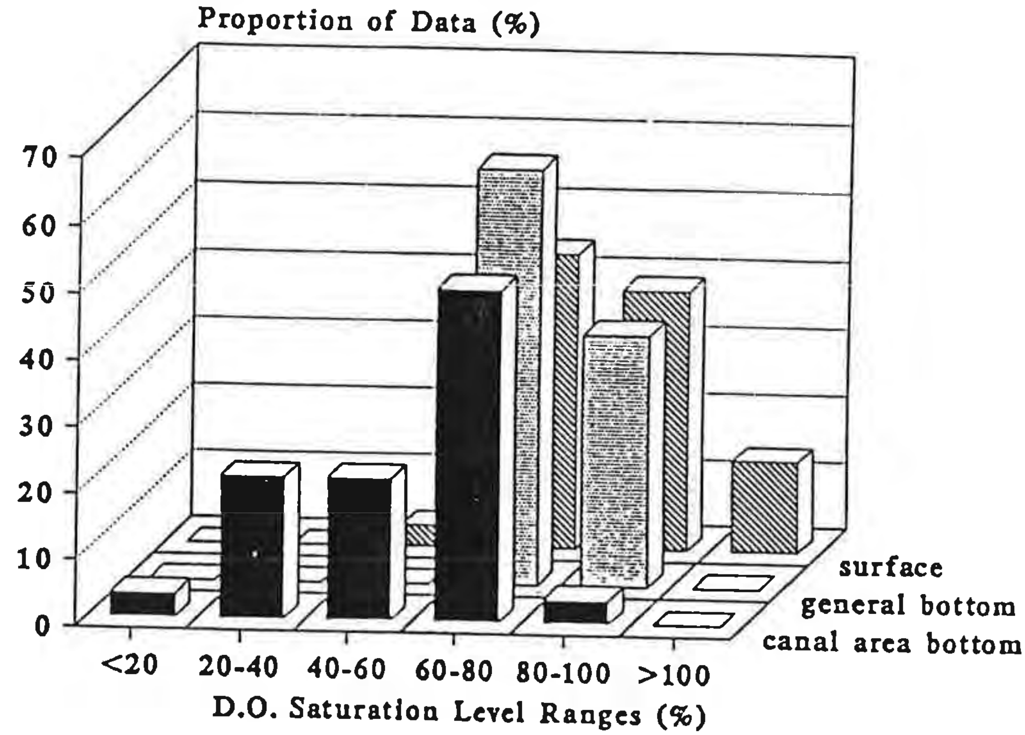
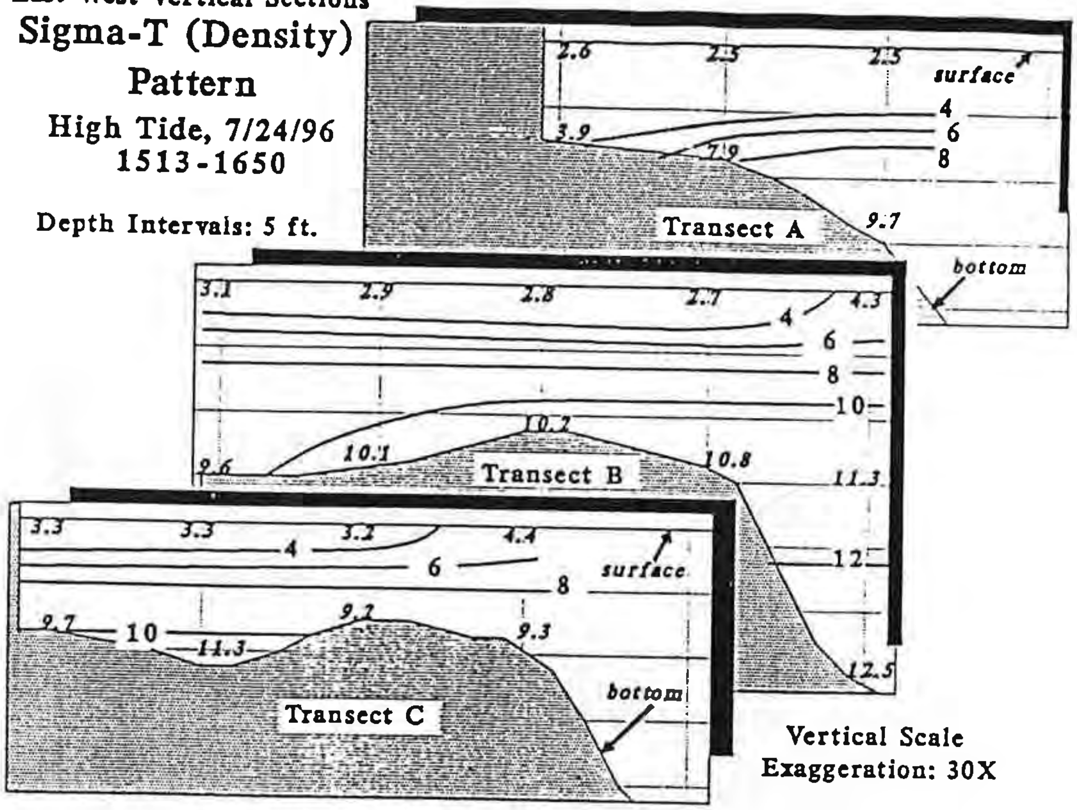


Fig. 12 East-West Vertical Sections Sigma-T (Density) Pattern High Tide, 7/24/96 1513-1650

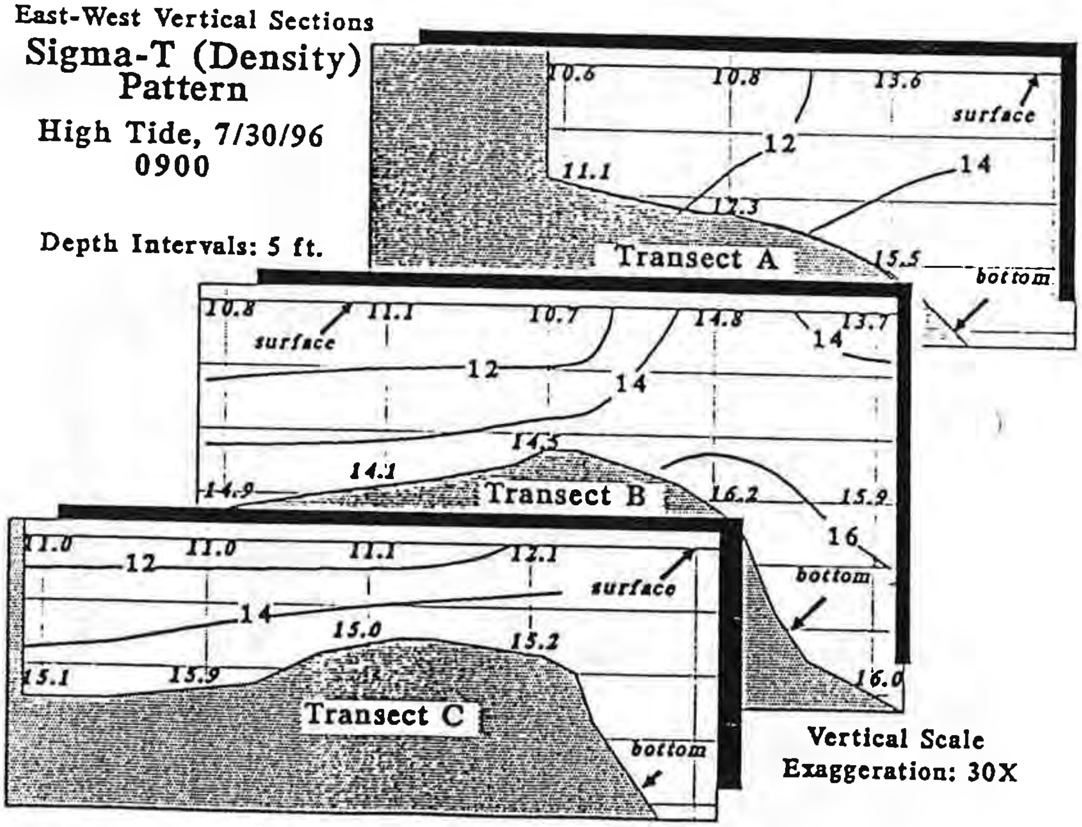
Depth Intervals: 5 ft.



Vertical Scale Exaggeration: 30X

Fig. 13 East-West Vertical Sections Sigma-T (Density) Pattern High Tide, 7/30/96 0900

Depth Intervals: 5 ft.



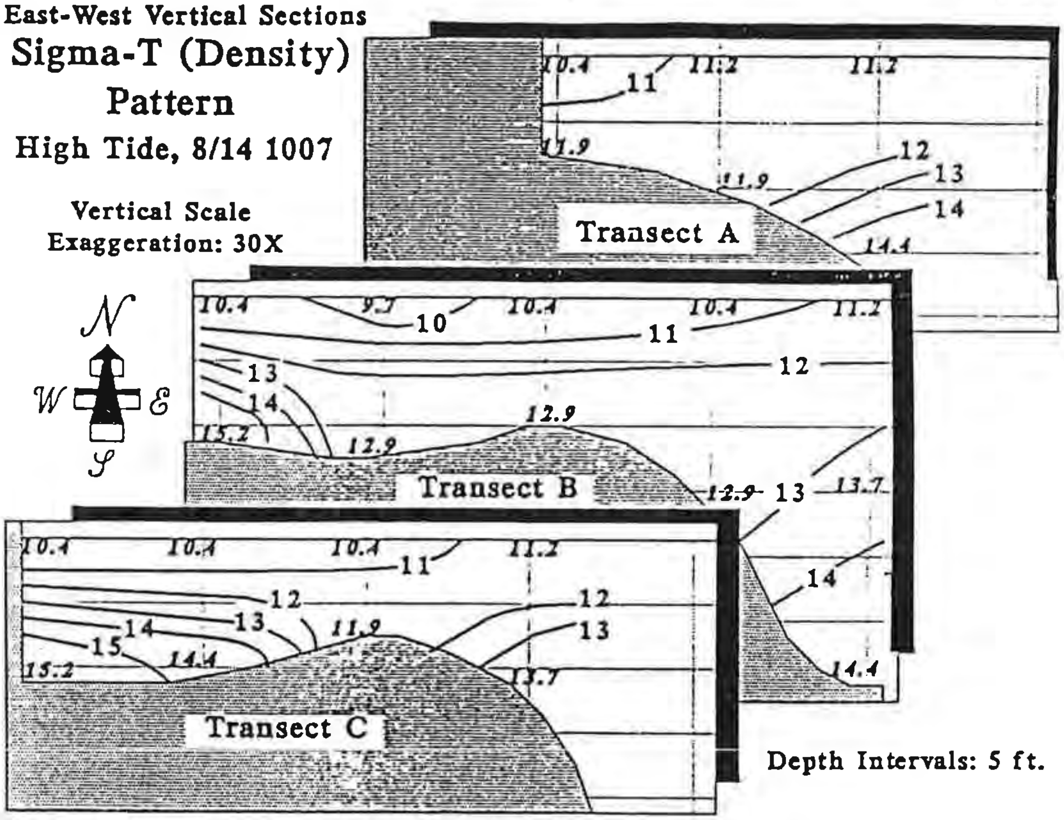
Vertical Scale Exaggeration: 30X

Fig. 14 East-West Vertical Sections

Sigma-T (Density) Pattern

High Tide, 8/14 1007

Vertical Scale Exaggeration: 30X



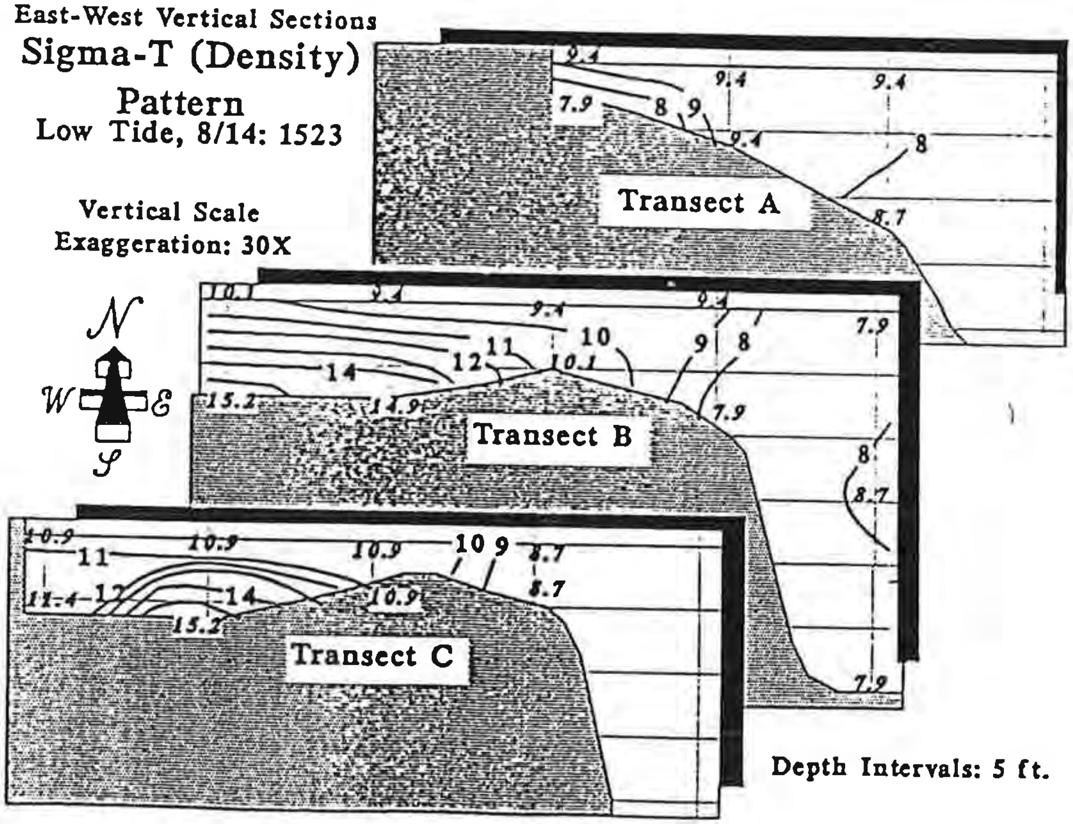
Depth Intervals: 5 ft.

Fig. 15 East-West Vertical Sections

Sigma-T (Density) Pattern

Low Tide, 8/14: 1523

Vertical Scale Exaggeration: 30X



Depth Intervals: 5 ft.

Fig. 16 East-West Vertical Sections

Sigma-T (Density) Pattern

Low Tide, 8/20: 0800

Vertical Scale Exaggeration: 30X

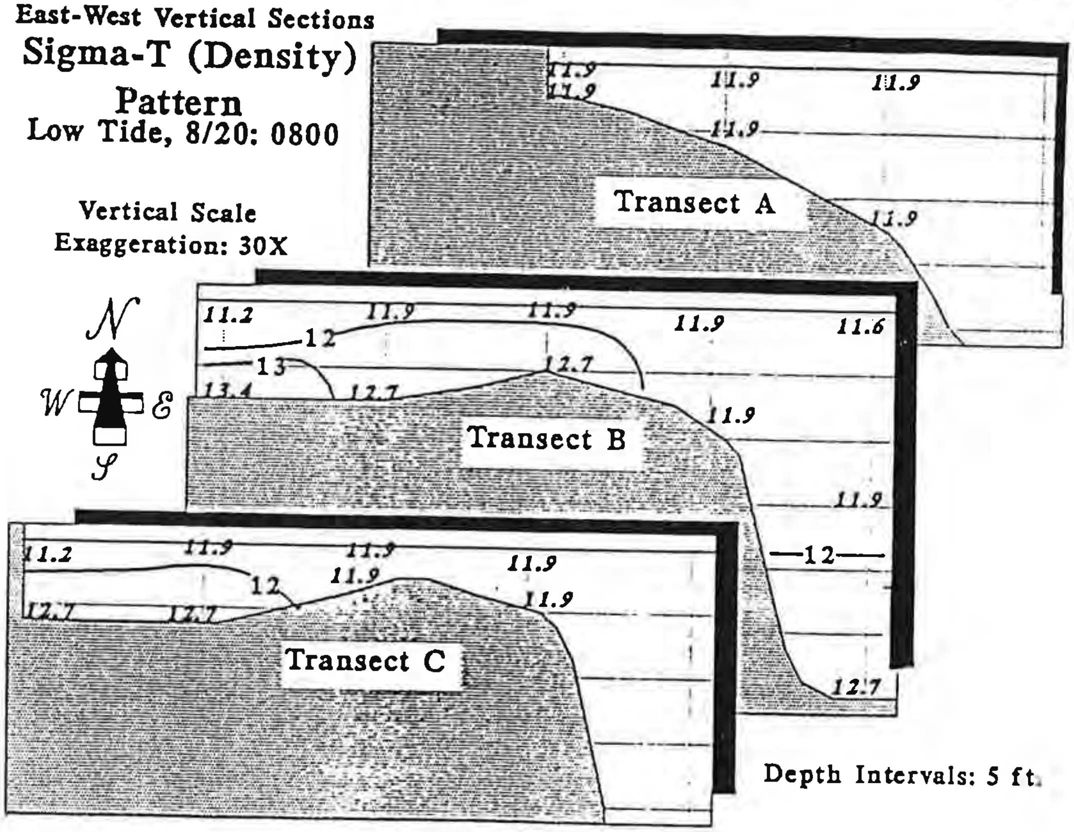
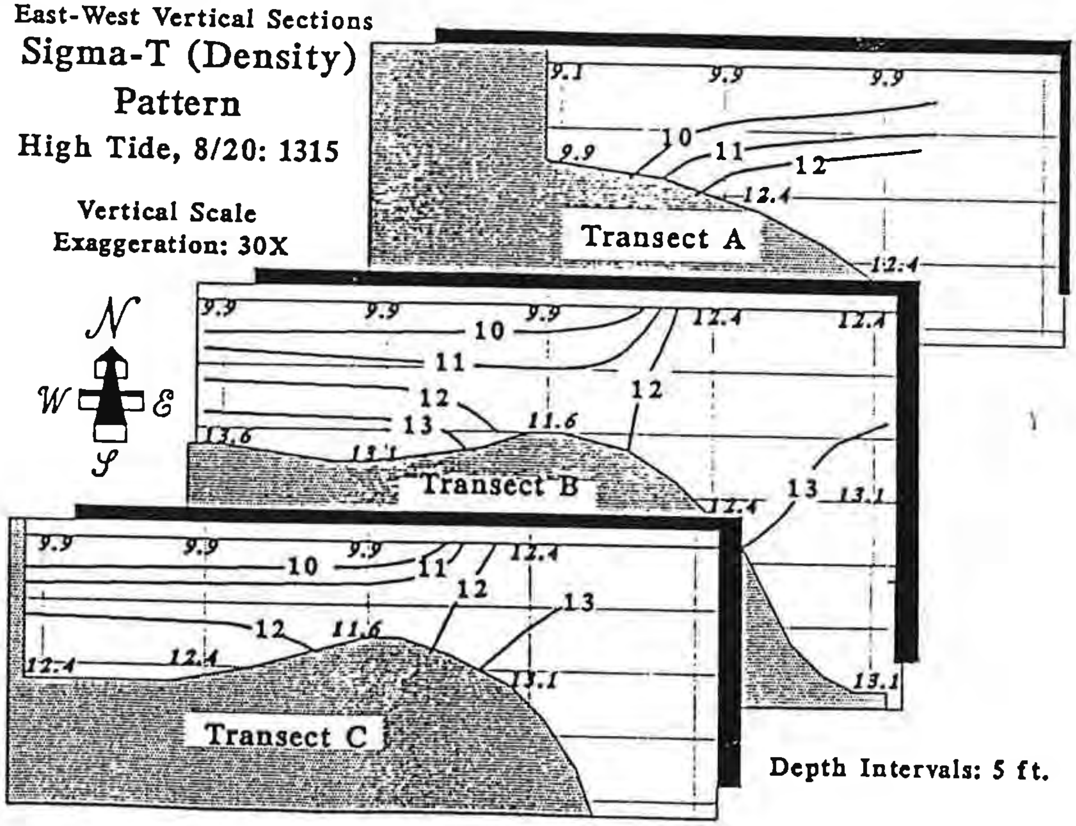


Fig. 17 East-West Vertical Sections

Sigma-T (Density) Pattern

High Tide, 8/20: 1315

Vertical Scale Exaggeration: 30X



Turbidity measurements were made on 7/24, 7/30 and 8/08. The values from 8/08 are suspect, but those from the other two dates are trustworthy. In general, turbidity of bottom water was much higher than surface water. As bottom water was of particular interest, a comparison was made of water from the deep inner stations where low D.O. was detected against all other bottom stations. There was no statistically significant difference ($p>0.05$). In other words, the oxygen-depleted water was no more cloudy than other estuarine bottom water. The oxygen-depleted water did not appear to be "wastewater" (which should be exceptionally turbid and with low salinity), but rather, tidewater that had had extended contact with organic-rich sediments and their oxygen-consuming microbiota in Long Slip Canal (2).

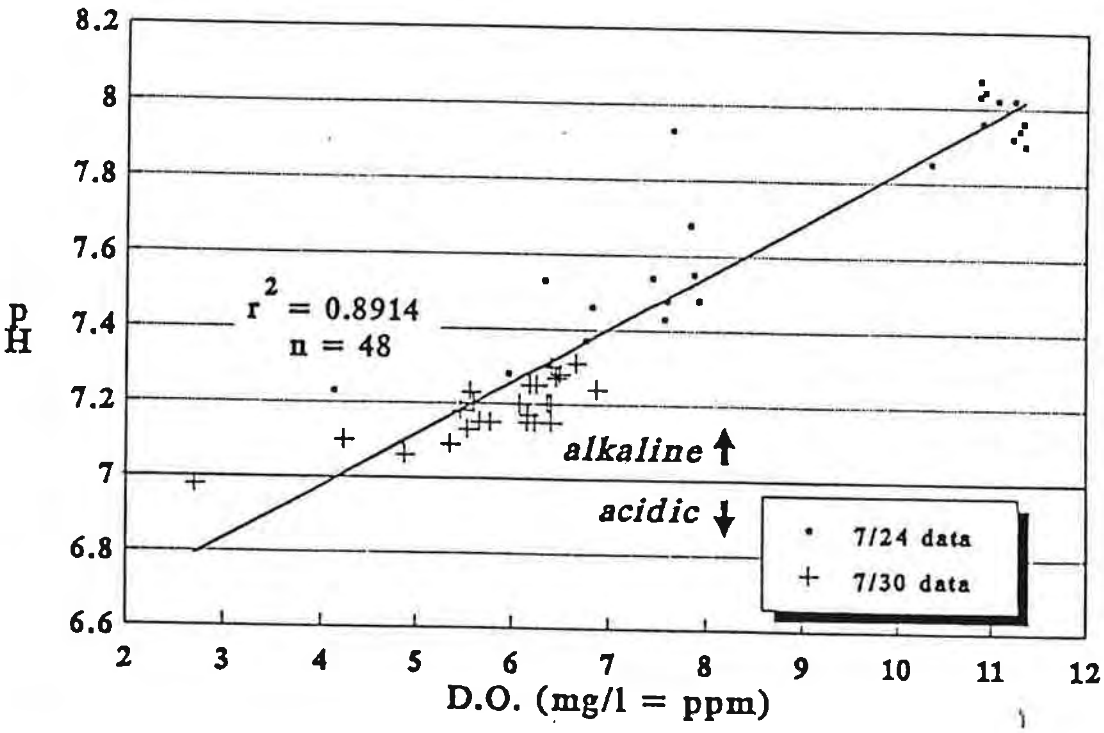
The pattern of pH values strongly suggest that dissolved oxygen concentration is primarily controlled by biological processes (respiration and photosynthesis) during warm weather. Measurements of pH were made on 7/24 and 7/30. When plotted against dissolved oxygen concentration, the two variables proved to be closely related (Fig. 18). Since O_2 itself does not affect pH, this relationship undoubtedly stems from the biological interchange between oxygen and carbon dioxide (which does lower pH). Where photosynthesis drove dissolved oxygen level up and $[CO_2]$ (and its by-product carbonic acid H_2CO_3) down, pH was high (7/24 data). Where respiration drove down D.O., drove $[CO_2]$ (and carbonic acid) up, and pH was low (7/30 data). This suggests that the key to avoiding low D.O. in this environment is to avoid contact with areas of very high organic content and respiratory activity...like the bottom sediments of Long Slip Canal (2,5). No values of pH below 6.95 were measured.

Analysis of the Present Situation

The micro-oxic to anoxic character of Long Slip Canal's waters in summer is well-documented, as is the high oxygen content of its waters during winter and early spring (1, 5). In its present configuration, the canal serves as the receiving water body for two CSOs, one each from the municipalities of Jersey City and Hoboken, depositing organic debris and causing the sediments beneath its western end to have an extremely high organic content (2). Most of the canal's bottom and that of the western end of the waterfront basin into which the canal opens are more than 13 feet deep at mean high water (MHW). These areas are separated from the deep river channel (30+ feet deep) by a shallow hump (11 feet deep or less at MHW). The biota of the canal itself is almost non-existent in summer, grading to depauperate in fall, undoubtedly due to the continuous low D.O. during warm weather (2).

High salinity water (exceeding 20 ppt) can become trapped in the deep bottom of the canal for periods exceeding a full tidal cycle, exposing it to anaerobic sediments with high microbial activity for more than six hours at a time, thus rendering it severely oxygen-depleted. This oxygen-poor, high salinity water is prevented from mixing with overlying water by strong density gradients that form as a result of tidal salinity fluctuations in the river and probably exacerbated by the discharge of fresh water from the two CSOs in the canal and an additional Hoboken CSO discharging directly into the waterfront basin. The flow patterns of the two canal outfalls is not known, but the waterfront basin discharge appears to be continuous, if small, even during dry weather. Bottom contours allow the low-D.O., saline water from the canal bottom to spread out over the western part of the waterfront basin and southward through the piling field, but prevent drainage eastward toward the

Fig. 18 Dissolved Oxygen vs. pH
Waterfront Basin Data: 7/24-7/30/96



river basin. The result is an extremely depauperate benthic community in the canal and western waterfront basin (2), and a degraded habitat for fish (1, 2) that probably includes at least part of an otherwise valuable piling field.

High flows from the canal's two CSOs during wet weather appear to create episodes of undesirable waste solids deposition and floatables discharge into the canal, but they also seem to temporarily break down the salinity stratification and bottom stagnation that characterizes dry weather conditions by simply flushing out the high salinity water (4).

During cool weather, the slowing of microbial oxygen consumption allows D.O. levels to approach saturation in the waterfront basin (3) and even in the canal itself (1, 5), where New Jersey SE-2 estuarine water quality standards are easily met during winter and spring. This slowing of oxygen consumption, however, allows organic matter inputs from the CSOs during cold weather to accumulate rapidly in canal sediments, producing a backlog of labile material to be oxidized when warm temperatures resume (5). Long, narrow canals have inherently poor circulation. Added to this that Long Slip's bottom is deeper than anything else around it and that stratification due to short-term salinity changes is characteristic of this reach of the Hudson Estuary, this situation is primed for anoxia as the temperature rises.

Aside from the low D.O. issue, there is the possibility that contamination of sediments with anthropogenic toxins could negate restoration efforts. Unfortunately, the level of toxic contamination of sediments in the waterfront basin is unknown. Sediment testing in the western third of Long Slip Canal have turned up moderate levels of contamination with lead, copper, zinc, arsenic and various aromatic hydrocarbons, but no detectable PCBs and only traces of chlorinated hydrocarbons. TCLP (leachate) tests with these sediments met New Jersey ID-27 criteria for non-hazardous industrial waste (5). Since this part of the canal is scheduled for closure by this project, the data has no direct bearing on the waterfront restoration project, except that it probably represents a worst case situation locally, as all sites sampled lie directly between the two CSOs that discharge into the canal.

Perhaps of greater relevance to possible sediment contamination issues is a more widespread and intensive survey of sediment toxicity in the entire Hudson-Raritan Estuary (6). In this study sediments from locations throughout the estuary were tested both for their toxicity toward amphipods, bivalves and bioluminescent bacteria, and analyzed for a full range of organic and metallic contaminants. Polynuclear aromatic hydrocarbons (PAHs) appeared to be contaminants most clearly correlated to toxicity toward amphipods and bacteria. Sediments from the lower Hudson River, while clearly contaminated, were among the *least* toxic in the estuary. Most tests, in fact, showed sediments from the first 18 mi. of the river (the Battery to Dobbs Ferry) to be non-toxic. These results suggest that well-planned and executed habitat restoration is likely to succeed on the Hudson River waterfront without interference from residual environmental toxicity. This would not be the case in the East River or Newark Bay, both of which contain highly toxic sediments.

Proposed Alterations and Water Quality Improvements

Proposed waterfront alterations include closure of at least the western half of Long Slip Canal, re-routing of two CSOs now emptying into the canal, and deepening of the outer waterfront basin so as to break through the saddle-shaped hump that now restricts bottom circulation. This will substantially improve the water quality during warm weather; it will shut off the source of de-oxygenation from contact with waterfront basin water and will allow bottom water to exchange freely with the river basin during each tidal cycle, thus preventing stagnation. Comparison of continuous records of D.O. from the North Piling Field in the waterfront basin against that from an underpier site in a more exposed waterfront site in Hoboken (3), suggests that the obvious depression of D.O. attributable to the canal begins in mid-June and becomes most severe from mid-July through September. This latter period is when the proposed alterations should have their most dramatic effect on water quality. Using the Hoboken underpier data (3) and a previous multi-site NJ survey (1) as guides, well-flushed bottom areas in this reach of the Hudson should produce minimum D.O. values of no less than 4.0 ppm during late summer, with average values of 5.0 or more. This is a feasible target value for the proposed alterations. The minimum values for the Long Slip Canal and the bottom sites in the adjacent waterfront basin in its present configuration have ranged from 0.0 to 2.5 ppm (1, 3, 4, 5). The average value during July and August 1994 around the north piling field was about 3.0 (3). These are all well below the DEP minimum standard (4.0 ppm) and below levels tolerated by most fish species.

Proposed Alterations and Fisheries Consequences

GENERAL CONSIDERATIONS

What kind of fish inhabit the shallow margins of the Hudson River and what environmental resources do they depend upon? How do Long Slip Canal and its adjoining waterfront basin compare with other areas with respect to providing those resources? How will the proposed project change the resource situation there?

During a 1994 spring-summer trapping study (3), 76% of the fish caught in waterfront habitats during in this region of the Hudson Estuary were accounted for by four species: striped bass, black sea bass, tomcod and winter flounder. Tomcod dominated catches in early summer (mid-May to mid-July), while striped bass and black sea bass became dominant from mid-July to mid-September. Virtually the entire catch of all of these fish consisted of young-of-the-year (YOY) juveniles. While trap design used and seasonal timing of this investigation probably skewed catches toward smaller size fish, this result indicates that shallow waterfront areas in this reach of the river are utilized heavily by a variety of fish as an estuarine nursery. Tautog were a minor component of the catch, accounting for less than 1% of the total. A total of nineteen species were collected.

Results of an earlier study (1982-83) using multiple collection methods may on a year-round basis be less skewed with regard to size (1). These results suggest that juveniles indeed accounted for most of the fish in shallow waterfront habitats. Both YOY and older juvenile striped bass predominated in shallow waterfront areas during most of the year, although adults or sub-adults were always present. Tomcod adults were abundant in every season except summer, but juveniles appeared there in spring only. Juvenile winter flounder were present in all seasons, with YOY individuals evident in summer. Juvenile American shad were present in all seasons but summer, YOY shad appeared in fall, and one adult appeared in spring. American eels of intermediate juvenile sizes (yellow eels) were present in all seasons except summer. White perch ranging from YOY to adult were also present in all seasons, but rarest in summer. Twenty fish species were collected in this study (see Appendix for details of this study and comparison with the 1994 study).

The preponderance of juveniles of most species in these habitats suggests that the principal beneficiaries of habitat improvement in the Long Slip waterfront area will indeed be juveniles, not catch-worthy adults...at least not immediately. The waterfront area now functions essentially as an estuarine nursery area, and habitat improvements will create an improved nursery area...not a fishing hole where you are guaranteed to get the big ones. Some big ones will undoubtedly come in, as they were shown to do in 1982-83, but the whole point of a nursery area is to provide a refuge for juveniles from large predators like adult striped bass and white perch.

Just south of the North Piling Field, trap collections yielded substantial numbers of juvenile fish <u>and</u> even more numerous sand and mysid shrimp (3)...preferred food resources for most of the fish species present (see Appendix). Although oxygen minima were quite low in summer (<2 ppm), these fish and crustaceans remained abundant, and caged tautog and winter flounder actually grew here (3). This growth, together with the abundance of such oxygen-sensitive fish as juvenile striped bass and tomcod (see Appendix) here seems paradoxical unless you realize that the experiments used to determine D.O. sensitivity exposed fish to continuous low oxygen concentrations whereas the D.O. pattern at the piling field site was cyclical, varying as much as 3 ppt with each tidal semi-cycle. Tidal D.O. minima were likely associated with Long Slip bottom water moving out of the canal. This apparently good biological condition despite D.O. the minima poses a question about whether increased D.O. resulting from planned basin alterations will really improve the habitat for fish and their food resources. The authors of the 1994 study suggest that such improvements will indeed help: "...for species susceptible to poor water quality and habitat degradation, habitat restoration projects for juveniles may yield long-term benefits and allow increased yields as great as those realized by reducing overfishing." (3).

STRIPED BASS, TOMCOD and WHITE PERCH

Striped bass and tomcod certainly qualify under this statement. Juveniles of both of these anadromous species had migrated down from upstream spawning areas in the months following hatching (3,7). As for susceptibility to poor water quality, feeding and growth in juvenile tomcod are known to be inhibited at D.O. concentrations below 7 ppm and temperatures above 24°C (8). While striped bass can tolerate habitats with D.O. values as low as 2 to 3 ppm (9), other evidence suggests they may prefer more oxic habitats. Well-maintained deep interpier zones have been shown to harbor larger populations of striped bass than shallow areas where siltation had occurred (10). In all probability, this is true because accumulated silt forms humps and sills that block good bottom circulation and encourage areas of oxygen depletion as in the Long Slip Canal waterfront basin. Removing the silty hump in this case will attract more striped bass as a result of higher D.O. Given the similarity in their life history, ecology and local migratory habits, the same may also be true of the white perch.

Indeed, striped bass are likely to be the primary beneficiaries of water quality improvements in the case of the proposed habitat improvement program because of the timing of their residence in this location. In 1994, juvenile tomcod dominated catches between May and early July, vacating shallow water habitats just as D.O. minima were becoming severely depressed and before temperatures reached 24° (3). This species appeared to vacate all shallow sites at this time , not just the Long Slip waterfront (NJ piling field) site. As the D.O. varied considerably from site to site, I speculate that temperature, not minimum D.O., was the deciding factor in this migration. The lowest D.O. levels in the Long Slip area, and those most different from sites with better circulation, occurred later in the summer, when tomcod were scarce at all shallow locations (mid-July to September). Improved circulation resulting from the proposed modifications of the waterfront basin would be expected to have its greatest effect on D.O. during this latter period, when striped bass dominate the shallows.

As most of the striped bass occurring in the Hudson probably belong to the local (non-migratory) population, the benefit of improved habitat will accrue primarily to that local population, i.e. it will not be substantially "diluted" by entry of local fish into far-ranging migratory stocks. Any benefit accrued to tomcod and white perch will also be reflected locally, since the local stocks are confined to the Hudson River. Benefits for these fish should become apparent within a short period, as these are all relatively fast-growing species.

TAUTOG and CUNNER

The situation with tautog and cunner are very different from that of the two previous species. These are temperate ocean reef fish that inhabit inshore waterfront areas only in the warm season, migrating to rock outcrops and other reef-like structures in deeper water during winter (11). They both require the shelter provided seaweed and pilings in the waterfront basin, particularly at night and during periods of stress (12). Unlike striped bass and tomcod, whose diets are rather broad (13, 14), tautog depend heavily on one prey species, the blue mussel, *Mytilus edulis* (12). Cunner eat this same mussel, but are less dependent upon it. Thus a good habitat for both fish, but tautog in particular, should include healthy mussel beds. The vertical concrete walls of the canal and waterfront basin did not have a healthy mussel population in 1994. Presumably as a result of poor water quality during the June-July peak period for local settlement of *M. edulis* (15), only a few small specimens were found in late fall (2): hardly the kind of population necessary to maintain a tautog population. Unfortunately, the piling fields in the basin were not investigated. Old pilings encourage mussel beds, but it is not known if there are good mussel populations specifically in the Long Slip waterfront basin. Increased circulation is likely to improve the potential of this waterfront basin for mussels by improving water quality and increasing planktonic food supply. This potentially should favor the tautog population.

The planned installation of an armored dike to close off the canal entrance should also favor tautog by providing more hard surface for mussel attachment by providing more of the crevices needed for shelter by tautog and cunner alike.

In addition to improving food resources and dissolved oxygen availability, increased circulation may favor tautog by reducing inter- and intra-specific competition pressure on juvenile tautog (12). However, these improvements may not yield immediate results, or any results. Tautog populations have been on the decline for several years for unknown reasons. Long-period natural population cycles or overfishing could be causing the observed decline just as readily as limitation of summer habitat. If suitable summer habitat is not the limiting factor, increasing that habitat by water quality improvements may have no effect on this fish stock, and yield no measurable change in the numbers of these fish in the Long Slip waterfront.

If, on the other hand, habitat is the limiting factor, the proposed waterfront improvements will clearly be beneficial to these two wrasses. The benefits will be evident locally, as neither species migrates far from the Hudson estuary, but it may take some time to become evident, as these are both slow-growing fishes.

WINTER FLOUNDER

This fish is another known to be sensitive to low oxygen, and more vulnerable than others to low D.O. associated with salinity stratification because of its strictly demersal habits (it never leaves the bottom). It is abundant in shallow areas in summer, when increased circulation is likely to provide the most benefit. Winter flounder eat primarily worms, clams and coelenterates, so food availability will not necessarily be affected by improved circulation; worms and clams are already moderately abundant (2). The winter flounder population is local and its growth is moderately fast, so improvement is likely to be evident fairly soon.

BLACK SEA BASS

Improved habitat will probably make the Long Slip waterfront more attractive to this species. This is another fish that, like tautog and cunner, prefers structured (reef-like) environments. Benefits to this population, however, are likely to be too diluted to detect, as the black sea bass in the Hudson belong to a large single migratory stock that extends from Cape Cod to Cape Hatteras. Furthermore, this stock seems to undergo long-period cycles in abundance that may have little to do with nursery habitat. While quite abundant in 1994 (3), it was entirely absent in 1982-83 (1).

BAY ANCHOVY and AMERICAN SHAD

Anchovies and American shad mid-water fish that will probably experience little benefit from improved bottom conditions in a waterfront area.

AMERICAN EEL

Eels are sensitive to low oxygen concentrations, so habitat improvements that raise bottom D.O. levels are likely to benefit these fish when present. Because of their peculiar life history (see Appendix), however, the benefit will not be to the most sensitive stage in their life cycle (generally recruitment from the larval stage). In fact, eels caught in these waterfront areas in 1982-83 were all large specimens (10" or more) not more vulnerable elvers (see Appendix), so there is not likely to be any impact on the stock (which includes the entire species) or on the Hudson river migrant sub-population.

SPAWNING HABITAT

The only fish species mentioned which are likely to spawn in the Long Slip waterfront basin are tautog and cunner. Other species spawn in the ocean, lower estuary, or upriver. The eggs of these wrasses are bouyant and are broadcast into currents to drift with the plankton. As such, they do not require a specific type of substrate, nor are they particularly sensitive to bottom water quality unless they happen to drift into a de-oxygenated bottom area. Wrass eggs (species unidentified) have been found in abundance in Long Slip Canal (2). Waterfront habitat restoration in general will thus not improve spawning habitats for major fish species.

CONSTRUCTION ACTIVITIES

One consideration that must be made regards the immediate impact of construction activities upon the waterfront basin habitat. The waterfront basin's bottom is covered with fine-grained silt (2), which is easily disturbed to create turbid water conditions. The animals that live there are well-adapted to temporary bouts of turbidity, otherwise they would not be living in such a muddy environment. However, extended periods of turbidity could be detrimental. Larval and juvenile fish are particularly sensitive, as most hunt by sight during daylight, and visibility can be severely impaired by suspended mud. Extended periods of turbid water can thus lead to starvation. Every effort should therefore be made to avoid creating extended periods of daytime turbidity, especially between April and October, when juveniles of most species are most abundant and active.

In summary, the proposed canal closure and waterfront alterations will improve tidal circulation within the waterfront basin, including the piling field and prevent entrapment and stagnation of high salinity water leading to anoxia or near-anoxia. The improvements will be most dramatic during mid to late summer, when migratory young-of-the-year striped bass are likely to be the principal beneficiaries. Conditions may be marginally improved earlier in the summer for migratory young-of-the-year tomcod, and potentially also for tautog during the entire summer, if their dwindling numbers are really habitat-limited. White perch and winter flounder are also expected to benefit. Extended daytime turbidity due to construction must be avoided.

REFERENCES

1. Andrews, W. 1984. Inventory of the Fishery Resources of the Hudson River. Final Report to the NJ DEP, Division of Fish, Game and Wildlife, Marine Fisheries Administration, Nacote Creek Research Station.

2. Guida, V. G., D. Zeroka and A. Choudhury. 1995. Biological Baseline Study of Long Slip Canal. Final Report to Frederic R. Harris, Inc., project no. 10-2758-03.

3. Able, K. W., A. L. Studholme and J. P. Manderson. 1995. Habitat Quality in the New York/New Jersey Harbor Estuary: An Evaluation of Pier Effects on Fishes. Final Report to the Hudson River Foundation.

4. Lawler, Matusky & Skelly Engineers, LLP. 1996. Hoboken Rail Yard Long Slip Canal Habitat Creation Project Water Quality and Bathymetric Surveys. Report to New Jersey Transit. Project # 694-006 under subcontract to Dames & Moore. Pearl River, NY.

5. Frederic R. Harris, Inc. 1995. Long Slip Canal Sediment and Surface Water Sampling. Draft Final Technical Memorandum to New Jersey Transit. NJT No. 92-CG-0024B-23.R2. Iselin, NJ.

6. Long, E. R., D. A. Wolfe, K. J. Scott, G. B. Thursby, E. A. Stern, C. Peven and T. Schwartz. 1995. Magnitude and Extent of Sediment Toxicity in the Hudson-Raritan Estuary. NOAA Tech. Memorandum NOS ORCA 88. NOAA Coastal Ocean Office, Silver Spring, MD.

7. Dew, C. B. and J. H. Hecht. 1994. Hatching, estuarine transport, and distribution of larval and early juvenile Atlantic tomcod, Microgadus tomcod, in the Hudson River. Estuaries 17(2):472-488.

8. Grabe, S. A. 1978. Food and feeding habits of juvenile Atlantic tomcod, Microgadus tomcod, from Haverstraw Bay, Hudson River, New York. U.S. Natl. Mar. Fish. Serv. Fish. Bull. 76:89-94.

9. Coutant, C. C. and D. L. Benson. 1990. Summer habitat suitability for striped bass in Chesapeake Bay: Reflections on a population decline. Trans. Amer. Fish. Soc. 119(4):757-778.

10. Cantelmo, F. R. and C. H. Wahtola, Jr. 1992. Aquatic habitat impacts of pile-supported and other structures in the lower Hudson River. pp. 59-75 in: W. Wise, D. J. Suszkowski and J. R. Waldman (eds.). Proceedings: Conference on the impacts of New York Harbor development on aquatic resources. Hudson River Foundation, N.Y.

11. Olla, B. L., A. J. Bejda and A. D. Martin. 1979. Seasonal dispersal and habitat selection of cunner, Tautoglabrus adspersus and young tautog, Tautoga onitis, in Fire Island Inlet, Long Island, New York. U.S. Natl. Mar. Fish. Serv. Fish. Bull. 77:255-261.

12. Auster, P. J. 1989. Tautog and Cunner. Species Profiles: Life Histories and Environmental Requirements of Coastal Fishes and Invertebrates (North and Mid-Atlantic). Biological Report 82(11.105) U.S. Dept. of Interior, Fish & Wildlife Service

13. Gardinier, M. N. and T. B. Hoff. 1982. Diet of striped bass in the Hudson Estuary. NY Fish Game J. 29(2):152-165.

14. Grabe, S. A. 1980. Food of age 1 and 2 Atlantic tomcod, Microgadus tomcod, from Haverstraw Bay, Hudson River, New York. U.S. Natl. Mar. Fish. Serv. Fish. Bull. 77:1003-1006.

15. Seed, R. 1976. Ecology. Ch. 2, pp. 13-65 in: B. L. Bayne (ed.), Marine Mussels: Their Ecology and Physiology. Cambridge Univ. Press, London

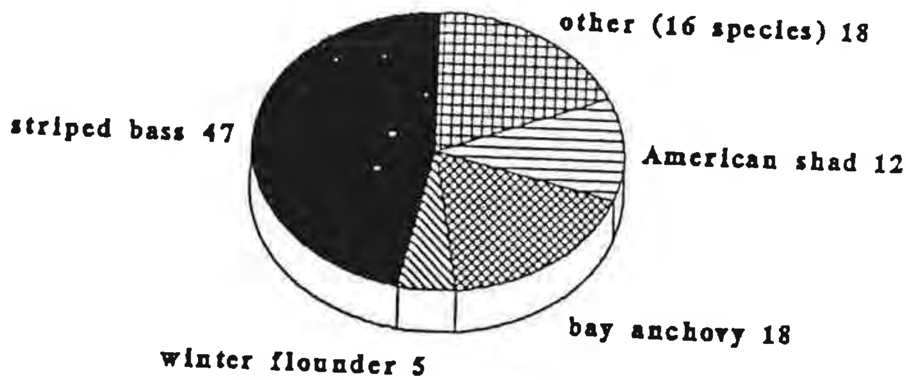
APPENDIX

ECOLOGY OF THE MAJOR FISH SPECIES OF THE WATERFRONT MARGINS
OF THE HUDSON RIVER: RIVER MILE 1.5 TO MILE 5.0

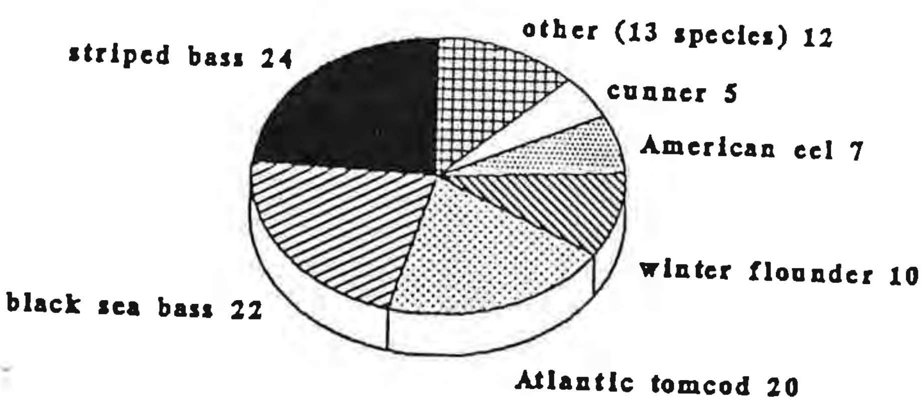
Most Abundant Fishes: Nearshore Sites
Lower Hudson River Waterfront

Comparison of selected shallow waterfront collections from multigear, all-season study on NJ side only in 1982-83 (Andrews, 1984) with trapping study done at comparable sites on both sides of River in spring-summer 1993-4 (Able et al., 1995)

Andrews, 1984



Able et al., 1995



Synopsis of Fish Capture Data Derived from Andrews, 1984

Sizes ranges of selected species of fish captured by otter trawl and trap net from the following stations (combined station data):

TN3 & T12: Jersey City, Pier 224, Essex Street, River Mile 1.5
T13: Hoboken, Erie-Lackawanna (Long Slip) Canal, River Mile 2.0
TN4 & T16: Hoboken, Stevens Institute, Pier 190, 5th St., River Mile 2.6
TN6: Weehawken, Interpier, Arcorp Development, River Mile 4.9
T18 & T19: Weehawken, Interpier, River Mile 5.0

Species	Upper Size Limit for		Size Ranges Captured (mm) in			
	YOY	Juvenile	Winter	Spring	Summer	Fall
striped bass	100	300	55-167	71-273	134-328	61-280
Atl. tomcod	77	77	136-283	26-240	137	150-182
Wint. flounder	70?	??	119-180	72-166	49-140	none
bay anchovy	60	60	33-41	73	58-95	none
Amer. shad	??	300	81-98	117	none	72-90
Amer. eel	60	900?	274	254-508	none	457-762
white perch	90	166	61-210	65-260	182	66-214

Sizes ranges of selected species of fish captured by gill from the following stations (combined station data):

GN2: Jersey City, Pier 224, Essex Street, River Mile 1.5
GN3: Hoboken, Stevens Institute, Pier 190, 5th St., River Mile 2.6

Species	Upper Size Limit for		Size Ranges Captured (mm) in		
	YOY	Juvenile	Spring	Summer	Fall
striped bass	100	300	244-388	291-318	258-767
Atl. tomcod	77	77	236-260	none	none
Amer. shad	??	300	550	none	none

Striped Bass (<u>Morone saxatilis</u>): ecology (Fay, Nevis & Pardue, 1983 and Hill, Evans & Van Den Avyle, 1989)

<u>General Character</u>: anadromous...coastal ocean and large rivers: estuarine to fresh water, including strictly riverine and land-locked lake populations. Coastal geographic range: St. Lawrence River to Louisiana, British Columbia to Ensenada, Mexico

<u>Life Stages</u>:

ADULT FEMALES SPAWN up to 2 million eggs in nearly fresh to fresh water mid-May to mid-June in first 30 mi. of Hudson: eggs semi-buoyant, non-adhesive, hatch in 29 to 80 h, depending upon temperature.
LARVAL STAGE lasts 1 mo. or more, depending on temperatures
YOUNG OF THE YEAR (YOY) (25 to 100 mm) arrive at downstream sites around July (Able <u>et al</u>., 1995), remain in estuary, esp. nearshore.
JUVENILE males to 300 mm (12", age 2-3), females to 500 mm (20", age 4-5)

ADULTS generally live up to 11 years (can live up to 29 yrs.): may be over 3' long, weighing up to 30 lbs.

<u>Migration</u>: Remain in natal estuary (where hatched) for first 2-3 years, moving downstream and shoreward from spawning areas during first summer. After first three years part of population becomes migratory, moving northward along coast in summer, south in winter, roughly between Cape Hatteras and New England, some entering rivers (including the Hudson) along the way to overwinter ...part remains in vicinity of natal river all year. Most of adult fish in Hudson are of latter type; resident Hudson stock probably self-perpetuating and self-contained. River miles 1.5 to 8.8 (Jersey City to Edgewater) are important overwintering habitat for juveniles (US FWS 1996). Schooling is characteristic of juveniles and smaller adults, but largest adults often found singly or in small groups.

<u>Population Dynamics</u>: Likely most important aspect is generally poor reproductive success with occasional highly successful years, resulting in populations dominated by single year-classes. Environmental suitability during larval stage probably determines the success of each year-class and thus future stock abundance. The Hudson River population is one of four distinct striped bass stocks in the mid-Atlantic region.

<u>Estuarine Habitat Requirements</u>:

SUBSTRATE: Juveniles prefer shallow areas with substrates ranging from rocks to sand...but not soft mud. Adults utilize wider range of substrates, including vegetated areas
TEMPERATURE: Tolerance range generally increases with age: 14-23°C as eggs, 10-27° as larvae and YOY juveniles, 0-30° as adults...pattern follows seasonal temperatures during spawning, development
SALINITY: Optimal range increases from egg to juvenile: 1.5 to 3.0 ppt as egg, 3.4 to 33.7 ppt as larvae (increasing with age by days), 10 to 20 ppt as YOY juveniles, 0 to 33.7 ppt as adults...pattern follows seasonal migration from spawning upriver, larval and juvenile migration downriver, through anadromous adulthood
DISSOLVED OXYGEN: All stages intolerant of D.O. below 3 ppm...optimal range generally over 5 ppm

FOOD/FEEDING: Larvae eat planktonic crustaceans, juveniles up to 200 mm (8")(includes entire YOY range) eat primarily sand shrimp and mysid shrimp, over 200 mm eat primarily other fish, especially anchovies, tomcod and clupeids (herring family fish). Feeding is most active on crepuscular (dawn and dusk) schedule.
CURRENTS: Primary concern is with egg survival: currents necessary to keep eggs from settling and getting smothered on bottom.
TURBIDITY: Striped bass in general are very tolerant of turbid water, though suspended sediment can be detrimental to eggs and larvae.
CONTAMINATION EFFECTS: Monocyclic aromatic hydrocarbons in the single digit mg/l (ppm) range are acutely toxic to juveniles. Single digit ug/l (ppb) levels have been shown to have sublethal behavioral effects. Residual chlorine (from discharge of chlorinated water) were toxic to eggs and larvae in the 40 to 500 ppb range. In 1982, Hudson River striped bass have been shown to have the highest levels of heavy metals, PCBs and other organochlorine residues and poorest bone strength among local stocks. Toxicity of mixed organic and metallic toxicants is influenced by salinity: the higher the salinity, the lower the toxicity.

<u>Population/Fisheries</u> <u>Status</u>: This is the most important of the Atlantic Anadromous Fisheries group as defined by the National Marine Fisheries Service. A severe decline in population throughout the 1970's and early '80's led to a commercial fishing moratorium and the subsequent development of a strong coastwide interstate regulatory program beginning in 1982 that has resulted in increased numbers and catches each year since '89. Co-ordinated management efforts and simultaneous environmental improvement efforts are credited with making this fishery one of the few in the northeast in which the stock level is above the long-term potential yield for that species and for which there is an increasing population trend. Recreational fishing catch for this species is about double the commercial landing (NOAA, 1995).

Atlantic Tomcod (<u>Microgadus tomcod</u>): ecology (Stewart & Auster, 1987)

<u>General Character</u>: anadromous bottom feeder...large riverine estuaries, exclusively in shallow salt, brackish or fresh water. Geographic range: southern Labrador to Virginia

<u>Life Stages</u>:

ADULT FEMALES SPAWN up to 65 thousand eggs in nearly fresh to fresh water in Jan. (often under ice) around mile 42 to 52 in Hudson: eggs are adhesive, sticking to bottom and hatch in Feb. to Mar.
LARVAL STAGE up to 10 mm: swims up in water column to eat plankton, may oscillate up and downstream with salinity fronts (Dew & Hecht, 1994)

YOUNG OF THE YEAR (YOY) (10 to 77 mm) become demersal (living on bottom), move downstream
ADULTS usually live 3 years, occasionally up to 5; maximum length up to 380 mm (15") long, weighing up to 1.3 lbs. (Ross & Biagi, 1991)

<u>Migration</u>: Remain largely within natal estuary (Hudson-inner NY Bight) throughout life, always within 1 mi. of shore, usually in less than 6 m (20 ft) of water. YOY arrive at estuarine waterfront sites in April or May, remain there till mid-June (Able <u>et al</u>., 1995), then leaving, probably for the cooler adjacent river channel and/or south toward Raritan and Sandy Hook Bays, avoiding temperatures >24° C. During summer, adults may move inshore and offshore during high and low tides, respectively. Adults migrate upriver toward spawning grounds in Nov.

<u>Estuarine Habitat Requirements</u>:

SUBSTRATE: All stages inhabit mudflats, marshes and aquatic vegetation beds; eelgrass beds are a preferred habitat, where present
TEMPERATURE: Upper lethal temperature for eggs is 6.6° C. Feeding and growth of juveniles are inhibited >24° C (Grabe, 1978). No tomcod are found at temperatures >26°. Adults can tolerate sub-freezing temperatures during spawning season because their blood contains a glycoprotein "antifreeze" constituent.
SALINITY: Larvae and early stage juveniles generally stay within 1.5 to 10.0 ppt, preferring 4.5 to 8.7 ppt. Later juveniles and adults tolerate 0 to 35 ppt.
DISSOLVED OXYGEN: (early) juvenile feeding and growth is inhibited at D.O. below 7 ppm (Grabe, 1978)
FOOD/FEEDING: larvae eat planktonic crustacea, juveniles and adults are bottom feeders, eating mainly shrimp, but also worms, mollusks, and small fish
PREDATORS: tomcod serve as major diet item for striped bass when herring and anchovies are not abundant: may be critical to striped bass population
CURRENTS & TURBIDITY: no documentation found
CONTAMINATION EFFECTS: no documentation found

<u>Population/Fisheries Status</u>: Population is strictly local...confined to Hudson estuary; this is the southernmost estuary where spawning is known to occur. Since early 1950's, no commercial fishery in the U.S., and only a small one in Canada (St. Lawrence River), but supports a small winter recreational fishery in New England (Ross & Biagi, 1991). Protected in New Jersey under "threatened" status.

Tautog (Tautoga onitis): ecology (Auster, 1989 and Ross & Biagi, 1991)

General Character: Temperate marine, non-schooling reef-dweller, in coastal ocean (to 24 m depth and 12 mi. offshore) and lower parts of estuaries. Geographic range: Nova Scotia to South Carolina.

Life Stages:

ADULT FEMALES SPAWN up to 670 thousand eggs in inshore areas during May to August, peaking in June. Eggs are buoyant and planktonic, drifting freely with currents, hatching within 2 days.

LARVAL STAGE up to 30 mm, last about 3 weeks (Sogard, Able & Fahay, 1992)

JUVENILES up to 20 cm (8") (3 years old)

ADULTS up to 10 kg (22 lb), ranging from 3 to 34 years old

Migration: No long distance migrations. Move generally inshore during spring, offshore in fall, but only to find adequate food and cover seasonally; this fish requires the cover such as rock crevices, seaweed or eelgrass beds during the night and during winter.

Estuarine Habitat Requirements:

SUBSTRATE: Cover required during night and winter: thus rocks, pilings, vegetation or other complex structures are necessary. Juveniles also need shelter during day to escape predators. Vegetated habitats are abandoned seasonally as they become defoliated (Olla, Bejda & Martin, 1979), males set up territories around structured environments to initiate mating activities.

TEMPERATURE: Seek deeper water as temperature falls below 10^{o} C, become torpid below 8^{o}, remaining in shelter throughout the day. Also seek shelter and become inactive when upper sublethal temperatures ($26\text{-}32^{o}$) reached.

SALINITY & DISSOLVED OXYGEN: no documentation

FOOD/FEEDING: feed in intertidal zone during high tide during daytime, often most active at dawn and dusk...diet dominated by blue mussel *Mytilus edulis*, but also eat some clams, crabs, barnacles and other crustaceans

CURRENTS: shifting currents in complex environment may reduce intraspecific and interspecific competition

TURBIDITY: no documentation found

CONTAMINATION EFFECTS: no documentation found

Population/Fisheries Status: The population is local. It had been stable for since colonial times until this decade, when catches began to decline. The cause(s) are unknown, but overfishing is at least suspected. This is a slow-growing, long-lived fish and is thus very susceptible to over-exploitation. While recreational fishing still dominate the catch, commercial exploitation increased dramatically in the 1980's. The additional pressure resulted in reduction of average size of individuals caught, an early sign of over-exploitation. Some states have enacted minimum size limitations in response. Population status is difficult to assess independently of catch data because of the peculiar habitat and feeding habits of this fish: capture methods that work well for other species do not work well for tautog.

Black Sea Bass (<u>Centropristis</u> <u>striata</u>): ecology (Mercer, 1989 and Ross & Biagi, 1991)

<u>General</u> <u>Character</u>: Migratory coastal marine bottom dweller (to 183 m or 600 ft depth), utilizing estuaries as nurseries for juveniles. Geographic range: sub-species <u>C</u>. <u>striata</u> <u>striata</u> from Cape Cod to Cape Canaveral, sub-species <u>C</u>. <u>striata</u> <u>melana</u> along the eastern and northern gulf coast.

<u>Life</u> <u>Stages</u>:

ADULT FEMALES SPAWN up to 1 million eggs in offshore areas during February to July in 18 to 45 m (59 to 148 ft) of water, peaking in early spring. Eggs are buoyant and planktonic, drifting freely with currents, hatching in 1.5 to 4 days.

LARVAL STAGE up to 13 mm, drift inshore

YOUNG OF THE YEAR (YOY) up to 50 mm utilize estuary as summer nursery

JUVENILES age varies: may become adult in as little as 1 year or as much as 4 years.

ADULTS can reach age 10, size 300 mm (12"), weighing 0.5 kg (1 lb.), are largely protogynous hermaphrodites, maturing first as females, then becoming males after 3-5 yrs. A few mature into males directly from the juvenile stage.

<u>Migration</u>: Northern stock travels offshore and south to region of Cape May to Cape Hatteras in winter, overwintering at 73 to 183 m on the continental shelf. Adults move northward and shoreward in spring to reach spawning areas closer inshore on the shelf. Gather around rocky bottoms, wrecks, pilings and wharfs in summer, leaving for offshore and southward migration as early as August. Young-of-the-year have migrated into estuaries by summer, and move offshore later in fall.

<u>Estuarine</u> <u>Habitat</u> <u>Requirements</u>:

SUBSTRATE: Prefer structured environments: rock outcrops, reefs, wrecks, pilings, etc.

TEMPERATURE: prefer 8-10^{o} C in winter, have been taken in water up to 30^{o} C in estuaries

SALINITY: have been collected from 1 to 36 ppt in estuaries, but most often in water >14 ppt

DISSOLVE OXYGEN: no documentation found

FOOD/FEEDING: juveniles eat mainly shrimp and other small crustaceans, adults eat rock crabs, hermit crabs, and some mollusks and fish

CURRENTS: no documentation

TURBIDITY: no documentation

CONTAMINATION EFFECTS: known to concentrate some contaminants, but no toxicity or safety data available

<u>Population/Fisheries</u> <u>Status</u>:

There are two Atlantic stocks: one ranging from Cape Cod to Cape Hatteras, the other from Cape Hatteras to Cape Canaveral. Catches from the northern stock (the source of Hudson River records) have been declining since the early 1960's. It is considered an over-utilized resource whose stock level is below Long Term Potential Yield level (NOAA, 1995)

Winter Flounder (*Pleruonectes americana*): **ecology** (Buckley, 1989 and Grimes *et al*., 1989)

General Character: Coastal marine/estuarine bottom dweller, utilizing estuaries as nurseries for juveniles. Geographic range: Labrador to North Carolina

Life Stages:
ADULT FEMALES SPAWN up to 3.3 million adhesive eggs on sandy bottoms in inshore coastal areas (depth 2 to 80 m) during winter at temperatures of 0 to 3° C. These hatch in 1 to 2.5 weeks, depending on water temperature and salinity
LARVAL STAGE up to 6.5 mm, duration about 2 mos.
JUVENILES remain in estuaries 1 to 2 years
ADULTS live up to 20 yrs. old

Migration: Adults spend winter in shallow coastal and estuarine waters, leaving for deeper water as temperatures exceed 12° C going as far as 3 mi. offshore, returning in fall as temperatures drop. Juveniles remain in estuary 1 to 2 years, moving further offshore as they age. Movements within the estuary are in response to extreme high and low temperatures.

Estuarine Habitat Requirements:
SUBSTRATE: Juveniles prefer sand or sand plus silt substrate.
TEMPERATURE: Certainly 0 to 25° C, possibly to 30°. May burrow into bottom when temperature is high. Juveniles generally more tolerant of high temperatures than adults.
SALINITY: Adults tolerate 5 to 35 ppt.
DISSOLVED OXYGEN: low abundance and reduced growth associated with poorly oxygenated waters (no numbers given) (Howell & Smith, 1991)
FOOD/FEEDING: Diet is primarily of worms, mollusks, coelenterates, fish eggs...primarily visual hunters, feeding throughout the daylight hours, but are inactive at night. Capture prey by lying still in wait, then lunging.
CURRENTS & TURBIDITY: no documentation
CONTAMINATION EFFECTS: fin rot disease occurs more frequently (up to 16% incidence) in polluted areas than in unpolluted areas (3%) in the NY Bight. Summer mortality was increased by contact with oiled sediments, and feeding rates were significantly reduced. Chlorinated hydrocarbon insecticide products (DDT, DDE, heptachlor, heptachlor epoxide and dieldrin), presumably from agricultural runoff, were found in tissues of flounder in Massachusetts. This contamination is reported to result in high mortality there.

Population/Fisheries Status: Population is local (Hudson Estuary). Groundfish and flounder stocks in the northeast were declining rapidly in the 1960's and early 70's. This decline was halted by the restriction of international fishing in the mid 70's, but resumed in the mid-80' and continued till the present despite management efforts. Winter flounder are considered an over-utilized resource below the long-term potential yield.

Bay Anchovy (*Anchoa mitchilli*): ecology (Morton, 1989)

General Character: Schooling coastal/estuarine planktivorous forage fish: among the most abundant of fishes. Geographical range: Atlantic and Gulf Coasts, Cape Cod to Yucatan

Life Stages:
ADULT FEMALES SPAWN in mid-water from May to September, during the evening. Eggs are buoyant, hatch in about 1 day
LARVAL STAGE to 16 mm
JUVENILES to 60 mm
ADULTS

Migration: In Hudson, juveniles and possibly adults move upstream from Manhattan to freshwater (Tapan Zee Bridge: mile 25) to feed as temperature approaches 10^{o} C in Spring, then mature fish move back down to 10 ppt area to spawn as water approaches 15^{o}. Larvae move upstream to mile 40 from June to August, then most resulting juveniles move downstream toward lower estuary and open coastal ocean in August and September, while a few continue upstream. All sizes vacate shallow water for deeper bays in winter.

Estuarine Habitat Requirements:
SUBSTRATE: ubiquitous distribution: substrate of no apparent consequence...found in all types of habitats
TEMPERATURE: 2.2^{o} to 27.1^{o} C in Hudson
SALINITY: 0 to 35 ppt, prefer 9 ppt or greater for spawning
DISSOLVED OXYGEN: no documentation found
FOOD/FEEDING: primarily copepods in young, copepods and mysid shrimp in older individuals, with occasional mollusks and fish larvae. These fish selectively capture even planktonic prey, rather than straining them out of the water non-selectively. Larvae are very susceptible to starvation in the first 6 days after hatching: must planktonic food patch
PREDATORS: anchovies are among six forage fish species that constitute most of the diet of the striped bass
CURRENTS & TURBIDITY: no documentation found
CONTAMINATION EFFECTS: no documentation found

Population/Fisheries Status: Population is probably local: no information is available on population trends. Commercial fishing is very limited...utilized to make anchovy paste and for bait.

American Shad (Alosa sapidissima): ecology (Stier & Crance, 1985)

General Character: Schooling anadromous fish. Geographic distribution: St. Lawrence River to Florida, Alaska to Mexico on Pacific coast.

Life Stages:

ADULT FEMALES SPAWN up to 659,000 eggs in freshwater...can spawn repeatedly in northern waters. Eggs are semi-buoyant and only temporarily adhesive.
LARVAL STAGE planktonic larvae last till 28 mm length: 4-5 weeks
JUVENILES to 300 mm (12") for males, 383 mm (15") for females: duration a minimum of 2 years, average around 4 years
ADULTS can live to be 11 years old and 584 mm (23") long.

Migration: Adult shad move upstream in spring to freshwater reaches of river and into natal tributary streams to spawn, then move down to the ocean during the summer and early fall, where they congregate and migrate southward. As the water warms in early spring, they move northward along with the 3° C isotherm, back to their respective natal rivers. Larvae and juveniles move downstream after hatching and may remain in the estuary for the entire first year or go directly out to sea. Non-spawning adults have been found 110 miles from the coast in up to 230 m (754 ft) of water.

Estuarine Habitat Requirements:

SUBSTRATE: primarily of concern for spawning in freshwater: require broad sand to gravel flats
TEMPERATURE: Spawning adults: 8°-26° C, preferably 14°-21°; eggs & larvae: 15.5°-26.0°; juveniles: 6°-31° C
SALINITY: Adults tolerate 0 to 35 ppt, but require some time to adjust to changing salinity as they move upriver. Eggs and larvae may tolerate up to 15 ppt salinity.
DISSOLVED OXYGEN: 5 mg/l or above necessary in spawning area, juveniles lose equilibrium below 3.0 mg/l, die below 2.0 mg/l; some mortality even below 5.0; similar for adults
FOOD/FEEDING: Larvae and juveniles eat aquatic insects and crustaceans, primarily from the water column rather than from the bottom or water's surface. Adults strain zooplankton from the water with their gill rakers, but do not feed during the spawning run upriver. Finding adequate food for larvae may be critical stage in development, when populations is susceptible to starvation.
CURRENTS: primarily of concern for spawning in freshwater: require sufficient current to prevent eggs from settling and being smothered
TURBIDITY: larvae are not very tolerant of suspended sediments: concentrations >100 ppm reduce survival.
CONTAMINATION EFFECTS: no documentation found

Population/Fisheries Status: Population is native to Hudson River. This is the second largest of the Atlantic Anadromous Fisheries as defined by NMFS. It has declined substantially in recent years, probably to a large extent due to non-fishing activities of mankind, including the interruption of spawning runs by creating areas of poor water quality, damming of streams and environmental pollution. The species is considered over-utilized and below the level of long-term potential yield (NOAA, 1995).

American Eel (<u>Anguila</u> <u>rostrata</u>): ecology (Facey and Van Den Avyle, 1987)

<u>General</u> <u>Character</u>: Catadromous (ocean-spawning) migrant bottom-dweller. Geographical range: Atlantic and Gulf Coasts: Greenland and Labrador to Panama, Greater and Lesser Antilles, northeast coast of South America

<u>Life</u> <u>Stages</u>:

ADULT FEMALES SPAWN up to 8.5 million eggs in upper few hundred meters of the Sargasso Sea (mid-Atlantic, south of Bermuda) during February to April. Adults presumably die after spawning. The incubation period is unknown, but may be about 1.5 to 2 days, based on data from the Japanese eel (<u>Anguila</u> <u>japonica</u>)

LARVAL STAGE called *Leptocephalus* is unpigmented and transparent and remains as larvae for about 8-12 mos., reaching 55-65 mm (2.2"-2.6") length.

JUVENILES called "glass eel" and "elver" stages while unpigmented or partially pigmented, "yellow eels" as they attain full pigmentation, grow to up to 1270 mm (4'2") and weigh up to 4.5 kg (9.9 lb.).

ADULTS "silver eels" develop at age 3 in males, age 4 to 7 in females, undergoing a number of physiological changes to prepare for their ocean spawning migration

<u>Migration</u>: Northeastern adult eels begin migration from freshwater streams in late summer and early fall...may develop silver eel characteristics after starting the seaward migration, reaching the spawning grounds in winter along with American eels from all other rivers. The shoreward migration of *leptocephali* from the Sargasso Sea requires 8 to 12 mos., so that their arrival in the estuary occurs during the next winter or spring, just as they begin to metamorphose into glass eels. At this stage (peaking in spring) they begin a slow upstream migration, often changing to yellow eels before arriving at their destination. Some remain in estuaries, even as yellow eels. The hypothesis was that these estuarine eels were all males and the freshwater migrants all females, but this has proven not to be true.

<u>Estuarine</u> <u>Habitat</u> <u>Requirements</u>:

SUBSTRATE: Postlarval eels are bottom dwellers that prefer structured environments, hiding in crevices, among vegetation or burrowing into the substrate. Mud is favored by migrating eels and by overwintering individuals that bury themselves to provide shelter.

TEMPERATURE: -0.8° to 30° C

SALINITY: 0 to 35 ppt, but require time to adjust to changes

DISSOLVED OXYGEN: Eels in general and elvers in particular are sensitive to low oxygen concentrations.

FOOD/FEEDING: eels are extremely opportunistic carnivores, eating whatever fauna is in their environment: they can scavenge, eat insects, worms, frogs and crayfish in freshwater; crabs, clams, fish and crustaceans in salt water. Eels are primarily nocturnal feeders with an extremely well-developed sense of smell. For this reason they do well under piers, where dark shadows discourage competing sight-hunting bottom fish like tomcod and winter flounder (Able <u>et al</u>., 1995)

CURRENTS: Tidal currents are essential to upstream migration by young juveniles. Structures that interfere with these can be deleterious.

TURBIDITY: no documentation found

American eel (continued)

CONTAMINATION EFFECTS: Little toxicity data is available. Eels are known to concentrate PCBs at ppm levels; possession and sale of Hudson River eels has was banned in New York State in 1978 because of this.

Population/Fisheries Status: All American eels from the entire geographic range of the species appear to belong to a single inter-spawning population that only assembles in a remote ocean location. This makes local stock assessment, total population and yield estimates impossible by the methods used with other fish. Catches have been stable in most locations, with the exception of the St. Lawrence River. The reason for the decline there is not known.

Cunner (Tautogolabrus adspersus): ecology (Auster, 1989 and Ross & Biagi, 1991)

General Character: Temperate marine, non-schooling reef-dweller, in coastal ocean (to 6 mi. offshore) and lower parts of estuaries. Geographic range: Newfoundland to New Jersey, occasionally in Chesapeake Bay.

Life Stages:

ADULT FEMALES SPAWN in inshore areas during May to August, peaking in June. Eggs are buoyant and planktonic, drifting freely with currents, hatching within 2 days.

LARVAL STAGE up to 15 mm

JUVENILES up to 2 years old

ADULTS up to 1.4 kg (3 lb.) and 43 cm (17") long, though usually not exceeding 0.5 kg (1 lb.), 25 cm (10"), age 6 years

Migration: No long distance migrations. Move generally inshore during spring, offshore in fall, but only to find adequate food and cover seasonally; this fish requires the cover such as rock crevices, seaweed or eelgrass beds during the night and during winter.

Estuarine Habitat Requirements:

SUBSTRATE: Cover required during night and winter: thus rocks, pilings, vegetation or other complex structures are necessary. Juveniles also need shelter during day to escape predators. Vegetated habitats are abandoned seasonally as they become defoliated (Olla, Bejda & Martin, 1979), males set up territories around structured environments to initiate mating activities.

TEMPERATURE: Seek deeper water as temperature falls below 10^{o} C, become torpid below 8^{o}, remaining in shelter throughout the day. Also seek shelter and become inactive when upper sublethal temperatures ($26\text{-}32^{o}$) reached.

SALINITY & DISSOLVED OXYGEN: no documentation

FOOD/FEEDING: feed on benthic and near-benthic fauna in daytime, often most active at dawn and dusk...diet includes mussels, barnacles, clams, worms, shrimp, small crustaceans, small fish: unlike tautog, not heavily dominated by one species

CURRENTS: shifting currents in complex environment may reduce intraspecific and interspecific competition

TURBIDITY: no documentation found

CONTAMINATION EFFECTS: no documentation found

Population/Fisheries Status: The population is local. It supports a modest recreational fishery. Population status and trends are not known.

APPENDIX REFERENCES

Able, K., A. L. Studholme & J. P. Mandersonf. 1995. Habitat Quality in the New York/New Jersey Harbor Estuary: An Evaluation of Pier Effects on Fishes. Final Report to the Hudson River Foundation. 85 pp.

Andrews, W. 1984. Inventory of the Fishery Resources of the Hudson River from Bayonne ot Piermont. Final Report to the NJ Dept. of Environmental Protection, Division of Fish, Game and Wildlife, Marine Fisheries Administration, Nacote Creek Station. 35 pp.

Auster, P. 1989. Species Profiles: Life Histories and Environmental Requirements of Coastal Fishes and Invertebrates (North Atlantic and Mid-Atlantic) Tautog and Cunner. Biological Report 82(11.105) TR EL-82-4 US Dept. of the Interior, Fish and Wildlife Service, Washington, DC and US Army Corps of Engineers. Vicksburg, MS. 13 pp.

Buckley, J. 1989. Species Profiles: Life Histories and Environmental Requirements of Coastal Fishes and Invertebrates (North Atlantic) Winter Flounder. Biological Report 82(11.87) TR EL-82-4 US Dept. of the Interior, Fish and Wildlife Service, Washington, DC and US Army Corps of Engineers, Vicksburg, MS. 12 pp.

Dew, C. B. & J. H. Hecht. 1994. Hatching, estuarine transport, and distribution of larval and early juvenile tomcod, Microgadus tomcod, in the Hudson River. Estuaries 17:472-488.

Facey, D. E.& M. J. Van Den Avyle. 1987. Species Profiles: Life Histories and Environmental Requirements of Coastal Fishes and Invertebrates (North Atlantic) American Eel. Biological Report 82(11.74) TR EL-82-4 US Dept. of the Interior, Fish and Wildlife Service, Washington, DC and US Army Corps of Engineers, Vicksburg, MS. 28 pp.

Fay, C. W., R. J. Neves & G. B. Pardue. 1983. Species Profiles: Life Histories and Environmental Requirements of Coastal Fishes and Invertebrates (Mid-Atlantic) Striped Bass. Biological Report 82(11.8) TR EL-82-4 US Dept. of the Interior, Fish and Wildlife Service, Washington, DC and US Army Corps of Engineers. Vicksburg, MS. 22 pp.

Grabe, S. A. 1978. Food and feeding habits of juvenile Atlantic tomcod, Microgadus tomcod, from Haverstraw Bay, Hudson River, New York. Fish. Bull. U.S. NMFS 76:89-94.

Grimes, B. H., M. T. Huish, J. H. Kerby & D. Moran. 1989. Species Profiles: Life Histories and Environmental Requirements of Coastal Fishes and Invertebrates (Mid-Atlantic) Summer and Winter Flounder. Biological Report 82(11.112) TR EL-82-4 US Dept. of the Interior, Fish and Wildlife Service, Washington, DC and US Army Corps of Engineers. Vicksburg, MS. 18 pp.

Hill, J., J. W. Evans & M. J. Van Den Avyle. 1989. Species Profiles: Life Histories and Environmental Requirements of Coastal Fishes and Invertebrates (South Atlantic) Striped Bass. Biological Report 82(11.118) TR EL-82-4 US Dept. of the Interior, Fish and Wildlife Service, Washington, DC and US Army Corps of Engineers. Vicksburg, MS. 35 pp.

Howell, P., & E. Smith. 1991. Winter Flounder. pp. 89-91 in: P. E. Hamer, J. M. McGurrin, L. C. Leach, M. C. Holliday and L. M. Schwab (eds.) Interstate Fisheries of the Atlantic Coast. Atlantic States Marine Fisheries Commission.

Leim, A. H. & W. B. Scott. 1966. Fishes of the Atlantic Coast of Canada. Bulletin No. 155, Fisheries Research Board of Canada. Ottawa.

Mercer, L. P. 1989. Species Profiles: Life Histories and Environmental Requirements of Coastal Fishes and Invertebrates (South Atlantic) Black Sea Bass. Biological Report 82(11.99) TR EL-82-4 US Dept. of the Interior, Fish and Wildlife Service, Washington, DC and US Army Corps of Engineers. Vicksburg, MS. 16 pp.

Morton, T. 1989. Species Profiles: Life Histories and Environmental Requirements of Coastal Fishes and Invertebrates (Mid-Atlantic) Bay Anchovy. Biological Report 82(11.105) TR EL-82-4 US Dept. of the Interior, Fish and Wildlife Service, Washington, DC and US Army Corps of Engineers. Vicksburg, MS. 13 pp.

NOAA, 1995. Our Living Oceans. Report of the status of U.S. living marine resources. NOAA Tech. Memo. NMFS-F/SPO-19. US Dept. Commerce, National Marine Fisheries Service, Washington DC.

Olla, B. L., A. J. Bejda & A. D. Martin. 1979. Seasonal dispersal and habitat selection of cunner, Tautogolabrus adspersus, and young tautog, Tautoga onitis, in Fire Island Inlet, Long Island, New York. Fish. Bull U.S. NMFS 77:255-261.

Ross, M. & R. C. Biagi. 1991. Recreational Fisheries of Coastal New England. University of Massachusetts Press. Amherst, MA.

Sogard, S. M., K. W. Able and M. P. Fahay. 1992. Early life history of the tautog Tautoga onitis in the Mid-Atlantic Bight. Fish. Bull. U.S. NMFS 90:529-539.

Stewart, L. L. & P. J. Auster. 1987. Species Profiles: Life Histories and Environmental Requirements of Coastal Fishes and Invertebrates (North Atlantic) Atlantic Tomcod. Biological Report 82(11.76) TR EL-82-4 US Dept. of the Interior, Fish and Wildlife Service, Washington, DC and US Army Corps of Engineers. Vicksburg, MS. 8 pp.

Stier, D. J. & J. H. Crance. 1985. Habitat Suitability Index Models and Instream Flow Suitability Curves: American Shad. Biological Report 82(10.88) US Dept. of the Interior, Fish and Wildlife Service, Washington, DC.

US FSW 1995. Regionally Significant Habitats and Habitat Complexes of the New York Bight Watershed. Draft Final Report. US Department of the Interior, Fish and Wildlife Service, Charlestown, RI

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February 15, 2000

To Distribution:

RE: MIMAC Board Meeting February 17, 2000
Public Notice No. 98-02350-J2 – Wetlands Mitigation Proposal
Long Slip Canal Habitat Creation Project
Hoboken/Jersey City, NJ

Dear Board Member:

NJ Transit received a Waterfront Development Permit for the above-referenced project from NJDEP on December 3, 1999 conditioned upon the creation of 4.6 acres of compensatory wetlands. NJ Transit proposes to meet that requirement through the purchase of credits at the Marsh Resources Inc. mitigation bank in the Hackensack meadowlands and requested that the Corps include this proposal on the agenda for the February 17, 2000 MIMAC meeting. This letter describes the mitigation proposal and presents the results of the Indicator Value Assessment undertaken to determine the appropriate mitigation bank acreage needed to replace wetlands services provided by the Long Slip canal.

Introduction – Overview of Mitigation Plan

NJ Transit proposed in the permit application to provide extensive (over 37 acres) water quality improvements and habitat creation as mitigation for the 4.6 acres of fill in Long Slip canal. This mitigation for the canal fill includes the following:

1. ***Create a confined disposal facility (CDF).*** Long Slip canal will be filled behind a containment dike across the entrance with 150,000 cubic yards (cy) of dredged sediment or other filled material. This will isolate 4.6 acres of oxygen-demanding sediments.

2. ***Upgrade the Jersey City CSO.*** The CSO upgrades will eliminate floatables, eliminate dry weather flows, and reduce the discharge of sediment. The measures will improve the CSO beyond the minimum improvements needed to comply with the requirements of the law. It also will collect and treat non-point contaminants from yard runoff.

3. ***Eliminate point and non-point discharges.*** The two City of Hoboken CSOs that cross the rail yard and discharge into the canal and canal entrance basin, respectively, will be closed at the regulators in Observer Highway and connected to a reconstructed outfall located offsite north of the Hoboken terminal. NJ Transit will support this North Hudson Sewer Authority (NHSA) stormwater and flood management project by funding the construction of approximately 2,000 linear feet of 6' by 12' sewer along Observer Highway at an estimated cost of $13MM. NHSA will be responsible for the design, construction and permitting of the new regulator, outfall and floatable removal devices.

4. *Construct waterfront walkway.* A nearly 1,000-foot long, 30-foot wide pedestrian/bicycle promenade will be constructed along the canal entrance basin and across the canal berm. This walkway will introduce public access to the waterfront and recreational activity along a scenic part of the river where no access currently exists. Other components of the walkway could include interpretive and educational displays.

5. *Create new aquatic habitat.* New and restored habitat for diverse fish, particularly juveniles, and invertebrate species will result from improvements to the water quality, hydrography, and physical characteristics of the 37.2-acre interpier area that includes 10.8 acres of open piles. An excavation in the canal entrance basin will substantially improve local dissolved oxygen and salinity to levels that are favorable to many fish species that presently are absent. Species populations and diversity also will benefit from the removal of biohazards now accessible to bottom-dwelling and spawning aquatic populations. The rip rap armor used for the containment berm will provide new substrate for attachment of food species and crevices for shelter. These measures fully support the objectives of Essential Fish Habitat protection stated in Fisheries Management Plans developed under the amended Magnusen-Stevens Act (see for example, Section 2 of *Amendment 12 to the Summer Flounder, Scup, and Black Sea Bass Fishery Management Plan*, Mid-Atlantic Fisheries Council, August 18, 1998).

6. *Create Compensatory Wetlands.* (Described below.)

Components 1 through 5 of this mitigation proposal, presented in the permit application filed December 19, 1997, are fully consistent with federal regulation and policy identified in Section 404B guidelines and the guidelines developed under the Sustainable Fisheries Act amendments to the Magnusen–Stevens Act. State and Federal regulators concurred at meetings with NJ Transit on December 11 and 17, 1998, but required NJ Transit to create one half to a full acre of compensatory wetlands in conjunction with this on-site habitat creation (added to the mitigation plan as Component 6). Subsequently, in view of this first-of-a-kind project, the USFWS and the other resource agencies increased the required acreage to 4.6 acres.

Clarification of Component 6 – Compensatory Wetlands Plan

This letter amends the mitigation plan by clarifying the NJ Transit's plan to provide compensatory wetlands and the basis of that plan. The selection of a mitigation site must adhere to the following sequence:

- Creation, restoration or enhancement of wetlands on site;
- Creation, restoration or enhancement of wetlands within the same river reach; and,
- Creation, restoration or enhancement of wetlands elsewhere.

The creation, restoration or enhancement of additional wetlands onsite is not feasible, and contrary to the primary project objective – an expanded commuter rail yard to meet current and near term capacity demands. Open waterfront suitable for the creation of wetlands is rare in the heavily urbanized Hudson River estuary. To locate a site, NJ Transit performed a comprehensive inventory of nearly 30 undeveloped waterfront sites along the lower Hudson River, the Kill van Kull, Arthur Kill to the Rahway River, Newark Bay, and the lower Hackensack River. Criteria that included acreage, known or probable soil contamination, ownership, and constructability screened potential sites, initially identified through a GIS study and aerial photography. The results of the screening were reviewed at a March 4, 1999 meeting with the BayKeeper and the Rutgers Environmental Law Clinic – commentors on the project application – who prefer that the mitigation site would be in the same reach of the Hudson River or in the Kill van Kull. Of the three sites that passed that final criterion, only Caven Point was realistic and acceptable to all parties. Wetlands creation was proposed at Caven Point, Jersey City and a preliminary wetland development plan was accepted by NJDEP and the Corps following a May 29, 1999 visit to the site. Subsequently, NJDEP indicated that at this time it could not commit mitigation acreage to NJ Transit at Caven Point within the project's time constraints because of current enforcement actions against the present and former owners. Should these issues resolve, however, the site may be available in the future.

Having exhaustively and unsuccessfully searched for a wetlands creation site that can be guaranteed within the next few weeks, NJ Transit is now committed to purchasing compensatory wetlands credits at the existing Marsh Resources, Inc. (MRI) mitigation bank in the Hackensack meadowlands (Department of the Army Permit No. 96-11660 issued August 24, 1998). The MRI mitigation bank in the Hackensack meadowlands is now the only available mitigation bank whose service area includes the project site. Wetlands at the mitigation bank are characterized as estuarine intertidal persistent emergent wetlands, irregularly flooded (Marsh Resources, Inc., 1999, *Executed Banking Instrument for the Purposes of Establishing the Meadowlands Mitigation Bank*, MRI, Inc, March 1999. Dames & Moore met a MRI representative at the bank site on January 13, 2000 to confirm this characterization. The MRI site is suitable mitigation because it functions to dissipate erosive tidal forces, bind and stabilize sediments, and trap and retain suspended sediments and chemical toxins.

Calculation of Mitigation Acreage at the MRI Bank

Methodology

To estimate the mitigation acreage that would be required at the bank, Dames & Moore evaluated the baseline conditions of Long Slip Canal, using Indicator Value Assessment (IVA) methodology developed by the HMDC in the 1995 Special Area Management Plan for the Hackensack Meadowlands District, NJ. That methodology is a semi-quantitative wetland assessment technique that involves answering a series of questions regarding the wetland and its drainage. Questions answered "no" receive no score. Questions answered "yes" receive a score or a score modifier that is used to calculate the value of three wetland attributes: wildlife habitat, water quality and social significance.

Marsh Resources, Inc. completed baseline assessments using IVA on the meadowlands mitigation site prior to any enhancement and then again in March 1999 after Phase 1 enhancements were completed. The difference in scores indicates the value of the enhancement on a points per acre basis for each of the three attributes. The values of the enhancements are compared to the baseline values of Long Slip canal in order to determine the mitigation ratio needed to replace the lost values.

Results

Long Slip Canal is located in the tidal lower Hudson River estuary. The canal is an unvegetated, artificial waterway, essentially a ditch, that is 100 feet wide, 2,000 feet long and about 15 feet deep. There is no inlet and a single outlet. The drainage area is fully developed and largely devoid of vegetation. Baseline biological surveys included in the permit application found that the canal's extremely poor water quality provides aquatic habitat for only the hardiest species. The baseline assessment results reflected this degraded condition. The scores for each wetland attribute are listed in Table 1 below. (Attachment 1 contains the questions and responses that yielded these results.)

Table 1 IVA Baseline Assessment of Long Slip Canal

	Wetland Attribute		
	Wildlife Habitat	Water Quality	Social Significance
Baseline Scores	23.8	16.8	37.3

The baseline and post-enhancement values of the mitigation bank are listed in Table 2. The third row "Gain in Value" indicates the values that are used to determine the mitigation ratio. The mitigation ratio is obtained by dividing the baseline score for the Long Slip canal by the "Gain in Value" score for the MRI mitigation bank (see Table 3). At a mitigation ratio of 1.1:1, a total of 5.06 acres are needed from the bank.

Table 2 IVA Assessment of the MRI Mitigation Bank

	Wetland Attribute		
	Wildlife Habitat	Water Quality	Social Significance
Baseline Scores	62	43	12
Post-Mitigation	83	80.8	49.7
Gain in Value	21	37.8	37.7

Table 3 Mitigation Ratios

		Wetland Attribute	
	Wildlife Habitat	Water Quality	Social Significance
Mitigation Ratio	1.1	0.4	1.0

Summary

NJ Transit found no viable mitigation sites within the same reach of the Hudson River, and therefore will purchase mitigation credits at the "Transco" Marsh Resources, Inc. mitigation bank in the Hackensack meadowlands. This option is suitable because Long Slip is within the service area of the bank designated by NJDEP and because it replaces the ecological function of the canal, namely sediment removal. Dames & Moore used the Corps-approved Indicator Value Assessment method to perform a baseline assessment of the Long Slip canal and found that the appropriate mitigation ratio is 1.1:1, based on the 1999 IVA assessment of enhanced wetlands at the MRI mitigation bank. Since this mitigation will be provided prior to or concurrent with the proposed construction at Long Slip, NJ Transit submits that this proposal meets the compensatory wetland requirement. Larry Baier and Suzanne Dietrick of the NJDEP Office of Dredging and Sediment Technology (telephone number 609 292-2903) reviewed a draft of this letter and stated their acceptance of the MRI credits to fulfill the compensatory wetlands requirement, recognizing that the NJDEP Waterfront Development Permit will have to be modified to incorporate this element.

I hope that this information is sufficient for your concurrence on this mitigation proposal. I look forward to seeing you at the MIMAC meeting. Please contact me if I can prepare additional materials or clarification at the time of the meeting.

Sincerely,

Eugene Peck
Project Manager

EP/encl.

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ATTACHMENT 1

Long Slip Canal Habitat Creation Project
Calculation of Mitigation Acreage Using IVA

The appropriate acreage needed to compensate impacts resulting from the proposed project was determined using the Indicator Value Assessment methodology. The values and multipiers assigned to affirmatively-answered questions of Table 3-8 of Appendix F of the Draft Environmental Impact Report on the Special Area Management Plan for the Hackensack Meadowlands District, NJ (USEPA, USCOE, 1995) are tabulated below, followed by the calculation of the required acreage. A tabulation of these attributes is included below.

Question Number	Wildlife Habitat	Water Quality	Social Significance		
			REC	FFAS	CON
35	X=.92				X=.97
57	29				30
66	15	2			18
124	3	3			9
145		1			
149		1			
150	X=.92	3			X=.97
152	X=.8	1			X=.89
155	1				
156	X=.92	X=.95			X=.95
175	45				45
186	0				45
200	20				21
203	1				
212		6			15
226	7				8
235	7				8
238	3	2			
272		3			
281	X=.88				X=.93
285		1			
300	10				
999			X=2		
Subtotals	141	23	0	0	199
Multiplier	0.55	0.95	2.00		0.74
Totals	77.30	21.85	0.00	0.00	147.23
Divisor	325.50	130.00	38.00	3.00	394.82
Normalize	23.75	16.81	0.00	0.00	37.29
SS Total					75.33
Acre-points	23.75	16.81	0.00	0.00	37.29
Points/acre	21	37.8			37.8
Acres	1.1	0.4			1.0

Calculated mitigation ratio = 1.1:1

(2/22/00 Alternative Calculation Submitted Separately)

ATTACHMENT 1

Long Slip Canal Habitat Creation Project
Calculation of Mitigation Acreage Using IVA

The appropriate acreage needed to compensate impacts resulting from the proposed project was determined using the Indicator Value Assessment methodology. The values and multipiers assigned to affirmatively-answered questions of Table 3-8 of Appendix F of the Draft Environmental Impact Report on the Special Area Management Plan for the Hackensack Meadowlands District, NJ (USEPA, USCOE, 1995) are tabulated below, followed by the calculation of the required acreage. A tabulation of these attributes is included below.

Question	Wildlife	Water	Social Significance		
Number	Habitat	Quality	REC	FFAS	CON
35	X=.92				X=.97
57	29				30
66	15	2			18
124	3	3			9
145		1			
149		1			
150	X=.92	3			X=.97
152	X=.8	1			X=.89
153	X=.8	X=.8			X=.82
155	1				
156	X=.92	X=.95			X=.93
175	45				45
186	0				45
200	20				21
203	1				
212		6			15
226	7				8
235	7				8
238	3	2			
272		3			
281	X=.88				X=.93
285		1			
300	10		X=2		
999					
Subtotals	141	23	0	0	199
Multiplier	0.44	0.76	2.00	0.76	0.59
Totals	61.84	17.48	0.00	0.00	118.19
Divisor	325.50	130.00	38.00	3.00	394.82
Normalize	19.00	13.45	0.00	0.00	29.93
SS Total					60.47
Acre-points	19.00	13.45	0.00	0.00	29.93
Points/acre	21	37.8			37.8
Acres	0.9	0.4			0.8

Calculated mitigation ratio = 0.9:1

QNO	QUES	WH	WQ	REC	FFAS	CON	SUMMARY
1	I1	x=5	0	9	0	0	Threatened/Endangered Species?
3	I3	0	0	9	0	0	State Listed Cultural Resource?
4	I4	x=2	0	3	0	0	Unusual or rare local type?
6	I6	0	0	1	0	0	Substantial previous $ expenditure?
8	I8	0	0	0	1	0	Features sensitive to flooding?
9	I9	0	0	0	1	0	Downslope sensitive features in floodplain?
18	I18	0	0	0	1	0	Features in erosion prone areas?
23	I23	0	0	1	0	0	Education opportunity?
24	I24	0	0	1	0	0	Research resource?
26	I26	0	0	3	0	0	Recreation in deficient area?
27	I27	0	0	3	0	0	Recreation access point?
34	Q1.3	3	0	0	0	0	Freeze-over > one month?
35	Q2.1.1	x=0.92	0	0	0	x=0.97	Area < 5 acres?
36	Q2.1.2	13	4	0	0	21	Area > 40 acres?
37	Q2.1.3	39	12	0	0	63	Area > 200 acres?
38	Q2.2.1	9	10	0	0	21	Forested area < 5 acres ?
49	Q5.1.2	0	6	0	0	11	AA > 20% of watershed?
50	Q5.2	2	0	0	0	0	Upslope wet depressions > 5% of watershed?
54	Q7	0	6	0	0	0	v < 10 cm/s?
55	Q8.1	10	2	0	0	14	Permanent inlet?
56	Q8.2	4	2	0	0	8	Intermittent inlet?
57	Q8.3	29	0	0	0	30	Permanent outlet?
58	Q8.4	3	2	0	0	6	Intermittent outlet?
59	Q9.1	0	2	0	0	0	Outlet < one third average width?
60	Q9.2	0	18	0	0	28	Sheet flooding?
63	Q10.B	6	2	0	0	10	Palustrine?
65	Q10.D	5	2	0	0	8	Riverine tidal?
66	Q10.E	15	2	0	0	18	Estuarine?
68	Q11	7	2	0	0	10	Fringe or island wetland?
71	Q12.Ab	2	1	0	0	0	Dominant veg: forested and needle-leaved evergreen
72	Q12.Ac	2	1	0	0	0	Dominant veg: forested and broad-leaved evergreen
73	Q12.Ad	2	1	0	0	0	Dominant veg: forested and needle-leaved deciduous
74	Q12.Ae	2	1	0	0	0	Dominant veg: forested and broad-leaved deciduous
77	Q12.Bb	2	1	0	0	0	Dominant veg: Scrub-shrub and needle-leaved evergreen
78	Q12.Bc	2	1	0	0	0	Dominant veg: Scrub-shrub and broad-leaved evergreen
79	Q12.Bd	2	1	0	0	0	Dominant veg: Scrub-shrub and needle-leaved deciduous
80	Q12.Be	2	1	0	0	0	Dominant veg: Scrub-shrub and broad-leaved deciduous
82	Q12.Ca	3	2	0	0	6	Dominant veg: Aquatic bed and algal
83	Q12.Cb	7	2	0	0	10	Dominant veg: Aquatic bed and floating vascular
84	Q12.Cc	13	2	0	0	16	Dominant veg: Aquatic bed and rooted vascular
87	Q12.Da	7	6	0	0	16	Dominant veg: Emergent and persistent
88	Q12.Db	15	1	0	0	16	Dominant veg: Emergent and non-persistent
92	Q13.Ab	2	1	0	0	0	Secondary veg: forested and needle-leaved evergreen
93	Q13.Ac	2	1	0	0	0	Secondary veg: forested and broad-leaved evergreen
94	Q13.Ad	2	1	0	0	0	Secondary veg: forested and needle-leaved deciduous
95	Q13.Ae	2	1	0	0	0	Secondary veg: forested and broad-leaved deciduous
98	Q13.Bb	2	1	0	0	0	Secondary veg: Scrub-shrub and needle-leaved evergreen
99	Q13.Bc	2	1	0	0	0	Secondary veg: Scrub-shrub and broad-leaved evergreen
100	Q13.Bd	2	1	0	0	0	Secondary veg: Scrub-shrub and needle-leaved deciduous
101	Q13.Be	2	1	0	0	0	Secondary veg: Scrub-shrub and broad-leaved deciduous

TABLE 3-8
(continued)

QNO	QUES	WH	WQ	REC	FFAS	CON	SUMMARY
103	Q13.Ca	3	2	0	0	6	Secondary veg: Aquatic bed and algal
104	Q13.Cb	7	2	0	0	10	Secondary veg: Aquatic bed and floating vascular
105	Q13.Cc	13	2	0	0	16	Secondary veg: Aquatic bed and rooted vascular
108	Q13.Da	7	6	0	0	16	Secondary veg: Emergent and persistent
109	Q13.Db	15	1	0	0	16	Secondary veg: Emergent and non-persistent
111	Q14.1	7	0	0	0	7	AA with 25 square foot island?
112	Q14.2	13	0	0	0	13	AA with 2 acre island?
113	Q15.1.A	4	2	0	0	7	Vegetation<-->Water = solid form
114	Q15.1.B	13	4	0	0	20	Vegetation<-->Water = intermediate
115	Q15.1.C	39	4	0	0	47	Vegetation<-->Water = checkerboard
116	Q15.2	11	18	0	0	39	Channel flow spreading?
117	Q16.A	1	0	0	0	0	Vegetation class = solid
118	Q16.B	3	0	0	0	0	Vegetation class = intermediate
119	Q16.C	10	0	0	0	0	Vegetation class = mosaic
120	Q17	3	0	0	0	0	Plant form richness
121	Q18	5	1	0	0	6	Upland<-->Wetland edge irregular?
122	Q19.1.A	12	1	0	0	13	Wind shelter?
123	Q19.1.B	0	0	0	0	0	No wind shelter + large fetch?
124	Q19.2	3	3	0	0	9	Wave protection?
125	Q19.3	1	0	0	0	0	Upland habitat wind shelter?
126	Q20.1	2	0	0	0	0	Zone B shaded?
127	Q20.2	1	0	0	0	0	Balance sun<-->shade?
133	Q22.1.1	9	0	0	0	10	AA contains a Channel?
134	Q22.1.2	1	2	0	0	0	AA contains a Sinuous channel?
137	Q23	1	0	0	0	0	Is the AA Channelized?
139	Q24.2	0	4	0	0	0	Fine mineral soils?
141	Q24.4	0	1	0	0	0	Slow percolation in watershed?
144	Q25.2.A	0	10	0	0	20	Primary source of sediment = sheetflow?
145	Q25.2.B	0	1	0	0	0	Primary source of sediment = channel flow?
146	Q25.3	0	3	0	0	13	Wetland stabilizes erosion?
147	Q26.1	2	3	0	0	0	Nutrient source in buffer zone?
148	Q26.2	2	9	0	0	0	Primary source of nutrients = sheetflow?
149	Q26.3	0	1	0	0	0	Primary source of nutrients = channel flow?
150	Q27.1	x=0.92	3	0	0	x=0.97	Toxic source in buffer zone?
151	Q27.2	x=0.88	9	0	0	x=0.93	Primary source of toxics = sheetflow?
152	Q27.3	x=0.8	1	0	0	x=0.89	Primary source of toxics = channel flow?
153	Q28	x=0.8	x=0.8	0	0	x=0.82	Has AA been Directly alterated?
154	Q29.1	8	2	0	0	11	Dense understory edge?
155	Q29.2	1	0	0	0	0	Buffer zone slopes < 5%?
156	Q30	x=0.92	x=0.95	0	0	x=0.93	Is AA subject to frequent Human disturbance?
157	Q31.1	1	4	0	0	7	Area of Zone A + Zone B > Zone C?
158	Q31.2	4	2	0	0	9	Area of Zone B > 10% of AA?
159	Q31.3	6	1	0	0	8	Area of Zone B > Zone A?
160	Q31.4	1	6	0	0	10	Area of submergent in Zone B > open water of Zones B + C?
161	Q31.5	1	0	0	0	0	Area of Zone A >= 10% of Zone B and C?
163	Q31.6.b	9	2	0	0	12	emergent in Zone B = 1% - 30% of Zones B and C?
164	Q31.6.c	15	6	0	0	24	emergent in Zone B = 31% - 60% of Zones B and C?
165	Q31.6.d	13	18	0	0	41	emergent in Zone B = 61% - 99% of Zones B and C?
167	Q32.A	22	2	0	0	28	Spatial Dominant Hydroperiod = perm flooded nontidal?
168	Q32.B	3	0	0	0	0	Spatial Dominant Hydroperiod = intermit exposed nontidal?

TABLE 3-8
(continued)

QNO	QUES	WH	WQ	REC	FFAS	CON	SUMMARY
169	Q32.C	3	0	0	0	0	Spatial Dominant Hydroperiod = semiperm flooded nontidal?
170	Q32.D	3	0	0	0	0	Spatial Dominant Hydroperiod = seasonally flooded nontidal?
171	Q32.E	1	0	0	0	0	Spatial Dominant Hydroperiod = saturated nontidal?
172	Q32.F	0	0	0	0	0	Spatial Dominant Hydroperiod = temp flooded nontidal?
173	Q32.G	0	0	0	0	0	Spatial Dominant Hydroperiod = intermit flooded nontidal?
175	Q32.I	45	0	0	0	45	Spatial Dominant Hydroperiod = regularly flooded tidal?
176	Q32.J	33	0	0	0	33	Spatial Dominant Hydroperiod = irregularly exposed tidal?
177	Q32.K	9	0	0	0	9	Spatial Dominant Hydroperiod = irregularly flooded tidal?
178	Q33.A	22	2	0	0	28	Permanent Hydroperiod = perm flooded nontidal?
179	Q33.B	3	0	0	0	0	Permanent Hydroperiod = intermit exposed nontidal?
180	Q33.C	3	0	0	0	0	Permanent Hydroperiod = semiperm flooded nontidal?
181	Q33.D	3	0	0	0	0	Permanent Hydroperiod = seasonally flooded nontidal?
182	Q33.E	1	0	0	0	0	Permanent Hydroperiod = saturated nontidal?
183	Q33.F	0	0	0	0	0	Permanent Hydroperiod = temp flooded nontidal?
184	Q33.G	0	0	0	0	0	Permanent Hydroperiod = intermit flooded nontidal?
186	Q33.I	45	0	0	0	45	Permanent Hydroperiod = regularly flooded tidal?
187	Q33.J	33	0	0	0	33	Permanent Hydroperiod = irregularly exposed tidal?
188	Q33.K	9	0	0	0	9	Permanent Hydroperiod = irregularly flooded tidal?
189	Q34.1	3	3	0	0	15	Local dams?
190	Q34.2	0	0	0	0	0	Upstream impoundment?
191	Q34.3.1	5	1	0	0	8	Flooding due to downslope impoundment?
196	Q36.1.2	3	6	0	0	12	Average width of erect veg in Zones A and B > 500 feet?
200	Q37	20	0	0	0	21	Open water (d>2ft,w>6ft,l>1000ft)?
201	Q38.1	1	0	0	0	0	Perm flood or seas flood and other < 1 mi
202	Q38.2	1	0	0	0	0	(nontidal with erect veg) or 1 acre hardwood and other < 0.5 mi
203	Q38.3	1	0	0	0	0	(estuarine/marine) or (fw palustrine/lacustrine) and other < 5 mi
204	Q38.4	3	0	0	0	0	mudflat or tidal scrub-shrub and other adjacent
205	Q38.5	9	0	0	0	0	mudflat > 5 acre or emergent veg > 5 acre and other adjacent
206	Q38.6	1	0	0	0	0	agr/early succession or evergr forest>10 acres and other < 0.5 mi
207	Q38.7	1	0	0	0	0	semiperm or seas flood or perm flood/intermit exposed and others < 1
209	Q39	9	0	0	0	0	Special habitat features?
212	Q41.1	0	6	0	0	15	Peak flow velocity < 10 cm/s?
213	Q41.2	1	0	0	0	0	Peak flow velocity > 30 cm/s?
220	Q43.A	5	0	0	0	6	Dominant Water Depth < 1 inch
221	Q43.B	5	0	0	0	0	1 in < dominant water depth < 4 inches
222	Q43.C	6	0	0	0	0	5 in < dwd < 8 inches
223	Q43.D	6	0	0	0	0	9 in < dominant water depth < 20 inches
224	Q43.E	7	0	0	0	0	21 in < dominant water depth < 39 inches
225	Q43.F	7	0	0	0	0	40 in < dominant water depth < 59 inches
226	Q43.G	7	0	0	0	8	5 feet < dominant water depth < 6.5 feet
227	Q43.H	7	0	0	0	8	6.5 feet < dominant water depth < 26 feet
228	Q43.I	7	0	0	0	8	dominant water depth > 26 feet
229	Q44.A	5	0	0	0	6	Secondary Water Depth < 1 inch
230	Q44.B	5	0	0	0	0	1 in < secondary water depth < 4 inches
231	Q44.C	6	0	0	0	0	5 in < secondary water depth < 8 inches
232	Q44.D	6	0	0	0	0	9 in < secondary water depth < 20 inches
233	Q44.E	7	0	0	0	0	21 in < secondary water depth < 39 inches
234	Q44.F	7	0	0	0	0	40 in < secondary water depth < 59 inches
235	Q44.G	7	0	0	0	8	5 feet < secondary water depth < 6.5 feet
236	Q44.H	7	0	0	0	6	6.5 feet < secondary water depth < 26 feet

Ranks for All Attributes – 27-Sep-91

QNO	QUES	WH	WQ	REC	FFAS	CON	SUMMARY
237	Q44.I	7	0	0	0	8	secondary water depth > 26 feet
– 238	Q45.B	3	2	0	0	0	Substrate: Muck?
239	Q45.C	0	6	0	0	0	Substrate: peat?
240	Q45.D	6	1	0	0	7	Substrate: sand?
241	Q45.A	6	2	0	0	8	Substrate: mud?
242	Q45.E	12	0	0	0	13	Substrate: cobble-gravel?
243	Q45.F	12	0	0	0	13	Substrate: rubble?
246	Q46.B	4	0	0	0	0	Physical Habitat Interspersion = intermediate
247	Q46.C	10	1	0	0	14	Physical Habitat Interspersion = mosaic
251	Q48.A	0	1	0	0	0	Salinity < 0.5 ppt
252	Q48.B	1	0	0	0	0	0.5 < Salinity < 5.0 ppt
258	Q49.1.2	1	0	0	0	0	Riffles?
259	Q49.2	18	0	0	0	18	Fish cover?
261	Q50	10	0	0	0	0	Plants: waterfowl value?
263	Q51.2	9	9	0	0	19	Plant productivity > 1500 g/sq.m/yr
271	Q55.3	0	1	0	0	0	Suspended Solids > 1200 mg/l
– 272	Q55.4	0	3	0	0	0	Suspended Solids > 4000 mg/l
– 281	Q61	x=0.88	0	0	0	x=0.93	DO limiting to fish?
283	Q63.1	0	0	0	0	0	Floodpeaks: inlet > outlet ?
284	Q63.2	0	1	0	0	0	Surface water inflows > outflows ?
– 285	Q64	0	1	0	0	0	Total Suspended Solids at inlet > outlet?
288	Q65.3	12	0	0	0	0	Warm Freshwater Fish present?
290	Q66.1.1	9	0	0	0	0	Group 1 Waterfowl Breeding present?
298	Q66.2.1	9	0	0	0	0	Waterfowl Group 1 Mig/Wint present?
– 300	Q66.2.3	10	0	0	0	0	Black Duck Mig/Wint present?
302	Q66.2.5	9	0	0	0	0	Mergansers Mig/Wint present?
304	Q66.2.7	9	0	0	0	0	Bufflehead/Goldeneye Mig/Wint present?
307	Q66.2.10	10	0	0	0	0	Geese Mig/Wint present?
– 999	Q99	0	0	x=2	0	0	Proximity to Major Roadways

State of New Jersey

Department of Environmental Protection

Christine Todd Whitman
Governor

Robert C. Shinn, Jr.
Commissioner

August 4, 1998

Mark Renna
Louis Berger & Associates, Inc.
100 Halsted Street
East Orange, New Jersey 07019

RE: Mitigation Council Meeting
Marsh Resources Inc. Meadowlands Mitigation Bank
Carlstadt, Bergen County

Dear Mr. Renna:

Congratulations on the Council' approval of MRI's Meadowlands Mitigation bank and the signing of the resolution approving the Council's action. Enclosed is a copy of the final resolution. Once the banking instrument with the MIMAC is signed please send me a copy.

If you have any questions feel free to contact me by telephone at (609) 984-0288 or write me at NJDEP, Land Use Regulation Program, PO Box 439, 501 East State Street, Trenton, N.J. 08625.

Sincerely

Virginia Kop'Kash

Virginia Kop'Kash
NJDEP Staff to the Council

Enclosure (x)

cc. Jay Springer, LURP, (with enclosure)

RESOLUTION ADOPTED BY THE NEW JERSEY WETLANDS MITIGATION COUNCIL CONDITIONALY APPROVING THE MARSH RESOURCES INC. MEADOWLANDS MITIGATION BANK IN THE HACKENSACK MEADOWLANDS DISTRICT

WHEREAS, the applicant, Marsh Resources Inc. (MRI), a newly established subsidiary of Transcontinental Gas Pipe Line Corporation, has applied for a wetlands mitigation bank designated as the Marsh Resources Inc. Meadowlands Mitigation Bank, to be located on a parcel of land approximately 206.24 acres adjacent to the Millstone River in the Town of Carlstadt, Bergen County, New Jersey and consisting of Block 137, Lots 18-24 & 26-46; and

WHEREAS, the applicant proposes through preserving, herbicide treatment, excavation, regrading and/or planting of the bank site to create 34.7 acres of open water channel, 78.8 acres of low marsh, 61.9 acre of high marsh, 19.7 acres of upland islands and preserve 10.9 acres of land; and

WHEREAS, MRI's mitigation bank is located in the Hackensack Meadowlands District; and

WHEREAS, in order for a mitigation bank to be approved and used to mitigate for wetlands impacts in the Hackensack Meadowlands District the banker must receive an approval from the Meadowlands Interagency Mitigation Advisory Committee (MIMAC); and

WHEREAS, the MIMAC is composed of representatives from the Army Corp of Engineers, U.S. Environmental Protection Agency, National Marine Fisheries, U.S. Fish and Wildlife Service, NJDEP Land Use Regulation Program and the Hackensack Meadowlands Development Commission (HMDC); and

WHEREAS, MRI through the MIMAC process has gone through an extensive review of the proposed bank site and proposed mitigation banking project; and

WHEREAS, as a part of that review process the applicant had to delineate and have verified the extent of wetlands, demonstrate the site is clear of hazardous substances, demonstrate sufficient wetland hydrology exists for the bank plan, develop for review and approval a grading plan and planting plan of the bank project; and

WHEREAS, as a part of the MIMAC agreement the applicant and all the review agencies must sign a bank agreement; and

WHEREAS, contained within the bank agreement is a requirement that the site be monitored for a minimum of five years and possibly up to ten years after completion of the grading/planting and MRI must secure sufficient financial assurance to cover contingency actions in the event of bank default or failure; and

WHEREAS, MRI requested at the May 21, 1998 Freshwater Wetlands Mitigation Council meeting to extend the service area of the bank facility beyond the boundaries of the HMDC; and

WHEREAS, the Council requested at their May 21, 1998 meeting that MRI provide a detailed description of the proposed service area and the type of wetland impacts to be mitigated for at this bank site; and

WHEREAS, in a June 22, 1998 letter to Land Use Regulation Program, MRI provided a written and a graphic description of the proposed service area of the bank facility and a description of the type of wetland impacts to be mitigated for at the bank site; and

WHEREAS, in that June 22, 1998 letter the service area (see attached appendix A) is shown on a mapped prepared by U.S. Geological Survey entitled, "Development of a 14-Digit Hydrologic Coding Scheme and Boundary Data Set for New Jersey" dated 1995 with a service area boundary depicted by watershed unit numbers 02030103170, 02030103180 and 02030104010; and

WHEREAS, in that June 22, 1998 letter the applicant will limit the type of wetland impacts in those three watershed unit numbers to emergent tidal and non-tidal wetland systems; and

WHEREAS, the Council has considered NJDEP staff comments dated May 20, 1998 and July 28, 1998 which were based on information submitted by MRI; and

WHEREAS, the Council finds that the MRI Meadowlands Mitigation Bank has the potential to restore an important wetlands ecosystem following the completion of the proposed mitigation activities in accordance with the MIMAC bank agreement, provided that all conditions of this conditional approval are met;

NOW THEREFORE BE IT RESOLVED that pursuant to the authority of N.J.S.A. 13:9B-13, the MRI Meadowlands Mitigation Bank is approved, subject to the following terms and conditions:

1. The MRI Meadowlands Mitigation Bank must receive all federal, State and local approvals.

2. The MRI Meadowlands Mitigation Bank Banking Instrument must be agreed to and signed by MRI and all parties involved in MIMAC.

3. The MRI must adhere to the MIMAC banking agreement. The Council's approval of this bank is conditioned upon all the conditions contained within the MIMAC banking instrument except concerning the extent of the service area and the wetland impacts that may be mitigated for at this bank facility outside the HMDC.

4. In order to allow emergent tidal and non-tidal wetland impacts within the watershed unit codes 02030103170, 02030103180 and 02030104010 to mitigated at this bank facility, the banker must provide an approval from HMDC permitting those wetland impacts to be mitigated for at this bank facility.

5. No credits shall be available for sale unless and until all conditions in paragraphs 1 through 4 are met.

6. Subject to the terms of this conditional approval, credits shall be available for regulated activities within the watershed unit codes defined as cataloging unit boundary 02030103170, 02030103180 and 02030104010 from the "Development of a 14-Digit Hydrologic Coding Scheme and Boundary Data Set for New Jersey" map prepared by U.S. Geological Survey.

7. MRI, shall maintain a registry of all mitigation credits awarded and available, and shall submit to staff to the Council a statement of credits sold and credits remaining, including the dates of sale, the names of the buyers/applicants, and the permit or file number from the appropriate regulatory agency. The mitigation bank statement must be submitted two weeks after every credit transfer, as well as in an annual report of all bank transactions by November 30th of each year. Failure to submit either of these records may be cause for the Land Use Regulation Program to reject the use of credits from the MRI Meadowlands Mitigation Bank and for the Mitigation Council to void this approval.

8. It is the intent of this Resolution that all reasonable efforts shall be made to ensure that the provisions of this Resolution are implemented and complied with in a cooperative manner. Reasonable efforts shall be made to resolve at the Program level issues arising during the term and operation of this Resolution. Issues that cannot be resolved at the Program level shall be presented to the Council for review and resolution, upon notice to MRI.

9. The Council must be notified by MRI of any changes made to the final banking instrument and the approved plans for the MRI Meadowlands Mitigation Bank in writing. The Council reserves the right to review and approve any changes made to the mitigation plan or the final banking instrument.

10. Nothing in this Resolution shall preclude the Department from enforcing any of its responsibilities under federal or State law.

So resolved as aforesaid

AYES:

NAYS:

ABSTENTIONS:

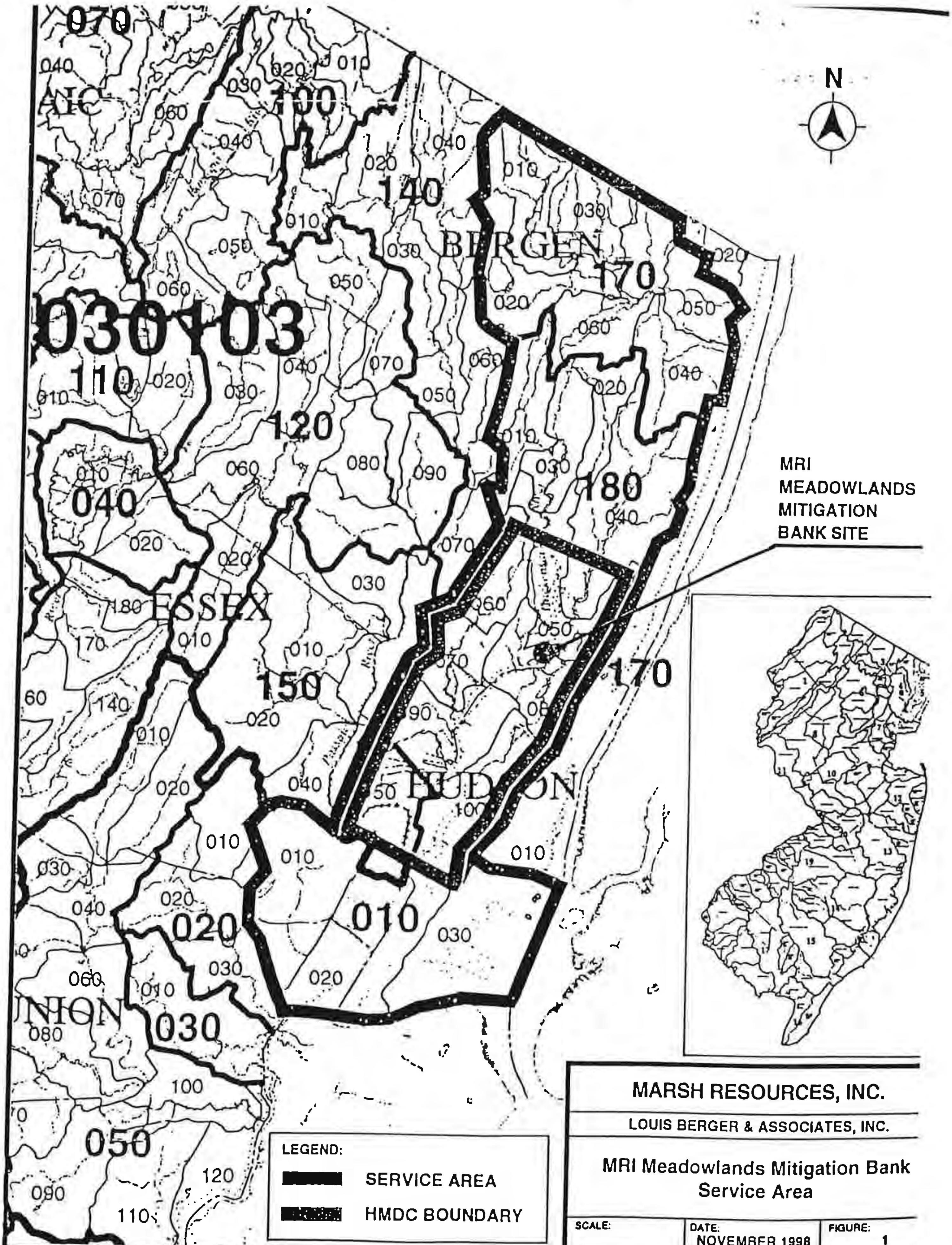
ABSENT:

ATTEST:

Virginia Kop'Kash
Staff to Council

Acting Chairperson

7/30/98
Date



MARSH RESOURCES, INC.

LOUIS BERGER & ASSOCIATES, INC.

MRI Meadowlands Mitigation Bank Service Area

SCALE:	DATE:	FIGURE:
	NOVEMBER 1998	1

APPENDIX 6

HISTORICAL RESOURCES

CONTENTS:

SHPO SECTION 106 REVIEW FINDINGS
PHASE 1A ARCHAEOLOGICAL ASSESSMENT
HISTORICAL RESOURCES STUDY

Christine Todd Whitman
Governor

State of New Jersey
Department of Environmental Protection
Division of Parks and Forestry
Historic Preservation Office
CN-404
Trenton, N.J. 08625-0404
TEL: (609)292-2023
FAX: (609)984-0578

Robert C. Shinn, Jr.
Commissioner

May 8, 1997
HPO-E97-26

Mr. David Koenig
Historic Preservation Specialist
New Jersey Transit
One Penn Plaza East
Newark, New Jersey 07105-2246

Dear Mr. Koenig:

As Deputy State Historic Preservation Officer for New Jersey, in accordance with 36 CFR Part 800: Protection of Historic Properties, as published in the Federal Register 2 September 1986 (51 FR 31115-31125), I am providing **Consultation Comments** for the following project:

Hudson County, New Jersey
Jersey City and Hoboken City
Long Slip Canal Fill In (Habitat Creation Project)
Federal Transit Administration, NJ Transit

I am writing in response to your submission of the following reports: **NJ Transit Long Slip Habitat Creation Project: Archeological Assessment of the Long Slip Canal**, by Dolan Research, Inc., March 1997, and **NJ Transit Long Slip Habitat Creation Project: Request for a Determination of Eligibility for Long Slip**, by Lynn Drobbin and Associates, March 1997.

800.4 Identifying Historic Properties

Erie-Lackawanna (Hoboken) Railroad and Ferry Terminal is included in the National Register of Historic Places (Listed 07/24/73).

The Southern Hoboken Historic District is eligible for inclusion in the National Register (DOE 04/25/80).

The Old Main Delaware, Lackawanna, and Western Railroad Historic District is eligible for inclusion in the National Register (SHPO Opinion 09/24/96).

I concur with your evaluation that Long Slip Canal is not individually eligible, and that it is not a contributing feature of the Southern Hoboken Historic District. Further, I concur with the finding of the **Archeological Assessment** that there is low potential for significant prehistoric or historic archeological remains.

However, it is my opinion as Deputy State Historic Preservation Officer, that the remaining area in Hoboken and Jersey City known as the Erie Lackawanna Railroad and Ferry Terminal and Yard is **eligible** as a contributing feature of the Old Main Delaware, Lackawanna, and Western Railroad Historic District. The boundaries of the district in this area should be delineated to include all property currently owned by NJ Transit, and on the south, would encompass Long Slip and the tracks between the slip and 18th Street in Jersey City (see attached map).

The existing yard is among the last remnants of an historically significant transportation infrastructure that once existed on New Jersey's Hudson River waterfront. Passenger and freight operations of the competing railroads in New Jersey shaped the waterfront from the mid-nineteenth century to the mid-twentieth century, and have all but disappeared on both sides of the river.

800.5 Assessing Effects

It is my determination that the proposed filling of Long Slip will have no effect on the Southern Hoboken Historic District, no adverse effect on the Erie-Lackawanna (Hoboken) Railroad and Ferry Terminal, and an adverse effect on the Old Main Delaware, Lackawanna, and Western Railroad Historic District.

Additional Comments

In order to expedite the process, I suggest execution of a simple Memorandum of Agreement (MOA) stipulating that the documentation of the yard currently in progress as part of the overall preservation plan shall include specific written and photographic information relating to the history and function of Long Slip Canal. It might also be appropriate to create a Railroad History page on NJT's existing Internet World Wide Web site that can serve as an online repository for information on NJT's historic properties and provide information about the former railroad companies that developed and operated the rail lines now operated by NJT.

Although the loss of this waterfront feature adversely effects the character of the Old Main DL&W Historic District, it does allow for expansion and continued utility of the rail yard, which helps ensure the long term preservation of the yard and terminal.

Thank you for you participation in the Section 106 review process. Please call Kinney Clark of this office should you have any questions (609-292-2023).

Yours Truly,

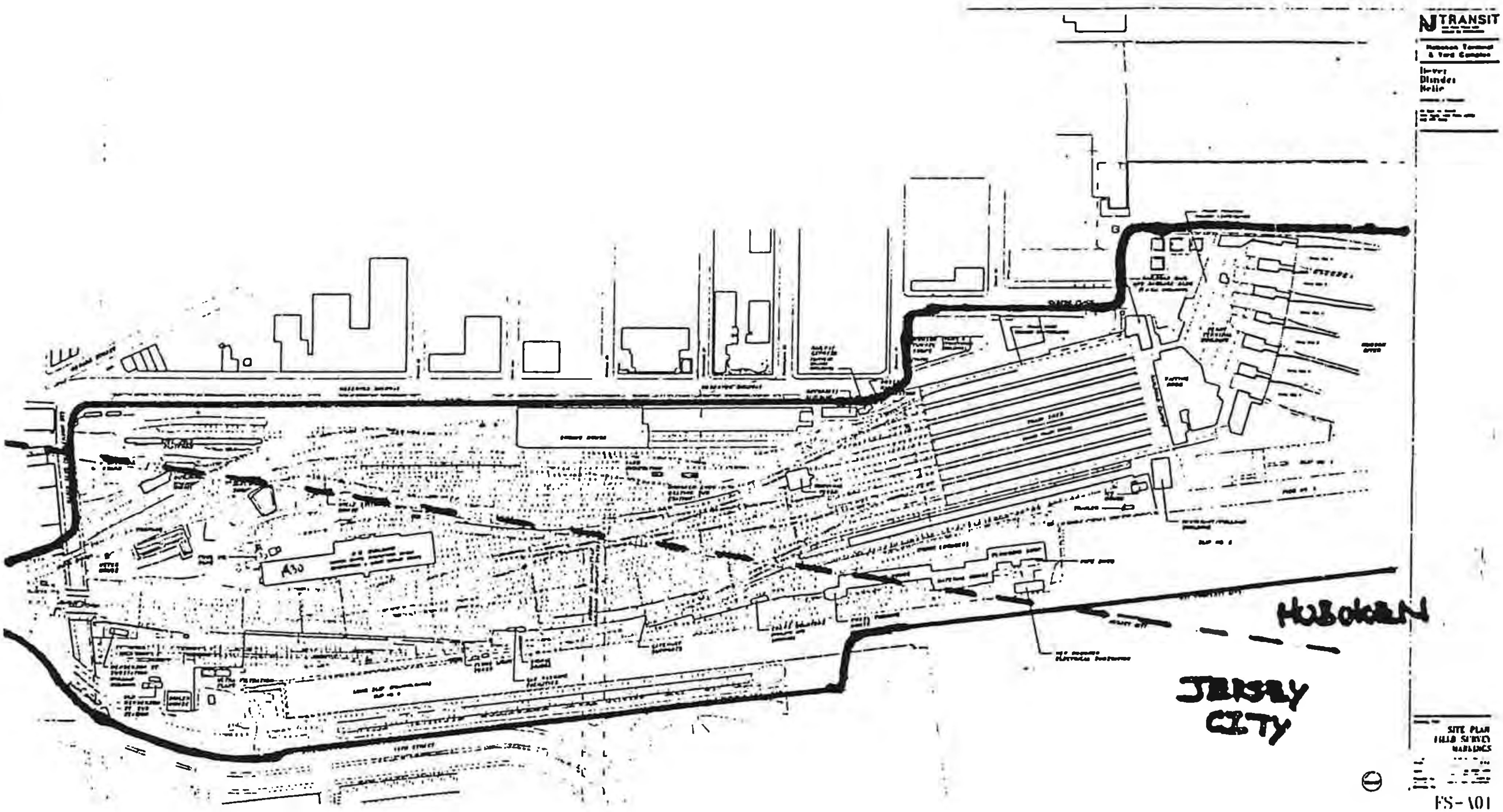
Dorothy P Guzzo

Dorothy P. Guzzo
Deputy State Historic
Preservation Officer

DG/kc97-1293

c. Advisory Council on Historic Preservation
Federal Transit Administration
C. Scott, HPO

8/20/96



Old Main DL+W HD
Eligible Boundaries - East End

MEMORANDUM OF AGREEMENT
AMONG
THE FEDERAL TRANSIT ADMINISTRATION,
THE NEW JERSEY STATE HISTORIC PRESERVATION OFFICE
AND NEW JERSEY TRANSIT
REGARDING THE LONG SLIP HABITAT CREATION PROJECT
AT HOBOKEN YARD

WHEREAS, the Federal Transit Administration (FTA) has determined that the NJ TRANSIT Long Slip Habitat Creation Project will require the filling in of the Long Slip Canal; and

WHEREAS the Federal Transit Administration (FTA) has determined that the filling in of the canal will have an adverse effect upon the Old Main Delaware, Lackawanna and Western Railroad Historic District, a property eligible for inclusion in the National Register of Historic Places; and has consulted with the State Historic Preservation Office (SHPO) pursuant to the regulations (36 CFR Part 800) implementing Section 106 of the National Historic Preservation Act (16 U.S.C. 470f); and

WHEREAS, HABS/HAER documentation of the Hoboken Yard is currently in progress pursuant to a 1994 MOA regarding demolition of the Freight Office Building and as part of the overall preservation plan for Hoboken Terminal; and

WHEREAS, NEW JERSEY TRANSIT (NJT) has participated in the consultation and has been invited to join in this agreement.

NOW, THEREFORE, FTA, the SHPO and NJ TRANSIT agree that the project shall be implemented in accordance with the following stipulations in order to take into account the effect of the undertaking on historic properties.

Stipulations

The FTA will ensure that the following measures will be carried out:

1. NJT shall include specific written and photographic documentation relating to the history and function of the Long Slip Canal in the HABS/HAER documentation of Hoboken Yard, to be reviewed and approved by the SHPO.

2. In consultation with the SHPO, NJT will create an interpretive exhibit describing the history and significance of the Long Slip Canal and the adjacent Delaware, Lackawanna & Western Railroad passenger and freight yards.

Execution of this Memorandum of Agreement by FTA and the SHPO, its subsequent acceptance by the Council and implementation of its terms, evidence that FTA has afforded the Council an opportunity to comment on the NJ TRANSIT Long Slip Habitat Creation Project and its effects on historic properties and that FTA has taken into account the effects of the undertaking on historic properties.

____

Federal Transit Administration

____

State Historic Preservation Officer

Concur:

____

New Jersey Transit

Accepted:

____

Advisory Council on HIstoric Preservation

NJ TRANSIT LONG SLIP
HABITAT CREATION PROJECT

ARCHAEOLOGICAL ASSESSMENT OF
THE LONG SLIP CANAL,
HOBOKEN AND JERSEY CITY
HUDSON COUNTY, NEW JERSEY

SUBMITTED TO:
EUGENE PECK
DAMES & MOORE
ONE BLUE HILL PLAZA - SUITE 530
PEARL RIVER, NY 10965

SUBMITTED BY:
J. LEE COX, JR.
DOLAN RESEARCH, INC.
4425 OSAGE AVE.
PHILADELPHIA, PA. 19014

March, 1997

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MANAGEMENT SUMMARY

In conjunction with NJ Transit Long Slip Habitat Creation Project, NJ Transit has proposed the filling of the Long Slip Canal, Hoboken and Jersey City, Hudson County, New Jersey. This Phase Ia archaeological evaluation was conducted to assess the potential of the canal to contain submerged and terrestrial historic and archaeological sites. Research confirms that the Long Slip Canal was created from man-made land during the last quarter of the nineteenth century. While the canal borders the Erie-Lackawanna Railroad and Ferry Terminal, a contributing resource to the Old Main Delaware, Lackawanna & Western Railroad Historic District, the District has no contributing elements that are archaeological. The land fill area in the vicinity of the Long Slip Canal has very little potential to yield potentially significant archaeological material.

1.0 Introduction

In conjunction with the planned filling of the Long Slip Canal, Hoboken and Jersey City, Hudson County, New Jersey, a preliminary Phase Ia archaeological evaluation was conducted to assess the potential of the canal to contain submerged and terrestrial historic and archaeological sites. The Phase Ia archaeological evaluation was carried out by Dolan Research, Inc. under contract to Dames and Moore. New Jersey Transit owns the 2,000 foot long and 100 foot wide Long Slip Canal, and is proposing to fill the waterway as part of the Long Slip Canal Habitat Creation Project. The Long Slip Canal Habitat Creation Project was authorized by NJ Transit to create a new habitat for diverse fish species at the canal entrance area, control point pollution sources by eliminating Hoboken outfalls into the canal and improving the Jersey City outfall, control non-point pollution sources, create public access consistent with the Hudson Waterfront Walkway, and to accept dredged material in a confined disposal facility to offset project costs.

Historical background research was gathered to determine the potential presence or absence of submerged and terrestrial historic archaeological resources that might be affected by the proposed canal filling project. Archaeological investigations assisted in this instance in compliance with Section 106 and 110 of the National Historic Preservation Act of 1966, as amended; the regulations of the Advisory Council on Historic Preservation (30 CFR Part 800); the National Environmental Policy Act of 1969, as amended; and other applicable federal mandates. No formal scope-of-work was issued for these investigations, but following consultation with the various state officials, it was agreed that a preliminary archaeological evaluation should be performed involving documentary and background research and the preparation of a brief summary.

The goal of the investigations was to determine the likelihood and nature of potentially significant archaeological and historical resources within the proposed canal filling project. Documentary data was used to provide a framework for identifying historic archaeological resources which may have been deposited within the canal area, and to determine the extent of subsequent activities that may have removed or disturbed such material. Historical and maritime activities relating to Long Slip Canal were researched and documented. Both primary and secondary source material, including historic maps and charts, were researched to provide data on local, county, and regional historical developments. The New Jersey State Archaeological Site Files, and the National and State Register of Historic Places were consulted to determine the existence of significant cultural sites in the vicinity of the canal.

Research confirms that the Long Slip Canal was created from man-made land during the last quarter of the nineteenth century. The land fill area in the vicinity of the Long Slip Canal has very little potential to yield potentially significant archaeological material.

2.0 Project Location And Description

The Long Slip Canal is located within the Hoboken Freight Terminal Yard along the western shoreline of the Hudson River, opposite Manhattan, New York. The 2,000 foot long and 100 foot wide man-made canal lies across the boundary separating Hoboken and Jersey City, New Jersey. It extends west, perpendicular from the Hudson River, to approximately 150 feet east of the foot of Henderson Street, Jersey City, New Jersey.

The canal was created from a filled (or man-made) section of New Jersey' Hudson River shoreline. During the nineteenth century, spoil from the navigational channels in the Hudson River was deposited along various places along the New Jersey shoreline, including Hoboken and Jersey City. The northern shore of Harsimus Cove, south of the the Hoboken Ferry, was filled in to accommodate the construction of the Hoboken Freight Terminal. The man-made land from which the canal was created was conveyed from the state of New Jersey by a riparian grants dated April 28, 1874, and April 14, 1888 to the Morris and Essex Railroad Company. The Morris and Essex Railroad Company had been leased to the Delaware Lackawanna & Western Railroad in 1868.

The canal was built as part of the general expansion of terminal for the Delaware Lackawanna & Western Railroad. The entire terminal complex was located on an unstable fill placed to a depth of 20 feet over nearly fluid silt underlying an old embayment of the Hudson River (Condit, 1980). Long Slip Canal first appears on a plat map dated 1872, located between Piers 4 and 5 of the Hoboken Rail Yard. In that year the canal was approximately two-thirds its present length, extending only to a point just west of the line of Hoboken's Garden Street. An 1890 plat map shows that the canal was extended at least two blocks further west to a point in line with Jersey City's Provost Street (Beyer Blinder, Belle, 1996).

It was constructed with a timber crib that extends down approximately 21 feet below mean low water. Although no primary source documentation of the construction process has been identified, using rocked filled timber cribs was a common method of constructing retaining walls on the Hudson River shorelines throughout the nineteenth and twentieth centuries. Similar timber crib construction was documented during the construction of a slip for the Central Railroad of New Jersey at Communipaw, Jersey City (Green, 1917). Typically, a channel would have been dredged through the fill to the design depth. A series of timber cribs would then have been floated to the site and sunken in place with stone ballast. The cribs would then be attached side by side. The back sides of the slip would have been backfilled to secure the structure. A concrete gravity wall was added to the Long Slip Canal ca. 1930.

Presently, the canal is owned by NJ Transit and is not currently used for any navigational or railroad purposes. The waterfront property houses an extensive network of commuter rail lines which terminate here and connect with the Port Authority Trans-Hudson rapid transit and ferry system. While the Hoboken Rail Yard serves more than 30,000 daily commuters to Manhattan, the canal slip has been abandoned ("Hoboken Rail Yard Fact

Sheet," Dames & Moore, n.d). It serves only as a discharge for stormwater and combined sewage overflows. The canal has not been used for navigational purposes since ca. 1960. The canal slip survives in a decayed condition. Sections of rusting steel rebar protrude from the concrete face of the canal wall. Diver inspections in 1994 documented the deterioration of the canal slip: large scours were evident where the concrete cap's base rested on the timber crib piles; severe scaling and spalling along the base of the concrete cap; timber work exhibiting cracks, rots, and accelerated decay; missing pile sections creating holes along the face of the slip, and widespread debris and loose aggregate were noted at the base of the crib (Dames & Moore, June 20, 22, 1994).

3.0 Previous Research

Previous background historical research has been conducted as part of several studies of the Hoboken Freight Terminal and the Long Slip Canal. Considerable historical research was included on the terminal and the canal in the Hoboken Terminal and Yard Preservation Plan (Beyer Blinder Belle, 1996). The historical significance of the canal was evaluated as part of the study entitled, NJ Transit Long Slip Habitat Creation Project, Request for a Determination of Eligibility for Long Slip (Lynn Drobbin & Associates, 1996). In conclusion, Long Slip was not considered eligible for listing on the National Register of Historic Places. "Long Slip is not eligible for listing as a contributing resource ... due to a loss of integrity caused by the demolition of the Freight Terminal and Yard and due to the lack of contributing resources that date form the period of significance... Substantial changes have been made to the original design and setting of Long Slip and the Hoboken Freight Terminal; these changes have impaired Long Slip's ability to convey its appearance and function during the period of significance (Lynn Drobbin & Associates, 196; p. 26).

4.0 Findings

Long Slip Canal, a late nineteenth century man-made waterway, was formerly a major part of the Delaware, Lackawanna & Western Railroad's Hoboken Freight Terminal. The entire terminal complex was created on top of filled material dredged from the Hudson River. The Morris & Essex Railroad Company, which had established a single line from Newark through Bergen Hill into Hoboken in 1862, was leased to the Delaware, Lackawanna, and Western Railroad (DL&W) in December, 1868. By the end of the nineteenth century, Jersey City railroads, including the DL&W, the Erie and the Pennsylvania, were handling approximately 90% of all export rail freight that passed through New York Harbor (Lynn Drobbin & Associates, 1996). Of these carriers, DL&W was the leader in carrying both freight and passengers.

The DL&W constructed the Long Slip Canal by 1872. It was expanded west to its present length to a point in line with Jersey City's Provost Street by 1890. The 2,000 foot long and 100 foot wide canal was built to accommodate the transfer of cargo between maritime lighter barges and railroad cars. Lighters, flat bottom barges with no means of propulsion, were brought to and from the canal by tugboats. Initially, anthracite coal was the primary freight shipped through the Hoboken Freight Terminal. Later after extensive renovations following major fires in 1904 and 1905, the DL&W evolved from a basically a coal and local freight carrier to a large scale freight carrier shipping to coastal and international ports. Two large 60 ton gantry cranes were operated alongside the canal slip to transfer a variety of heavy freight to and from lighters.

The canal was actively used until ca. 1960 when profound changes occurred in New York's marine and railroad freight operations. Large, uniform size containers were widely used to handle maritime shipping material. Newark's port facilities were designed to handle these containers and soon much of the maritime traffic moving through New York was diverted to Newark. Coal was also soon replaced by oil as a fuel source, eliminating much of the coal traffic from the Hudson River. Additionally, the St. Lawrence Seaway was opened in 1957 allowing sea-level navigation into the Great Lakes, taking away much of the grain traffic from the Hudson River.

5.0 Potential Archaeological Resource Types in Long Slip Canal

Since the canal was created from landfill during the last quarter of the nineteenth century, the canal does not contain intact archaeological material. The canal was extensively used by lighter barges. Coal, grain, and other assorted material was transferred between the barges and railroad cars. The barges were towed to and from the canal by tugs that could transport several of the lighters at one time. The canal has not been actively used for navigation since ca. 1960. Although unlikely, the potential does exist that one of these barges was abandoned and sank within the canal after it ceased as a navigational artery. However, such a potential barge would possess little historical and/or archaeological significance and would be unlikely to merit consideration for inclusion in the National Register of Historic Places.

A nautical vessel, generally excepting reconstructions and reproductions, is considered historic if it is eligible for listing in the National Register of Historic Places at a local, regional, national, or international level of significance. To be eligible for the National Register of Historic Places, a vessel "must be significant in American history, architecture, archaeology, engineering, or culture, and possess integrity of location, design, setting, materials, workmanship, feeling, and association." To be considered significant the site must meet one or more of four National Register criteria:

A. Association with events that have made a significant contribution to the broad patterns of our history; or

B. Association with the lives of persons significant in our past; or

C. Embodiment of the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction; or

D. Sites that have yielded, or may be likely to yield, information important in prehistory or history.

National Register Bulletin 20 clarifies the process for nominating historic vessels and shipwrecks to the National Register of Historic Places. There are five basic types of historic vessels which may be eligible for listing in the National Register. These types are: Floating historic vessels; Dry-berthed historic vessels; Small craft; Hulks; and Shipwrecks. Shipwrecks. Vessels must meet at least one of the above criteria and retain integrity of location, design, settings, materials, workmanship, feelings and association. Determining the significance of a historic vessel depends on establishing whether the vessel is:

1. the sole, best, or a good representative of a specific vessel type; or

2. is associated with a significant designer or builder; or

3. was involved in important maritime trade, naval, recreational, government, or commercial activities.

Properties which qualify for the National Register, must have significance in one or more "Areas of Significance" that are listed in National Register Bulletin 16A. Although 29 specific categories are listed, only some are typically relevant to the historic vessels. Architecture, archaeology, commerce, communications, engineering, entertainment & recreation, exploration & settlement, industry, invention, maritime history, military, science, and transportation are potentially applicable Areas of Significance for many types of historic vessels.

It is considered very unlikely that such a potentially significant submerged site was deposited in the vicinity of Long Slip Canal.

6.0 Summary and Recommendations
Long Slip Canal is part of the historic Hoboken Rail Yard Terminal on the Hudson River waterfront. Numerous surveys have been completed on the significance of the terminal and the canal slip. While the canal borders the Erie-Lackawanna Railroad and Ferry Terminal, a contributing resource to the Old Main Delaware, Lackawanna & Western Railroad Historic District, the District has no contributing elements that are archaeological. A report evaluating the National Register eligibility of the Long Slip Canal concluded that the canal was not eligible for listing on the National Register of Historic Places (Lynn Drobbin & Associates, 1996)..

The canal, approximately 2,000 feet long, 100 feet wide and 21 feet deep, was created from filled land during the last quarter of the nineteenth century. While the potential exists that a barge has been abandoned and sunk in the canal since it was last used for navigation, it is unlikely that such a potential vessel would meet eligibility requirements for inclusion to the National Register of Historic Places.

Furthermore, the construction methods of the timber cribbing comprising the canal structure is not considered historically or archaeologically significant. The cribbing technique employed at Long Slip Canal was of a standard design that was used along many portions of the Hudson waterfront. A concrete cap was added to the canal ca. 1930, and the entire structure was reported in a decayed state as recently as 1994.

7.0 References Cited

Beyer, Blinder, Belle "Hoboken Terminal and Yard Preservation Plan, Final Draft." Report submitted to NJ Transit. Newark, NJ. 1996.

Condit, Carl The Port of New York, A History of the Rail and Terminal System from the Beginnings to Pennsylvania Station. The University of Chicago Press. Chicago. 1980

Dames & Moore "Hoboken Rail Yard, Long Slip Canal Habitat Creation Project, Fact Sheet." Submitted to NJ Transit. Newark, NJ. n.d.

Dames & Moore "Long Slip Canal Field Inspection Notes." Submitted to NJ Transit. Newark, NJ. 1994

Correspondence from Jo Ann Cubberlay, Manager New Jersey Bureau of Tidelands Management, to Joseph Porrovecchio, Dames and Moore, regarding riparian grants for the Long Slip Canal. June 25, 1996.

Correspondence from Michael L. Gregg, Senior New Jersey Historic Preservation Specialist, to Eugene Peck, Dames and Moore, regarding prospects for the presence of archaeological sites and historic structures that are listed or may be eligible for listing on the New Jersey or National Register of Historic Places. March 6, 1997.

Lynn Drobbin & Associates "NJ Transit Long Slip Habitat Creation Project, Request for A Determination of Eligibility for Long Slip, Hoboken and Jersey City, Hudson County, New Jersey." Report submitted to NJ Transit. Newark, NJ. 1996

FINAL
SECTION 4(f) STATEMENT
FOR THE

NJ TRANSIT
LONG SLIP HABITAT CREATION PROJECT

HOBOKEN, HUDSON COUNTY, NEW JERSEY

Prepared for:
NJ TRANSIT

By: Lynn Drobbin & Associates

March, 2000

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I. INTRODUCTION

A. HISTORIC STATUS

The Long Slip Canal Habitat Creation Project 4(f) Evaluation has been prepared in compliance with Section 4(f) of the U.S. Department of Transportation Act of 1966 which states that "a detailed 4(f) analysis is required if the project uses land which is considered significant by the national, state or local official having jurisdiction over it" and which "for historic properties, 4(f) land is significant if it is listed in or eligible for inclusion in the National Register of Historic Places".

Long Slip is a man-made canal located in the NJ TRANSIT Hoboken Yard in Hoboken, Hudson County, New Jersey. The Long Slip Canal Habitat Creation Project will fill Long Slip to provide an expanded and improved Hoboken Terminal Rail Yard. Filling Long Slip will allow for construction of additional storage tracks to accommodate a greater number of full-length trains and additional maintenance facilities where minor running repairs can be conducted.

In correspondence dated May 8, 1997 from Dorothy P. Guzzo, Deputy State Historic Preservation Officer (SHPO) to David Koenig, Historic Preservation Specialist, NJ TRANSIT, the SHPO stated that Long Slip was "eligible for listing on the National Register as a contributing feature of the Old Main Delaware, Lackawanna and Western Railroad Historic District" and that "the proposed filling of Long Slip would have an adverse effect on the Old Main Delaware, Lackawanna & Western Railroad (DL&W) Historic District." (Appendix A).

The adverse effect finding for the filling of Long Slip constitutes a "significant impact" under US DOT regulations, therefore, this Section 4(f) Evaluation has been prepared to determine that all feasible and prudent alternatives to the adverse effect on Long Slip were evaluated prior to the implementation of the project.

In accordance with SHPO recommendations, a Memorandum of Agreement has been executed as of May 7, 1999 to mitigate the adverse effects of the filling of Long Slip on the Old Main DL&W Railroad Historic District (Appendix B). See Chapter IV. Mitigation Measures for a discussion of the content of the MOA. Also, included in Appendix C is the Department of the Interior approval of the Section 4(f) Evaluation.

B. PROJECT SUMMARY

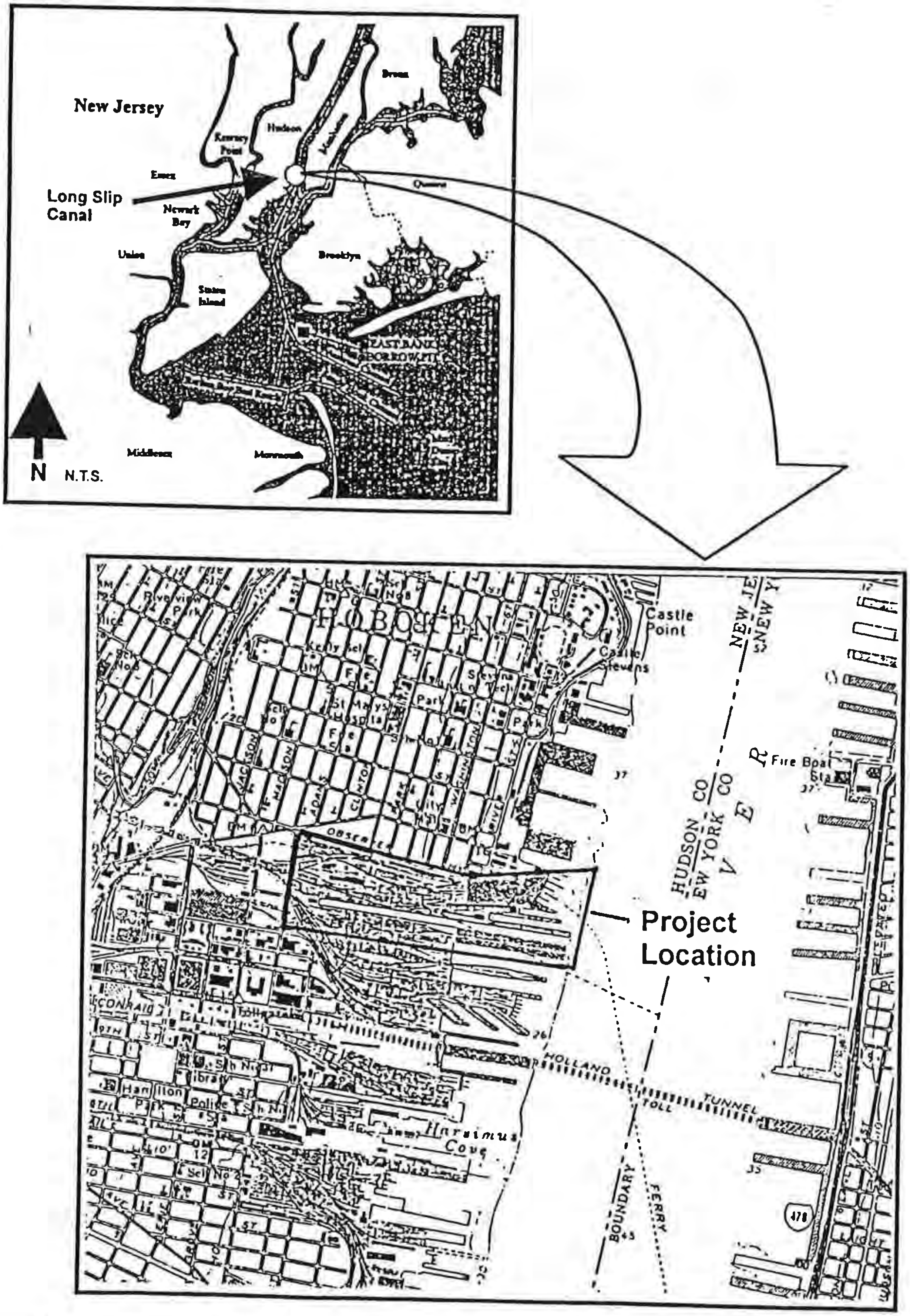
NJ TRANSIT owns and operates the historic Erie-Lackawanna (Hoboken) Railroad and Ferry Terminal and Rail Yard Terminal. The Long Slip Canal Habitat Creation Project is a component of the Hoboken Rail Yard Rehabilitation project that includes rehabilitation of the Erie-Lackawanna Railroad Terminal, an interface with the Hudson Bergen Light Rail Transit System and the Hoboken Rail Yard expansion and infrastructure improvements.

The yard facilities at Hoboken Terminal are located immediately west of the train shed and passenger platforms, bordered by Observer Highway to the north, 18th Street to the south, Marin Boulevard (Henderson Street) to the west and the Hudson River on the east. Currently, the southern boundary of the functioning rail yard terminates at the north side of Long Slip.

The yard provides for inbound and outbound train movements and contains facilities for storage of locomotives and cars for running repairs, train washing and other equipment servicing functions. Five main tracks in the yard feed into 18 platform tracks and yard storage tracks. The slip, 100 feet wide and 2000 feet long from the bulkhead line, handles the discharge of stormwater and combined sewerage overflows but is not used for any rail or marine purposes.

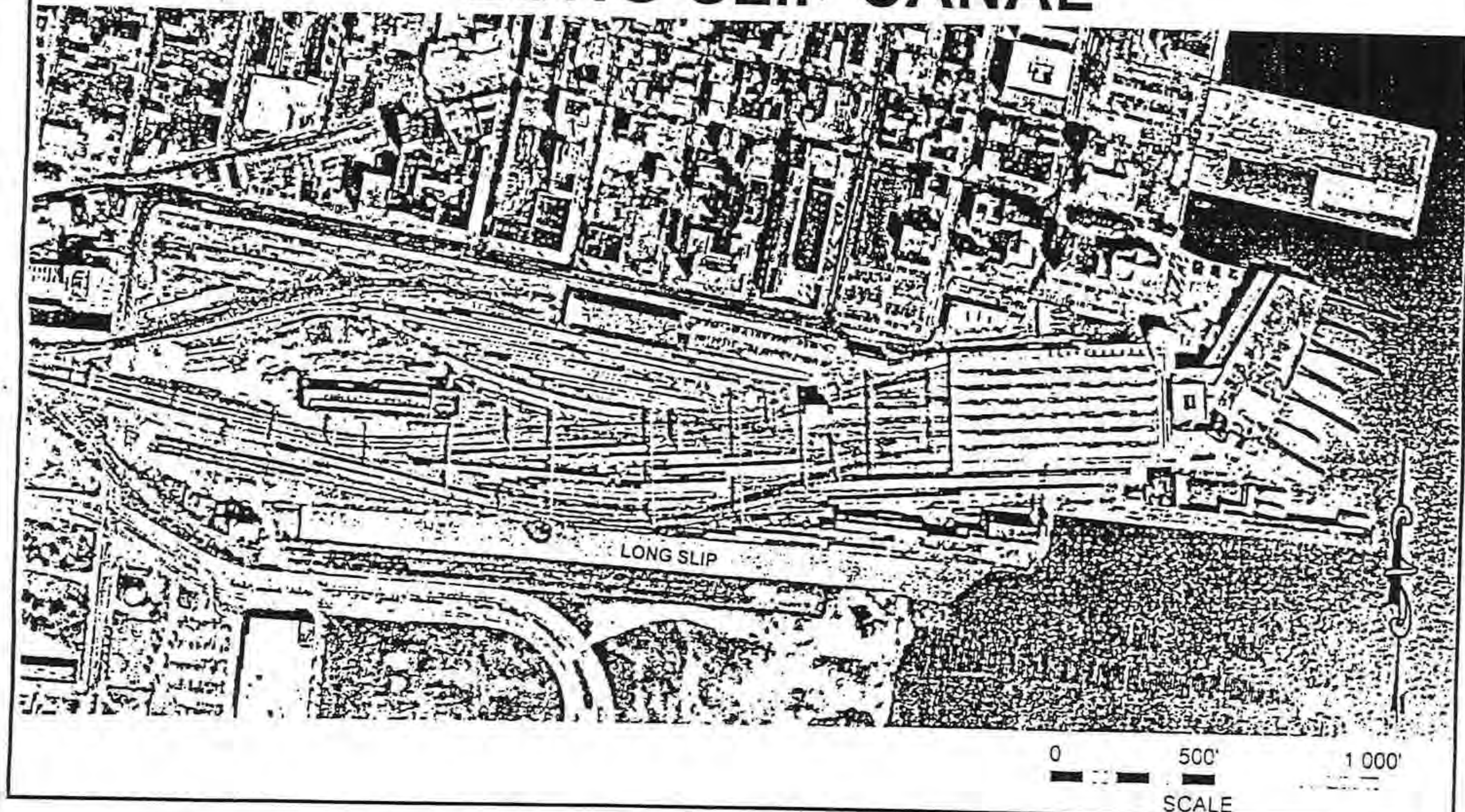
The Long Slip Canal Habitat Creation Project will convert Long Slip from a water use to a land use. Long Slip, formerly used by lighters or barges to load and unload materials by crane as part of the former freight operations of the Delaware, Lackawanna & Western Railroad, is the only substantially unused piece of property within the existing yard boundaries.

Although the impetus to fill Long Slip is due to the proposed yard expansion, the project has been called The Long Slip Canal Habitat Creation Project because it will use an ecosystem approach to comprehensively address local and regional water quality problems with the objective of creating sustainable fish habitat where none could otherwise exist. Environmental benefits will include the restoration of interpier fisheries habitat and improved water quality. Commuters and local residents will benefit from the creation of up to three acres of new public access to the waterfront.



PROJECT LOCATION MAP

LONG SLIP CANAL



AERIAL PHOTOGRAPH OF HOBOKEN TERMINAL AND LONG SLIP

II. DESCRIPTION AND SIGNIFICANCE OF THE AFFECTED PROPERTY

The information presented below regarding the description and significance of Long Slip has been excerpted from the *NJ TRANSIT Long Slip Canal Habitat Creation Project, Request for a Determination of Eligibility for Long Slip*, Lynn Drobbin & Associates. March 6, 1997. This document is contained in its entirety in Appendix C.

A. DESCRIPTION

Long Slip is a man-made canal slip located in the Hoboken Terminal Rail Yard in Hudson County, New Jersey. The canal, its eastern end bisected by the municipal boundaries of Jersey City and Hoboken, extends west from the Hudson River to approximately 150 feet east of Marin Boulevard, Jersey City. Long Slip measures approximately 100 feet wide by 2,000 feet long.

Constructed ca. 1870 by the Delaware Lackawanna & Western Railroad (DL&W), the slip consists of a timber crib at approximately 21 feet below mean sea level with a concrete gravity wall constructed ca. 1930. As described in the *Stability Analysis and Environmental Findings, Parcel No. 1 Bulkhead at Newport City, Jersey City, New Jersey, Dravo Van Houten, Inc., for Vollmer Associates, New York, NY, 1986*, "This type of crib would have been built and floated over a previously prepared bed which had been dredged to firm material or, if firm material was too deep, as on the east end of Long Slip, the bed would have been overdredged and backfilled to the design depth. The crib would then be filled with stone ballast and sunk".

A 1917 publication, *Wharves and Piers: Their Design, Construction and Equipment*, by Carleton Green, describes a stone-filled timber crib as one of the most common forms of a retaining structure:

> "This crib wall construction, as built by the Central Railroad of New Jersey at Communipaw, Jersey City, consists of "large round-log cribs that are from 30 to 50 feet deep and are founded on hardpan. In these cribs, vertical logs were placed in the corners of the pockets to prevent vertical shrinkage and the floored pockets are continuous from front to rear. Where it was expected that mud would flow into the trench, stone filling was deposited as soon as the dredging was completed and the crib placed on this layer of stone".

Cast iron mooring cleats, formerly used to moor the lighters that serviced Long Slip, remain intact along the concrete gravity wall. Sections of rusting steel reinforcement rods jut out from the concrete wall. The southern side of the slip, formerly Pier 5 and later renamed to Pier 3, is now unused with several old freight cars and other pieces of deteriorated rail equipment. The southern border is demarcated by a chain link fence beyond which is 18th Street, Jersey City. Several large retail stores and Newport City, a multi-story apartment complex, have been constructed on the portion of the freight yard that extended south of 18th Street to 12th Street. North of Long Slip, at the former location of Pier 4 (later renamed Pier 2), is a single abandoned track with several unused rail passenger cars and an abandoned snow plow engine. (See Photos 1-14 in Appendix C).

B. HISTORY

Long Slip, a man-made canal that extends from the Hudson River to several feet east of the western boundary of the Hoboken Rail Yard, was formerly a major component of the Delaware, Lackawanna & Western Railroad (DL&W) Hoboken Freight Terminal. The Hoboken Freight Terminal was located southwest of the DL&W Hoboken Passenger Rail and Ferry Terminal. The Freight Terminal and its Yards were one of the finest rail freight complexes west of the Hudson River between 1902 and 1912. Long Slip is one of the last remnants of the former Hoboken Freight Terminal which, at its peak of operations, extended south to 12th Street, Jersey City. The Slip, owned by NJ TRANSIT, is not currently used for any navigational or railroad purposes. It is used to handle the discharge of stormwater and combined sewage overflows.

Long Slip was significant for its critical role in facilitating the transfer of goods from lighters to freight cars. Large manufactured items that required a crane were unloaded at Long Slip; smaller items not requiring a crane were unloaded into one of the covered piers to await the availability of the exporting ship. Long Slip, which was served by two sixty-ton gantry cranes used to transfer heavy export freight, was a major factor in the success of the DL&W's export freight traffic.

The importance of Hoboken Yard and Long Slip for freight storage and transport declined in the mid-1950s due to a dramatic change in the marine and railroad freight operations in the New York Harbor area. Containerization grew rapidly and diverted freight traffic to Port Newark where large open areas could store and transport the enormous containers. Powerplants and buildings switched from coal to oil eliminating coal traffic from the Hudson River. The St. Lawrence Seaway, opened in 1957, provided a direct inland route to the plains area and as a result, captured grain traffic away from both the DL&W and the New York Central. The construction and expansion of super highways promoted the transport of freight merchandise by private trucking companies.

In 1960, the DL&W and the Erie Railroad, both in dire financial straits, merged to form the Erie-Lackawanna. However, the railroads continued to decline and the old DL&W Yard south of 18th Street was closed. Freight business continued to be diverted from the railroads through the 1960s and by the 1970s, the remaining Erie-Lackawanna freight traffic was transferred to the Pennsylvania Rail Yards.

In the 1980s, almost the entire Hoboken Freight Terminal, from 18th Street south to 12th Street, Jersey City, was sold to Newport Development Associates who demolished all of the Terminal and Yard structures south of Long Slip and several piers to construct a high-rise apartment complex. Shortly afterwards, several retail establishments were also constructed on the former Freight Yard site. Newport Development Associates also facilitated the construction of 18th Street east of Marin Boulevard, a new roadway that extends along the current southern border of the Yard. NJ TRANSIT demolished the power house and smokestack located at the foot of Long Slip. In 1995, the Hoboken Freight Terminal Office Building at the foot of Pier One was demolished.

C. SIGNIFICANCE

Despite the fact that much of the original historic architectural integrity of the former Hoboken Freight Yard is not intact, the SHPO found that the remaining area in Hoboken and Jersey City known as the Erie-Lackawanna Railroad and Ferry Terminal and Yard (currently known as the NJ TRANSIT Hoboken Terminal and Yard) is eligible as a contributing feature of the Old Main Delaware, Lackawanna and Western (DL&W) Railroad Historic District; and that the boundaries of this district would include all property currently owned by NJ TRANSIT and would encompass Long Slip and the tracks between the slip and 18th Street in Jersey City. Therefore, Long Slip, while not individually eligible for listing on the National Register of Historic Places, is eligible as a contributing feature to the Old Main DL&W Railroad Historic District.

The Old Main DL&W Railroad Historic District, which extends from Hoboken Terminal to the Delaware River, has a SHPO Opinion of Eligibility for listing on the National Register of Historic Places due to its associations with suburbanization, commuter and passenger traffic, freight traffic, engineering and architecture.

The SHPO also stated that the existing yard is important as one of the last remnants of an historically significant transportation infrastructure that once existed on New Jersey's Hudson River waterfront. Passenger and freight operations of the competing railroads in New Jersey shaped the waterfront from the mid-nineteenth century to the mid-twentieth century, and have all but disappeared on both sides of the river.

B. DEMANDS ON SYSTEM

One of the most critical elements of the NJ TRANSIT transportation system is Hoboken Terminal, a multi-modal facility located at the Hudson River waterfront. As a center of passenger activity, it ranks ahead of all but one other facility in New Jersey. It is equally as important in terms of train movements. Nine commuter rail lines (offering 287 daily trains) terminate here and interface with ferry service, the Port Authority Trans-Hudson (PATH) rapid transit system, the NJ TRANSIT Bus Depot, and various other bus lines. This network of services links lower and midtown Manhattan with many urban and suburban points in 13 counties of northern and central New Jersey and southern New York State. In New Jersey alone, these counties have a resident population of 5.5 million persons (per 1990 Census).

The importance of this transportation facility will intensify in future years. The Hudson-Bergen Light Rail Transit System (HBLRTS), when completed, will serve the complex. More frequent service will operate as a result of the Secaucus Transfer station project now under construction. Under the current configuration, the Hoboken facility is experiencing difficulty in meeting the operational and maintenance requirements of the current demands; it will be physically and financially unable to accommodate the future increases. Additional rail services are being planned, including the introduction of trains along the West Shore corridor in eastern Bergen and Rockland Counties (an area of extremely high automobile use) and along the New York, Susquehanna & Western corridor through Passaic and Sussex Counties. Total fleet requirements associated with Hoboken commuter rail services is estimated to grow from 260 cars (current) to 366 cars (in 2002) and eventually to 485 cars (in 2010). Table I derives this growth by rail corridor.

Table I - Basis of Future Fleet Demands - Numbers of Cars Daily

Source	1997	2002	2010	1997-2010 Change
Waterfront Connection Services	27	27	65	38
M&E, Montclair Connection, Boonton	123	147	171	48
Main/Bergen, NYS&W	51	102	110	59
Metro North Services	25	27	29	4
Pascack Valley	34	63	68	34
West Shore Line Service	0	0	42	42
Total	**260**	**366**	**485**	**225**

Trains move into and out of Hoboken Terminal at a peak rate of 30 trains per hour in the peak direction, using four main approach tracks. Additional trains moving in the reverse direction during this time compete for use of the same trackage. This hourly rate is forecasted to grow to 41 trains over the next decade. While the Midtown Direct project has diverted a small number of train movements away from Hoboken Terminal, a net increase of train service will occur nonetheless, as more trains are operated on existing rail lines to meet expected customer demand, or on new rail corridors to provide a transit alternative to private auto use.

In addition to total fleet requirements and peak hour movements, a key capacity and operational requirement is train storage during non-peak times. Peak train storage requirements occur during the midday period and currently total 42 train positions. This number is expected to grow to 50 by 2002 at the inception of the Secaucus Transfer project and thereafter, to as many as 62 to 71 trainsets to accommodate passenger growth and service expansions. Table II indicates the anticipated storage requirements based on planned and proposed system expansions. Since some of the projects are proposed but may not be funded, a 2010 storage requirement of 62-66 trains is considered conservative and realistic.

Table II - Basis of Future Train Storage Demands

Source	1997	2010	Change
Waterfront Connection Services	4	12	8
M&E, Montclair Connection, Boonton	19	24	5
Main/Bergen, NYS&W	9	15	6
Metro-North Services	5	6	1
Pascack Valley	5	9	4
West Shore Line Service	0	5	5
Total	**42**	**71**	**29**

C. OPERATIONAL NEEDS

The yard provides for the inbound and outbound movements of NJ TRANSIT trains, the storage of locomotives and cars, and facilities for running repairs, fueling, train washing, and other equipment servicing functions. Five main tracks through the yard cumulatively feed into 18 platform tracks and various yard storage tracks. The platform tracks can be aggregated into three groups that tend to be linked with certain equipment types, rail lines, and yard storage areas. Thus, not all segments of the yard and platforms are universally available, creating less than full flexibility of operations.

The station and yard facilities that remain at Hoboken are inadequate in terms of size and layout. NJ TRANSIT has embarked on a $350 million program to restore, modernize, and reconfigure the station buildings, train shed, and rail yard to meet current and future travel patterns and needs. The proposed project is a key component in this program.

E. CONCLUSION OF PURPOSE AND NEED

The Long Slip Canal Habitat Creation Project resulted from a growing need to expand facilities to meet existing and projected operational and ridership demands, as described above. Several previous studies, conducted from 1981 to 1997, developed and evaluated alternatives to provide cost-effective train storage, maintenance and operations, while avoiding or minimizing adverse environmental, social, or economic impacts. After the evaluation of several alternatives, the expansion of existing Hoboken Terminal facilities through the use of the area containing the currently abandoned Long Slip emerged as the preferred solution.

IV. PROPOSED USE / PROJECT DESCRIPTION

The project consists of the filling of Long Slip to create approximately 4.6 acres of land for the expansion of commuter rail capacity in order to meet current and projected operating requirements. Long Slip is a component of the Hoboken Rail Yard Terminal, a 54-acre parcel of land located on the south side of Hoboken, New Jersey, and bordering Jersey City, New Jersey and the Hudson River. The Hoboken Rail Yard Terminal is owned by NJ TRANSIT and is used as a terminal and rail yard. The Terminal ranks second in the state in terms of passenger service, providing service to over 30,000 passengers per day. Nine rail lines terminate at the Terminal. Interface with ferry and rail rapid transit service to New York is provided.

The Rail Yard provides for the inbound and outbound movement of NJ TRANSIT trains, is used for storage of locomotives and cars, and contains facilities for running repairs, fueling, train washing, and other equipment servicing functions. Five main tracks direct trains to 18 passenger platform tracks and various storage yard tracks. Long Slip, a waterway measuring nearly 2,000 feet from the bulkhead line, straddling the Hoboken-Jersey City border bisects the Rail Yard. The Slip is about 100 feet wide and isolates a narrow strip of the yard to the south. Lighters and barges for loading and unloading of materials formerly used the waterway, but the last recorded dockage was in the 1960s. Currently, the Slip handles only stormwater discharges and combined sewer overflows.

A number of previous studies identified deficiencies in the present rail yard operations. Internal analysis of these studies by NJ TRANSIT revealed that the ideal facilities at Hoboken require:

- Rearranged and/or additional tracks (to efficiently handle over 40 train movements per hour)
- Expanded train storage spots (to accommodate in the range of 62-67 trains during midday hours)
- More generous track spacing (14 feet on center, to facilitate train servicing, repairs and greater safety)
- A running repair shop

Also critical are a new enclosed wheel truing facility (with minimum width of 30 feet and length of 380 feet), materials storage areas, personnel welfare facilities (lockers, showers, etc.), and improved roadways for materials delivery, worker circulation, and emergency response vehicle access.

Another important aspect of a more efficient yard is the elimination or minimization of stub-end tracks in favor of tracks with connections at both ends. Tracks with double-end access have several advantages. They allow individual cars to be detached from train sets for servicing or repairs from either end of the track, simplifying activities and minimizing conflict with other yard operations at the time the move is required. Secondly, train movements between points are made more straightforward, with less "jockeying". And finally, alternate routing is made available in the event of a track blockage at one end, avoiding "trapped" trains.

As a public transportation project undertaken by a public corporation, the project is inherently in the public interest and beneficial. The project will benefit the railroad and the public by:

- Reduced railroad-operating costs through the expansion at Hoboken of existing maintenance facilities.
- High flexibility for the subsequent reorganization of rail yard to meet existing and projected future needs.
- Improved operational efficiency through the minimization of stub-end tracks, increased track spacing, and increased storage capacity off the main tracks.
- Improved regional air quality through improved operational capacity for public rail transportation.
- Promote public transportation by creating direct access to the Newport City development and other areas south of the rail yard.
- Increased support to the region's economic competitiveness through the improved operational capacity for public rail transportation.
- Potential development associated with public access, such as restaurant and retail development that could generate revenue to offset annual maintenance costs.

A. MASTER PLAN FOR HOBOKEN TERMINAL YARD

Figure 4.1 from the *Hoboken Terminal & Yard Master Plan, February 1998,* Beyer Blinder Belle with STV Inc. for NJ TRANSIT, illustrates the existing conditions in the Hoboken Terminal Yard. Figure 4.2 illustrates the modifications to the Hoboken Rail Yard which would be implemented in the yard expansion which would be undertaken with the filling in of Long Slip. The former Long Slip site, represented by the dotted line, would be the new site for the new wheel truing facility, running repair shop, employee welfare and storage, NJ TRANSIT employee parking, five additional train storage tracks and a new Hoboken Terminal access road from 18th Street in Jersey City. Currently, there is no roadway access from south of the yard.

Currently, most of the office and employee facilities and maintenance and shop facilities are located within the historic Hoboken Terminal or the former Ferry Terminal. The relocation of these facilities will enable much of the space in the current Rail and Ferry Terminal to be rehabilitated and restored to either the original use or adapted to a new, public use.

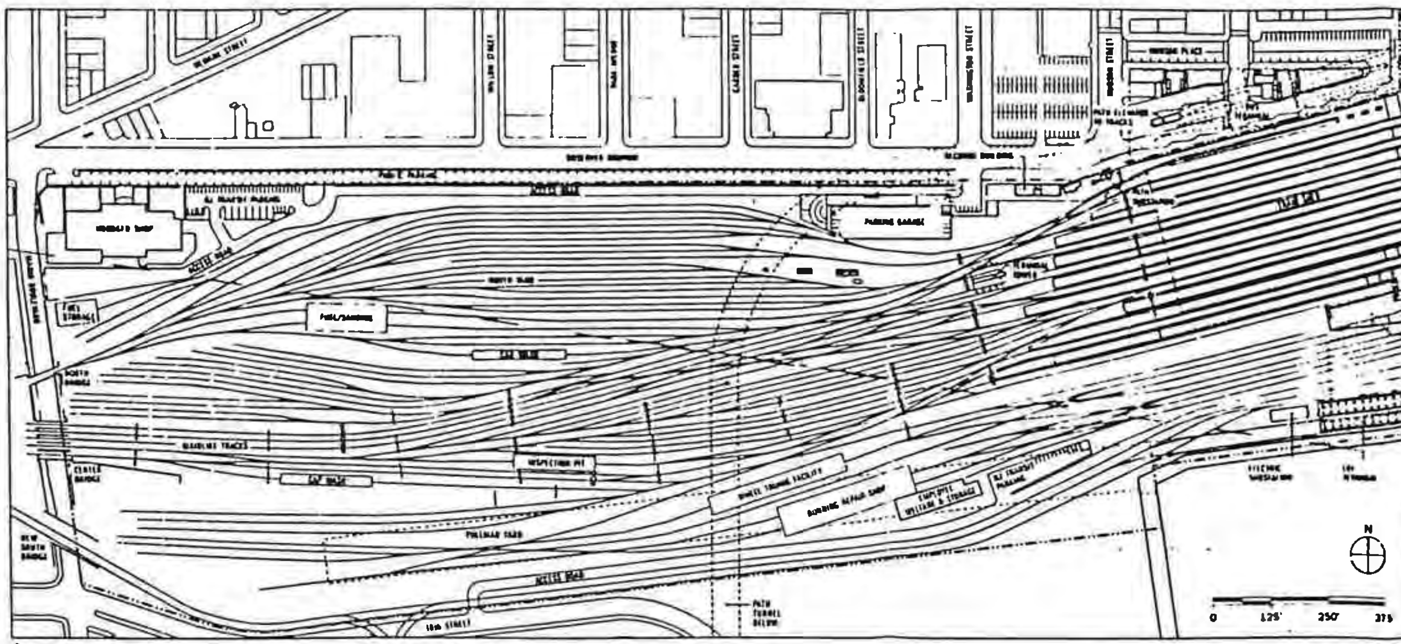
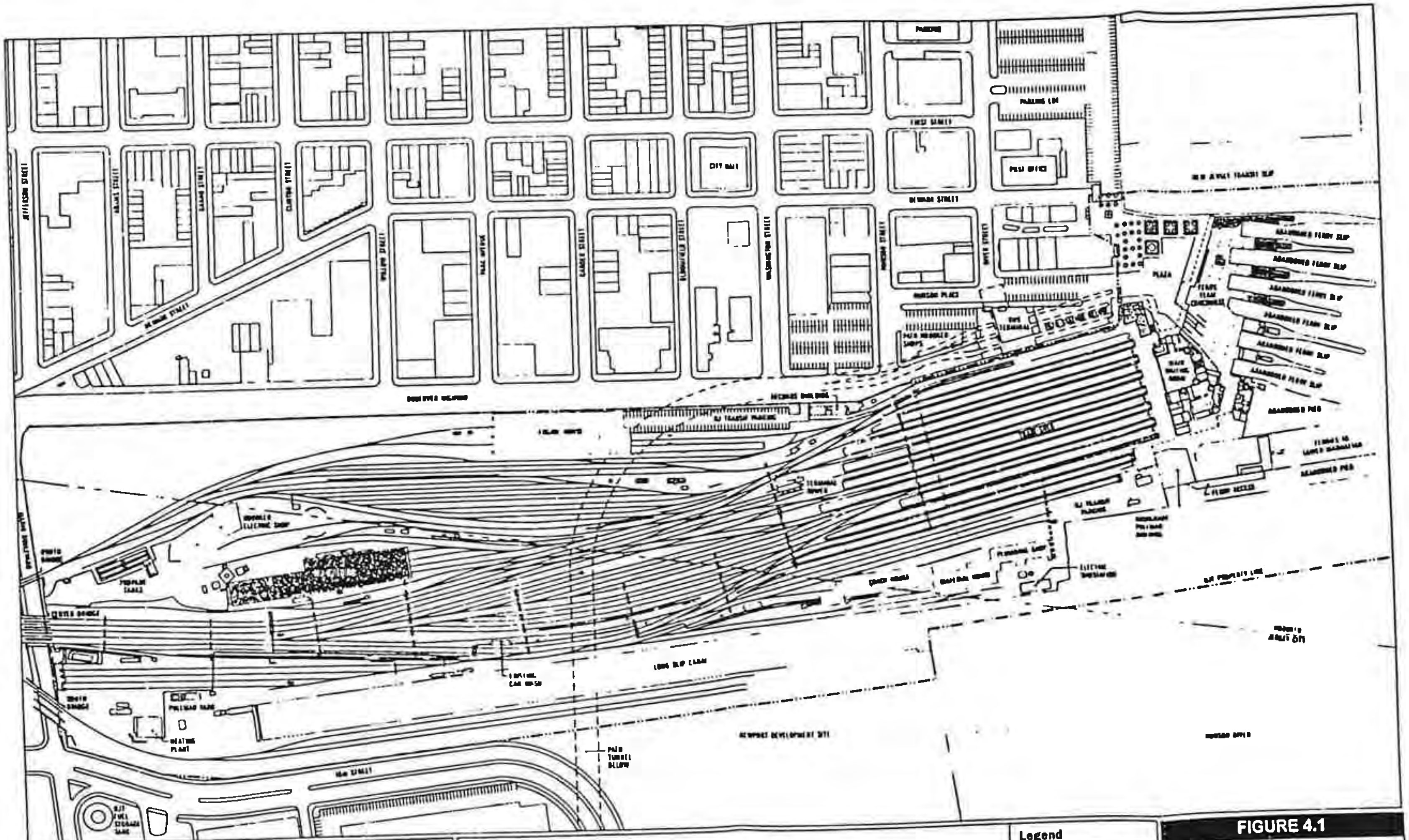


fig. 4.1

FIGURE 4.2

PROPOSED PLAN



Legend

- Public Circulation
- Retail Space
- NJT Space
- Ferry Space
- Vacant Space

N

0 — 120' — 240' — 360'

FIGURE 4.1

EXISTING CONDITIONS

Client: NJ TRANSIT
One Penn Plaza East • Newark, NJ 07105-2246

Architects: Beyer Blinder Belle

Engineers: STV, Inc.

B. FILL PLAN

Long Slip will be filled with approximately 180,000 cubic yards of fill. For the purpose of conservatively estimating the volume that can be accommodated, a total of 150,000 cubic yards is assumed. This fill will be comprised of dredged materials not suitable for ocean disposal from New Jersey waters elsewhere in the harbor. The canal entrance basin will contain an additional 55,000 cubic yards. This material will be used for the berm core, for public access area fill, and as cap of clean fine-grained dredged material to close the confined disposal facility.

C. EXCAVATION PLAN

Approximately 120,000 cubic yards will be excavated from the canal entrance basin. The will improve circulation in the basin and pile field areas by the removal of a shoal at the east end of the basin. The footprint of this dredging will be 270 feet wide (in the north-south direction) and 900 feet long (east-west), covering about 5.6 acres. A nearly 15-foot wide no-dredge buffer will be held along the north and south so that existing pier and piles, respectively, will not lose toe support. All dredging will be outside of the Hudson River federal navigation channel and will not occur in areas deeper than 30 feet mean sea level.

Management practices for dredging recommended by *The Management and Regulation of Dredging Activities and Dredged Material in New Jersey's Tidal Waters* (NJDEP, 1996) will be used. The dredge will be a closed clamshell bucket to minimize material losses and the associated turbidity. Bottom sediments will be dredged in lifts so that material unsuitable for ocean disposal will be separated from the underlying clean fine grained material. Surficial dredged sediments that are likely to be unsuitable for ocean disposal will be loaded onto hopper dredges - barges (often self-propelled) - that will be navigated into the canal and the material discharged in slurry form through a hinged bottom or sides. Stiffer, underlying clean material may require an alternative methods such as a dipper dredge.

V. ALTERNATIVES

A. INTRODUCTION

1. Primary Objectives of the Project

The primary objectives of this project are to increase the train storage capabilities and improve the efficiency of train operations at the Hoboken Terminal rail complex, and upgrade obsolete, antiquated equipment and facilities that are expensive to maintain. Numerous alternatives were identified and evaluated on their ability to satisfy those objectives while avoiding or minimizing adverse environmental, social, or economic impacts. The primary objectives were not fully satisfied by most of the alternatives considered, and only an alternative involving the filling of Long Slip was concluded to effectively meet those objectives.

2. Alternatives Evaluated

A total of seven alternative schemes were considered. In addition to the No-Build alternative and two schemes to reorganize the yard within the existing area of active rail facilities, alternatives were developed to expand the physical size of the active rail yard. Specifically, the alternatives evaluated were:

- *Alternative 1 - No-Build:* This alternative maintains the "status quo". There will be no significant reorganization of the yard, only maintenance and repair of existing facilities.
- *Alternative 2 - Reorganization within Existing Yard:* Under this alternative, the rail yard will be reorganized within its existing boundaries. No additional land will be used or acquired. Two schemes, 2a and 2b, were developed under this scenario.
- *Alternative 3 - Annexation of adjacent property*: Under this alternative, adjacent private property would be condemned and annexed to accommodate an expanded rail yard. Given the intensive development in Hoboken, north of the project site, only property in Jersey City immediately south of the yard was considered;
- Alternative 4 - *Use of non-contiguous property at a remote location*: Under this alternative, a 6-acre satellite facility would be developed on railroad lands west of the Hoboken Terminal.
- Alternative 5 - *Use of property occupied by Long Slip*: Under this alternative, the rail yard would be expanded over the land now occupied by the canal. Two scenarios regarding the use of Long Slip were evaluated. These were:
    - Option 5A: The Bridging of Long Slip
    - Option 5B. The Filling of Long Slip

3. Programmatic Requirements

Criteria for the development and evaluation of alternatives to meet the future demands were derived from a number of previous studies that identified deficiencies in the present rail yard operations. Internal analysis of these studies by NJ TRANSIT revealed that the ideal train storage and passenger yard facilities at Hoboken would have the following programmatic requirements:

- Rearranged and/or additional tracks to efficiently handle over 40 train movements per hour
- Expanded train storage spots (to accommodate in the range of 62-67 trains during midday hours
- Track spacing to be expanded to 14 feet on center, to facilitate train servicing and repairs
- A running repair shop
- Adequate space for a new enclosed wheel truing facility (with minimum width of 30 feet and length of 380 feet), materials storage areas, personnel welfare facilities (lockers, showers, etc.)
- Improved roadways for materials delivery, worker circulation, and emergency response vehicle access
- Elimination or minimization of stub-end tracks in favor of tracks with connections at both ends

B. EVALUATION OF ALTERNATIVES

Alternative 1: No Build

The evaluation of an alternative that would maintain the status quo of the Hoboken Terminal facilities serves to illustrate the existing and anticipated problems that require attention and have prompted the multi-million dollar yard and terminal renovation program. The major problems entail a shortage of train handling and storage space, poor juxtaposition of facilities, and the consequent inability to physically and financially operate trains efficiently. In fact, the existing yard will be incapable of accommodating the levels of train service that are planned to accompany the opening of the Secaucus Transfer facility in 2002.

The "no-build" title of this alternative is something of a misnomer in that engineering investigation has revealed that the Long Slip bulkhead walls have deteriorated to the extent that costly reconstruction and repair is, in fact, essential (whether or not the yard is modified). The expense of this repair, assuming a simple plan of driving sheet piles (about one foot in front of the existing face of the bulkhead) and backfilling the gaps, is estimated at nearly $11 million (1994 dollars). This then represents the capital cost of continued operation under existing difficult conditions that will only become inadequate in future, leading to operation failure. An annual operating cost of $40,000 for maintenance of the repaired bulkheads was also estimated. The bulkhead repair plan would create a waterway impact of approximately 4,000 square feet.

Conclusion for Alternative 1: No-Build Alternative:

Although the No-Build scenario would be feasible, it would not be prudent as 1) the No Build Alternative would not satisfy any of the Programmatic Requirements, and 2) Long Slip is currently deteriorated and if it remained intact, would require future rehabilitative action. Therefore, the No-Build Alternative was considered feasible but not prudent when considered both in the interests of the yard expansion or the preservation of the resource.

Alternative 2: Reorganization of the Yard Without Expansion

Conceptual investigations were made of rail yard reorganization schemes that would address existing and anticipated inadequacies while staying within the existing physical dimensions of the yard. It was determined that no scheme could be developed that would comprehensively alleviate the yard's shortcomings, when limited to the present yard geography. Relaxing that condition slightly, the study concluded with the identification of two basic yard schemes that, while not ideal, could produce some operational improvement. Both of these schemes, Alternatives 2a and 2b however, encroached on Long Slip.

Both of the schemes entail elimination of the existing multiple-unit car repair shed, relocation of the wheel truing facility, and provision of a new shop for running repairs and component change-outs, as sought. To maximize train storage capacity, each plan concentrates the siting of yard tracks in the level areas of the property north of Long Slip and locates the new shop on the narrow parcel of land south of that waterway. The shop is designed for through-movement operation and return to the main tracks. The return track must therefore pass over Long Slip via a new bridge. The balance of the southern land parcel would be used for a tail track for the shop and the new wheel-truing machine shed. Both plans include an access road less than ideal in width AND which would travel through bottleneck areas and cross several tracks at-grade.

The two plans differ in their ability to accommodate several of the train operations objectives. Alternative 2a produces an increase to 62 train storage locations in the yards, just satisfying the range of projected demand. But this increase is accomplished by providing a higher proportion of stub-end tracks, exploiting most of the level parts of the yard. This simultaneously creates the biggest drawback of this plan, namely the limitation of access to only the eastern-most end of these tracks. Of the 39 tracks positioned in the northernmost portion of the yard, none allow for direct full trainset movement west to reach a main track. All told, 51 of the 62 storage positions are on stub-end tracks.

Alternative 2b on the other hand would maximize the number of storage tracks with double-end access, but at the expense of total storage capacity. Of the 34 tracks positioned in the northernmost portion of the yard, 21 allow for full trainset movement west to reach a main track. In total, 21 storage positions would be on stub-end tracks. Although better access is provided, only 57 train storage positions are created, more than exist today but fewer than are needed in the long term. This scheme offers less flexible train movement at the east end of the yard and provides fewer storage positions for lengthier trains. Some of these problems can be overcome, but only at the cost of further reduction of train storage capacity.

The two schemes have identical environmental impacts. Beyond the construction period, the major impacts are the introduction of bridge piers in Long Slip and the associated restriction of navigation in the westernmost portion of the waterway. The extent of impacts will vary according to options for the angle and type of bridge construction selected. The bridge width would vary from 20 to 24 feet and the bridge deck area from 4200 to 6200 square feet. Open deck construction could allow for increased light penetration. Piers would number from 4 to 7, individually requiring a footprint area of between 120 and 715 square feet, each resting on between 9 and 16 piles imbedded in the slip bottom. Neither scheme would involve any combined sewer outflows abatement measures.

The estimated cost of the bridge to carry track over Long Slip under either Alternative 2a or 2b ranges from $3.2 to $7.2 million, and annual maintenance costs would vary from $46,000 to $59,000 (1994 dollars). Both yard alternatives also require the same bulkhead repair (approximately $11 million) required under the no-build alternative. While in each case the bridge would be designed to work effectively with the yard reorganization plans contemplated, its fixed alignment would seriously limit future yard reorganization opportunities.

Since the time that these conceptual yard improvement plans were developed, preliminary design of the HBLRTS has progressed to a point indicating that the light rail alignment and the construction of a new power substation will usurp additional portions of the outer edges of Hoboken yard, and will require replacement of at least one rail bridge over Marin Boulevard at a new raised elevation. These developments worsen current problems of shortage of land and variance in elevation, and thus lessen the effectiveness of the 2a and 2b schemes. The viability of Alternative 2a is lessened because some storage tracks must be shortened and the repair shop cannot be sited as proposed under either alternative because of unacceptable grades on the shop's approach tracks. Shifting the shop eastward onto or adjacent to Long Slip could only attain workable grades. Over and above the environmental impacts of this encroachment, the cost of both these plans would increase to the extent that part of the western end of the waterway is accordingly filled in or decked to accommodate the relocated shop, and the combined sewer/outfall is correspondingly extended (under the fill option).

Conclusion of Alternative 2: Reorganization of Yard Without Expansion

To recap, these two alternatives offer partial, but not full solutions to existing and anticipated problems, and some of that improvement is severely undermined by developments related to the HBLRTS. While encroachment on Long Slip *might* be limited to construction of a new bridge, this simultaneously limits the long-term flexibility of the yard facilities and the ability to respond to future needs. Considering these aspects, along with the associated costs of each alternative, neither alternative is feasible nor prudent is preferred since they are too expensive to justify the incomplete relief of existing and future conditions in the yard.

Alternative 3: Annexation of Adjacent Properties

Alternative 3 involves acquisition of portions of the Newport development property in Jersey City to the south of the yard, including portions of 18th Street (a major local thoroughfare serving the Newport development) and several retail establishments. NJ TRANSIT has the power of eminent domain and could acquire these properties where the public benefit justifies the usurpation of private enterprise and property. In this case, the negative local impacts and the potential level of ill will created between the affected localities and the agency would be substantial impediments to the acquisition. The loss or modification of part of 18th Street will have significant adverse impacts on local traffic conditions, and the loss of part or all of the retail enterprises (recently established) could affect employment opportunities and run counter to long-standing city and state urban redevelopment aspirations for the community.

Use of this adjoining property for rail yard expansion (e.g., for train storage tracks or the new repair shop) would also eliminate the existing buffer zone that exists today between the yard and the nearest developed areas, reducing private property values and undermining investor confidence in the related downtown improvements in the affected areas of Jersey City.

While the additional property would allow an adequate amount of additional train storage facilities, those facilities would not necessarily be convenient if located here. The yard would still be functionally split by the Long Slip, requiring awkward manipulation of trains between the new area and the boarding platforms. While the new running repair shop can be tolerated south of Long Slip (because typically few shop-related train movements would occur during times that bear on other routine yard activities), the same tolerance would not apply at this site to storage tracks, which involve a more frequent interplay with the main tracks and platform areas.

As with the previous alternatives, Alternative 3 requires the investment of about $11 million for restoration of Long Slip bulkhead walls. The need for a bridge over Long Slip (as under Alternatives 2a and 2b) will also likely occur. Additional substantial costs would be incurred for land acquisition (not estimated). This alternative does not address any combined sewer outflows abatement measures.

Conclusion for Alternative 3: Annexation of Adjacent Properties

This alternative is similar in its outcome to that of Alternative 2a, in that it allows adequate room for trains, but likewise in a less than efficient manner. Because this alternative offers no net improvement in operations over Alternative 2a, and can be expected to produce substantial negative impacts in Jersey City, all at higher costs, this alternative was considered feasible but not prudent.

Alternative 4: New Satellite Storage Yard

Alternative 4 would create a satellite yard facility of approximately 6 acres providing for remote storage of trains (up to the maximum estimated unmet future need). Although the former Erie Railroad Monmouth Street yard site is nearby, it measures just under 4 acres in size and is therefore inadequate. Because of the topography and dense development of the remaining urban area at and approaching Hoboken Terminal, any candidate site for this new facility would have to be located west of the Palisades geological formation (Bergen Hill) and the Bergen (rail) Tunnels, i.e., somewhere in the area of the Hackensack Meadowlands Development District (HMDD). Without specifying any particular site, it can reasonably be expected that if an available and suitably-sized parcel could be found in the HMDD, it would invariably involve some level of environmental drawbacks (wetlands disturbance, site contamination, community opposition, loss of ratable, etc.). This likelihood is illustrated by the following discussion of one seemingly appropriate site:

> The former Koppers Coke property in Kearny is the closest large and vacant property moving west from Hoboken. It is located alongside the electrified M&E rail lines, which are situated on an elevated embankment that serves as a protective barrier along the southern edge of the property. A tunnel under the tracks allows vehicle access between the property and nearby Belleville Turnpike via a short gravel road. Much of the remaining property border is along the Hackensack River, offering potential waterway access to the site. The property is zoned industrial.
>
> The site contains about 145 acres, much more than adequate for the yard expansion being sought. Some of the property contains wetland area, but

yard development is probably possible without disturbing these areas. Early in 1981, the property was the leading candidate site for construction of NJ TRANSIT's major consolidated rail vehicle maintenance/repair facility (since constructed 4 miles west at the site of a former Conrail yard in Kearny). At that time, the need for substantial upgrade of utilities at the Koppers site was recognized; and the site was rejected. More critical as a negative factor was the identification of an existing soil contamination problem. The site was the previous home of a coal gasification plant, and the legacy of that operation is saturation of the soil with highly carcinogenic coal tar. The prospect of extremely expensive remediation efforts and the subsequent emerging availability of an alternate nearby site resulted in construction of the rail shop elsewhere. Rejection of this site for Hoboken Yard expansion is justified for similar environmental reasons.

The satellite facility concept has other more restrictive drawbacks. At best, train operations would become more expensive. Increased operating costs would be attributable to the inherent and substantial increase in non-revenue (deadhead) train moves required between the site and Hoboken, and to the inefficient provision/operation of duplicative employee quarters, supervisory staffing, and other necessary elements which would otherwise be consolidated at Hoboken. Assuming establishment of a site within 4 miles of West End Interlocking, annual operating costs in 2002 would increase by between $4.4 million and $4.6 million (depending on the mix of diesel vs. electric equipment involved). This increment would grow to about $ 6.4 million by 2010. Additional evaluation was conducted of alternate sites: alongside the Meadowlands Maintenance Center (where some staffing costs could be overlapped) and at the Monmouth Street site (which would involve fewer total train-miles of movements). The recurring fiscal impacts at these sites in 2002 would also be quite substantial, at $3.1 million and $3.7 million, respectively.

More critically, operations reliability under the satellite yard concept would be severely jeopardized. The trunklines leading into and out of Hoboken and connecting to any potential new site are already active throughout most of the day. Those track segments that pass through the Bergen Tunnels constitute an extremely sensitive bottleneck of the rail system, and have no reasonable expansion potential. Introduction of the added deadhead train activity would intolerably increase the potential for train conflicts along these congested tracks. An analysis of morning peak period train movements through the tracks of the West End interlocking in 2002 was conducted to determine if adequate capacity exists to accommodate the added train movements associated with the remote storage site. It was determined that with all trains operating on schedule, only half of the necessary deadhead train movements could be accomplished. The evening peak period, with slightly higher anticipated service levels, can be expected to have equal, or even more acute problems. In years beyond 2002, there would be demand through the interlocking for additional revenue and deadhead train movements, exacerbating this situation further.

Conclusion to Alternative 4: New Satellite Storage Yard

This alternative again requires the capital and operating cost investments associated with Long Slip bulkhead wall repairs. No combined sewer outflow abatement measures are involved. Additional capital costs (not estimated) would be required for land acquisition and construction of tracks and other yard facilities at the remote site. As previously mentioned, operating costs of normal train service activities would also increase. This alternative is considered not prudent due to the same reasoning for Alternative 3a, namely that it produces net improvements that are similar (or more likely inferior) to those of Alternative 2a, while involving higher capital investment and substantially increased operating costs. Moreover, this alternative is not believed to be operationally feasible.

Alternative 5: Use of Long Slip Property

Alternative 5 considers expansion of the physical yard acreage by including some portion of Long Slip. The Long Slip is the only substantially unused acreage within the existing yard boundaries. Two methods were considered to accomplish the merger of Long Slip property with its contiguous land areas (at the elevation of those adjacent properties):

a. Decking of the waterway (Alternative 5A)
b. Filling of the waterway (Alternative 5B)

These two options offer similar advantages to railroad operations, as described below.

1. The storage track goal can be met while still providing a west end connection on many of the yard storage tracks (About 62 positions would be created, with 29 on stub-end tracks).
2. Many of the new storage tracks would be of sufficient length to accommodate the greater number of full-length trains expected as ridership grows. The tracks would have a minimum spacing of 14 feet, improving safety, giving ample room for inspections and servicing.
3. More substantial land buffers between the yard and adjacent public and private properties can be provided, as compared to the other alternatives investigated. Use of Long Slip would allow the repair shop and wheel truing facility to be shifted away from the southern yard property line and the adjacent proposed Newport site.

4. The yard access road would meet acceptable standards and be realigned to connect south with 18th Street rather than west with Marin Boulevard, adding to the buffer zone and avoiding the at-grade crossings.
5. Tracks approaching and passing through the new shop can be constructed at mandatory level grades, and the incidence of conflicting train movements between the shop and other yard areas would be minimized.
6. Adequate room for employee facilities, materials storage, vehicle access, and HBLRTS land needs would be available without further private property takings.

While decking and fill options entail comparable benefits, they differ significantly in their environmental impacts and capital investment requirements.

1. Alternative 5A: Decking Long Slip

Decking Long Slip with a continuous impervious metal plate or concrete cover would block or filter the penetration of sunlight to the water surface (over 4 acres) and would entail subsurface (wetlands) disruption during construction of substantial supporting structures (2 piers running the length of the slip). The result would be an enclosed waterway accessible to fish and other aquatic life but severely degraded by the continued discharge of a combined sewer outfall and relatively turgid flows leaving a dark and generally unsupportive as well as non-navigable estuarine environment.

Conclusion to Alternative 5A: Decking Long Slip

Alternative 3c-1 involves the same capital and annual operating expenses ($11 million and $40,000, respectively) discussed previously for renovation of Long Slip bulkhead walls. In addition, construction of a deck over the waterway will require over $50 million, in 1994 dollars. The annual maintenance cost associated with this option is $67,000.

Decking Long Slip is feasible but not prudent due to equivalent adverse impacts on water quality and aquatic habitat as to filling the slip but incurring costs estimated at five times ($50 million) of the cost of filling the slip.

2. Alternative 5B: Filling Long Slip - the Preferred Alternative

Under Alternative 5B, Long Slip would be filled to existing grade with suitable materials. Filling Long Slip involves the filling of 4.6 acres of water.

The actual filling of the slip will be accomplished partly through disposal and entombment under clean fill material of dredged materials excavated from the greater New York harbor dredging program which would otherwise have to be disposed of elsewhere, with greater environmental consequences or at greater cost, or both.

Conclusion to Alternative 5B: Filling Long Slip

Alternative 5B is estimated to cost $8,540,000 to fill in the entire slip. Interestingly, the cost decreases when Long Slip is filled, because necessary bulkhead wall repairs are avoided. Included in these 1994-dollar estimates are costs associated with extension of combined sewer lines. Offsetting revenue strategy is up to $3 million anticipated from the acceptance of dredged material from New York Harbor (based on 200,000 cubic yards of material at $16 per cubic yard), making this not only the most effective, but the least costly of all the options evaluated including the No-Build. In addition, Alternative 5B produces the greatest current and future benefits for rail yard operations with minimum cost and minimum impact on adjacent properties.

C. SUMMARY FOR ALL ALTERNATIVES

Table III summarizes the characteristics, costs, and benefits of the seven rail yard alternatives evaluated. Both Rail Yard Alternatives 5A and 5B allow for an improved and adequate yard arrangement that would increase the reliability of rail operations. Both also have the potential to create a pleasing public access area conveniently linked to the passenger station and adjacent properties, and only these alternatives offer flexibility for further yard modifications, should such future need arise. They differ in costs and environmental impacts, with the fill option being the only means of accomplishing an integrated solution to the combined sewer discharge problem while also providing for storm water pre-treatment and habitat augmentation. Given the prohibitively higher costs of Alternative 5A, and with the much healthier environmental program associated with option 5B, Alternative 5A is considered feasible but not prudent when considered as a means of accomplishing the necessary yard expansion, while Alternative 5B is both feasible and the most prudent of all of the alternatives considered.

Table III: Alternatives Evaluation Summary

Criteria	No Build	Reorg/No expansion		Annex Land	Satellite Yard	Deck Long Slip	Fill Long Slip
	1	2A	2B	3	4	5A	5B
Capital Cost ($M) [a]							
Bulkhead repair	10.9	10.9	10.9	10.9	10.9	10.9	0
Pedestrian walkway	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Rail bridge	3.2-7.2	3.2-7.2	3.2-7.2				
Other							
Revenue Offset from CDF						50.3	8.5
							(3.2)
Total	11.5	14.7-18.7	14.7-18.7	14.7-18.7	11.5	61.8	5.9
Annual Operating Cost ($K)							
Hoboken facilities	41	46-59	46-59	46-59	41	108	6
Other					6,384		
Flexibility to Meet Future Needs	Low	Low	Low	Medium	Medium	High	High
Adequacy of Trackage							
2002 Supply							
In yard(s)	38	62	57	64	64	62	62
At platforms [b]	7	7	7	7	7	7	7
2002 Demand	50	50	50	50	50	50	50
Excess/(Shortfall)	(5) [c]	19	14	21	21	19	19
2010 Supply							
In yard(s)	38	62	57	64	64	62	62
At platforms [b]	3	3	3	3	3	3	3
2010 Demand	67	67	67	67	67	67	67
Excess/(Shortfall)	(26) [c]	(2)	(7)	0	0	(2)	(2)
Trains on Stub-End Tracks	12	51	21	12	12	29	29
Long Slip Encroachment (KSF)							
Displacement	4.0	4.5 - 9.0	4.5 - 9.0	4.5 - 9.0	4.0	5.0	200.0
Shading	4.2 - 6.2	4.2 - 6.2	4.2 - 6.2	0	NA	196.0	0 - 1
Institution Feasibility	None	None	None	None	Low	Low	High

Notes:

(a) Certain additional costs are likely to be incurred but are not included in this summary. These costs are acknowledged below:

Costs of yard track and other facility reconfiguration/construction at or adjacent to Hoboken or at a remote site. (Applicable to all but Alternative #1).

Costs of land acquisition at adjacent or remote yard sites. (Applicable to Alternatives #3A and 3B).

Costs of partial filling or decking of the western end of the Long Slip, (and associated extension of combined sewer outflow), to accommodate potential shift of repair shop. An estimate for filling 25 percent of the slip is an additional $4.3 million. (Applicable to Alternatives #2a, 2b, and 3a).

(b) The value of these positions is subject to diminution pending a decision on construction of high-level platforms.

(c) The shortfall of train storage facilities could be even higher than indicated here (by 7 to 10 positions) if indeed "no action" is taken to elongate tracks at the north end of Hoboken Yard so that longer trains required for the Secaucus Transfer operating plan can be accommodated, thus making some of the supply less usable.

VI. MITIGATION MEASURES

A. HISTORIC DOCUMENTATION

In accordance with SHPO recommendations, a Memorandum of Agreement (MOA) has been drafted to mitigate the adverse effects of the filling of Long Slip on the Old Main DL&W Railroad Historic District (Appendix B). The MOA stipulates that written and photographic documentation relating to the history and function of Long Slip be conducted as part of the currently ongoing Historic American Buildings Survey and Historic American Engineering Record (HABS/HAER) documentation of Hoboken Yard.

B. HUDSON RIVER WATERFRONT WALKWAY

Pursuant to a Waterfront Development Permit, as required by the State of New Jersey Department of Environmental Protection, an additional mitigation measure will be the construction of the Hudson River Waterfront Walkway on the segment of the waterfront that is in the vicinity of the project. The Waterfront Walkway will be a continuous public access pedestrian walkway that will extend from the George Washington Bridge to Bayonne. The segment of the walkway that will be constructed for this project will extend from the north side of Hoboken Terminal at the Plaza to the southern boundary of the Hoboken Rail Yard near Newport City.

The Hudson River Waterfront Walkway will provide open access to the waterfront and its associated historic sites and will also provide educational and retail opportunities as well as dramatic, unrestricted views of the harbor and lower Manhattan, and the historic Erie-Lackawanna Ferry Terminal. Visitors will have the unique opportunity to observe ferry, shipping, and railway operations.

From the north, the walkway enters the NJ TRANSIT property from the South Waterfront Development at the Sinatra Drive/Newark Street intersection and passes through the terminal areas to the Immigration/Pullman Building. The exact route and characteristics of the walkway's passage through the terminal area is under design as part of NJ TRANSIT's Hoboken Terminal Master Plan Project. From the Immigration/Pullman Building, the walkway will follow the crest of the containment dike, connecting to the future Newport City Development walkway segment in the south.

C. INTERPRETIVE EXHIBIT ON THE HUDSON RIVER WATERFRONT WALKWAY

The MOA also stipulates that NJ TRANSIT will create an interpretive exhibit describing the history and significance of Long Slip and the adjacent Delaware, Lackawanna & Western Railroad passenger and freight yards along the Hudson River Waterfront Walkway.

VII. COORDINATION

A. PROJECT STATUS IN THE NEPA PROCESS

The Long Slip Canal Habitat Creation Project is seeking a Finding of No Significant Impact (FONSI) with the Army Corps of Engineers (ACOE). The project report was submitted to the ACOE on December 30, 1997 and to the New Jersey Department of Environmental Protection on January 2, 1998 for a waterfront development permit which has been granted December 3, 1999. Public comments have been received and addressed; the public comment period has been closed.

B. COORDINATION

NJ TRANSIT staff met with regulatory agency representatives throughout the period of permit application preparation. NJ TRANSIT consulted with the U.S. Army Corps of Engineers and its federal regulatory colleagues, the United States of Environmental Protection and the National Marine Fisheries Service in Spring 1996, prior to commencing the permit application process (a "pre-application" meeting), and again as the application was nearing completion, in Fall of 1997. NJ TRANSIT also consulted with the New Jersey Department of Environmental Protection in Summer 1997, to review the concept and proposed mitigation, and to discuss regulatory agency concerns. This meeting was also attended by a representative of the U.S. Fish and Wildlife Service.

NJ TRANSIT has also involved local officials and citizens in the application process. NJ TRANSIT staff met with the Hoboken City Council in Spring 1997, for a calendared briefing session. NJ TRANSIT staff also met in Autumn 1997 with the Hudson County Executive, the highest elected county official, to gain his views of the project. Staff met with representatives of the Jersey City Sewer Authority three times over the course of the permit application preparation, the North Hudson Sewer Authority twice, the Jersey City Planning and Engineering Departments twice, the chair of the Jersey City Environmental Commission in Fall 1997, and a local Hoboken environmental group concerned with proper design of the proposed waterfront pedestrian walkway, a major mitigation included in the project permit application once in Winter 1997. It is NJ TRANSIT's understanding that the Jersey City Engineering and Planning staffs have kept the Mayor and the City Council appraised of the project status. All pertinent correspondence is contained in Appendix D.

The Long Slip Canal Habitat Creation Project has also been coordinated with the State Historic Preservation Office. *A Request for a Determination of Eligibility for Long Slip* was forwarded to the SHPO on March 28, 1997 (Appendix C). The SHPO responded in correspondence dated May 8, 1997 that Long Slip was eligible as a contributing resource to the Old Main Delaware, Lackawanna &

Western Railroad Historic District. In the May 8, correspondence, the SHPO also determined that The Long Slip Canal Habitat Creation Project, which would fill Long Slip, would have an adverse effect on Long Slip and the Old Main DL&W Railroad Historic District (Appendix A). Mitigation measures for the adverse effect on Long Slip and the DL&W Railroad Historic District are contained in the MOA which was executed May 7, 1999 (Appendix B).

APPENDIX A: SHPO OPINION OF ELIGIBLITY FOR LONG SLIP

Christine Todd Whitman
Governor

State of New Jersey

Department of Environmental Protection

Division of Parks and Forestry
Historic Preservation Office
CN-404
Trenton, N.J. 08625-0404
TEL: (609)292-2023
FAX: (609)984-0578

Robert C. Shinn, Jr.
Commissioner

May 8, 1997
HPO-E97-26

Mr. David Koenig
Historic Preservation Specialist
New Jersey Transit
One Penn Plaza East
Newark, New Jersey 07105-2246

Dear Mr. Koenig:

As Deputy State Historic Preservation Officer for New Jersey, in accordance with 36 CFR Part 800: Protection of Historic Properties, as published in the Federal Register 2 September 1986 (51 FR 31115-31125), I am providing **Consultation Comments** for the following project:

Hudson County, New Jersey
Jersey City and Hoboken City
Long Slip Canal Fill In (Habitat Creation Project)
Federal Transit Administration, NJ Transit

I am writing in response to your submission of the following reports: **NJ Transit Long Slip Habitat Creation Project: Archeological Assessment of the Long Slip Canal**, by Dolan Research, Inc., March 1997, and **NJ Transit Long Slip Habitat Creation Project: Request for a Determination of Eligibility for Long Slip**, by Lynn Drobbin and Associates, March 1997.

800.4 Identifying Historic Properties

Erie-Lackawanna (Hoboken) Railroad and Ferry Terminal is included in the National Register of Historic Places (Listed 07/24/73).

The Southern Hoboken Historic District is eligible for inclusion in the National Register (DOE 04/25/80).

The Old Main Delaware, Lackawanna, and Western Railroad Historic District is eligible for inclusion in the National Register (SHPO Opinion 09/24/96).

I concur with your evaluation that Long Slip Canal is not individually eligible, and that it is not a contributing feature of the Southern Hoboken Historic District. Further, I concur with the finding of the **Archeological Assessment** that there is low potential for significant prehistoric or historic archeological remains.

However, it is my opinion as Deputy State Historic Preservation Officer, that the remaining area in Hoboken and Jersey City known as the Erie Lackawanna Railroad and Ferry Terminal and Yard is **eligible** as a contributing feature of the Old Main Delaware, Lackawanna, and Western Railroad Historic District. The boundaries of the district in this area should be delineated to include all property currently owned by NJ Transit, and on the south, would encompass Long Slip and the tracks between the slip and 18th Street in Jersey City (see attached map).

The existing yard is among the last remnants of an historically significant transportation infrastructure that once existed on New Jersey's Hudson River waterfront. Passenger and freight operations of the competing railroads in New Jersey shaped the waterfront from the mid-nineteenth century to the mid-twentieth century, and have all but disappeared on both sides of the river.

800.5 Assessing Effects

It is my determination that the proposed filling of Long Slip will have no effect on the Southern Hoboken Historic District, no adverse effect on the Erie-Lackawanna (Hoboken) Railroad and Ferry Terminal, and an adverse effect on the Old Main Delaware, Lackawanna, and Western Railroad Historic District.

Additional Comments

In order to expedite the process, I suggest execution of a simple Memorandum of Agreement (MOA) stipulating that the documentation of the yard currently in progress as part of the overall preservation plan shall include specific written and photographic information relating to the history and function of Long Slip Canal. It might also be appropriate to create a Railroad History page on NJT's existing Internet World Wide Web site that can serve as an online repository for information on NJT's historic properties and provide information about the former railroad companies that developed and operated the rail lines now operated by NJT.

Although the loss of this waterfront feature adversely effects the character of the Old Main DL&W Historic District, it does allow for expansion and continued utility of the rail yard, which helps ensure the long term preservation of the yard and terminal.

Thank you for you participation in the Section 106 review process. Please call Kinney Clark of this office should you have any questions (609-292-2023).

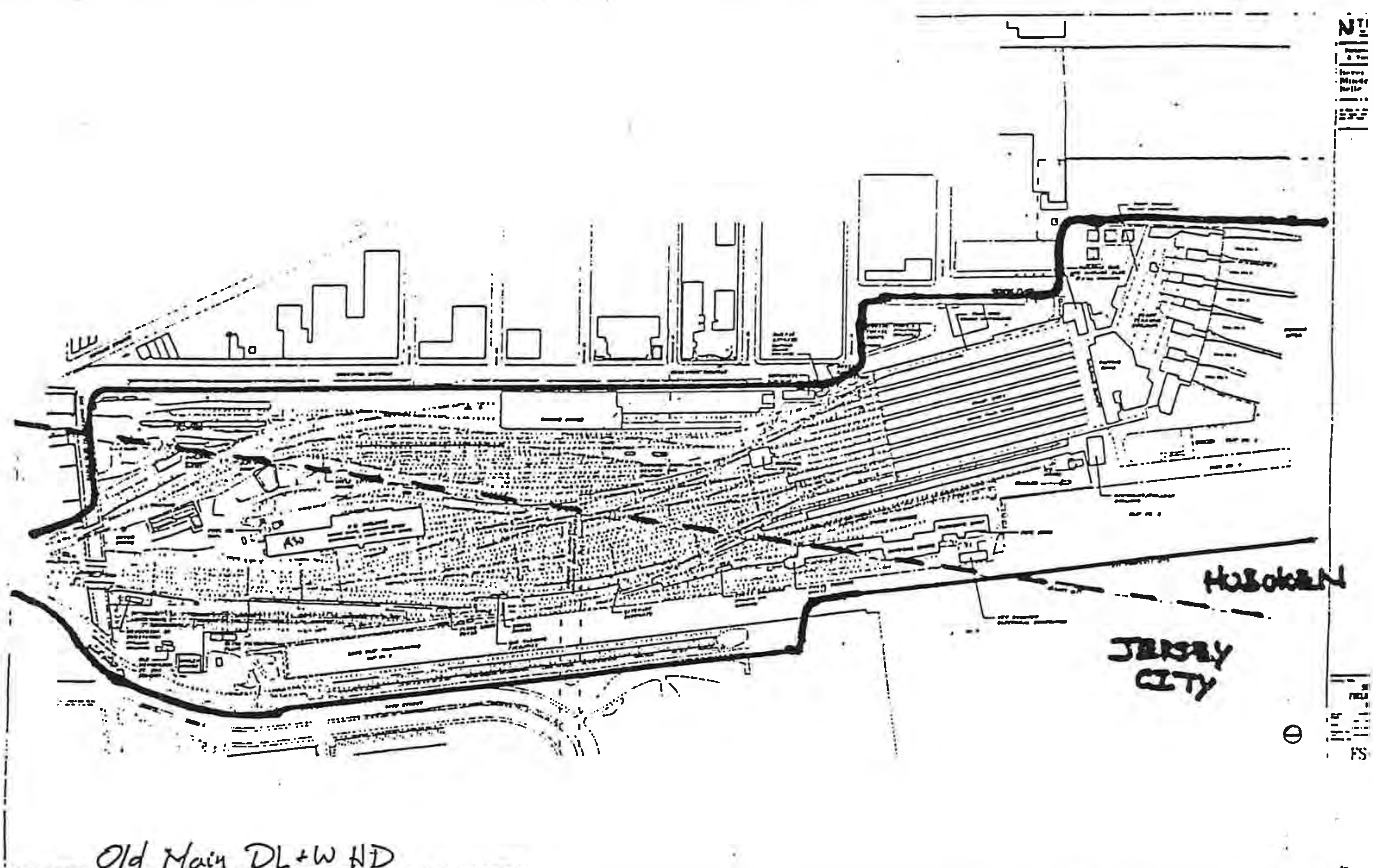
Yours Truly,

Dorothy P. Guzzo

Dorothy P. Guzzo
Deputy State Historic
Preservation Officer

DG/kc97-1293

c. Advisory Council on Historic Preservation
Federal Transit Administration
C. Scott, HPO



Old Main DL+W HD
Eligible Boundaries - East End

APPENDIX B: MEMORANDUM OF AGREEMENT FOR LONG SLIP

MEMORANDUM OF AGREEMENT
AMONG
THE FEDERAL TRANSIT ADMINISTRATION, THE NEW JERSEY STATE HISTORIC PRESERVATION OFFICE AND NEW JERSEY TRANSIT REGARDING THE LONG SLIP HABITAT CREATION PROJECT AT HOBOKEN YARD

WHEREAS, the Federal Transit Administration (FTA) has determined that the NJ TRANSIT Long Slip Habitat Creation Project will require the filling in of the Long Slip Canal; and

WHEREAS the Federal Transit Administration (FTA) has determined that the filling in of the canal will have an adverse effect upon the Old Main Delaware, Lackawanna and Western Railroad Historic District, a property eligible for inclusion in the National Register of Historic Places; and has consulted with the State Historic Preservation Office (SHPO) pursuant to the regulations (36 CFR Part 800) implementing Section 106 of the National Historic Preservation Act (16 U.S.C. 470f); and

WHEREAS the Army Corps of Engineers will issue a permit for this undertaking pursuant to Section 404 of the Clean Water Act; and

WHEREAS, Historic American Building Survey/Historic American Engineering Record (HABS/HAER) documentation of the Hoboken Yard is currently in progress pursuant to a 1994 MOA regarding demolition of the Freight Office Building and as part of the overall preservation plan for Hoboken Terminal; and

WHEREAS, NEW JERSEY TRANSIT (NJT) has participated in the consultation and has been invited to join in this agreement.

NOW, THEREFORE, FTA, the SHPO and NJ TRANSIT agree that the project shall be implemented in accordance with the following stipulations in order to take into account the effect of the undertaking on historic properties.

Stipulations

The FTA will ensure that the following measures will be carried out:

1. NJT shall include specific written and photographic documentation relating to the history and function of the Long Slip Canal in the HABS/HAER documentation of Hoboken Yard, to be reviewed and approved by the SHPO.

2. In consultation with the SHPO, NJT will create an interpretive exhibit describing the history and significance of the Long Slip Canal and the adjacent Delaware, Lackawanna & Western Railroad passenger and freight yards.

Execution of this Memorandum of Agreement by FTA, Army Corps of Engineers and the SHPO, its subsequent acceptance by the Council and implementation of its terms, evidence that FTA has afforded the Council an opportunity to comment on the NJ TRANSIT Long Slip Habitat Creation Project and its effects on historic properties and that FTA has taken into account the effects of the undertaking on historic properties.

FEDERAL TRANSIT ADMINISTRATION

By: Letitia Thompson

Letitia Thompson, Regional Administrator, TRO-II

Date: 6/1/99

ARMY CORPS OF ENGINEERS

By: William [illegible]

Date: 6 Apr 99

STATE HISTORIC PRESERVATION OFFICER

By: Dorothy P. Guzzo

Dorothy P. Guzzo, Deputy State Historic P.O.

Date: 2/26/99

Concur:

NEW JERSEY TRANSIT CORPORATION

By: Stanley J. Rosenblum

Stanley J. Rosenblum, Acting Executive Director

Date: 1/26/99

Accepted:

ADVISORY COUNCIL ON HISTORIC PRESERVATION

By:

(for) Executive Director

Date: 5/7/99

APPENDIX C: NJ TRANSIT LONG SLIP CANAL HABITAT CREATION PROJECT: REQUEST FOR A DETERMINATION OF ELIGIBILITY FOR LONG SLIP

NJ TRANSIT LONG SLIP HABITAT CREATION PROJECT

REQUEST FOR A DETERMINATION OF ELIGIBILITY FOR LONG SLIP

HOBOKEN AND JERSEY CITY
HUDSON COUNTY
NEW JERSEY

Prepared by:

Lynn Drobbin & Associates
for Dames & Moore

March 6 1997

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LIST OF FIGURES

REQUEST FOR A DETERMINATION OF ELIGIBILITY FOR LONG SLIP

I. PROJECT DESCRIPTION

This report was contracted by Dames & Moore for the NJ TRANSIT Long Slip Canal Habitat Creation Project. This report has been prepared to assess the eligibility of Long Slip in the Hoboken Freight Terminal Yard in compliance with Section 106 of the National Historic Preservation Act of 1966. The Long Slip Habitat Creation Project will fill the Long Slip Canal to provide an expanded and improved Hoboken Terminal Rail Yard. Filling Long Slip would allow for construction of additional storage tracks to accommodate a greater number of full-length trains and additional maintenance facilities where minor running repairs could be conducted.

NJ TRANSIT owns and operates the historic Erie Lackawanna (Hoboken) Railroad and Ferry Terminal and Rail Yard Terminal. The Long Slip Canal Habitat Creation Project is a component of the Hoboken Rail Yard Rehabilitation project that includes rehabilitation of the Erie-Lackawanna Railroad Terminal, an interface with the Hudson Bergen Light Rail Transit System and the Hoboken Rail Yard expansion and infrastructure improvements.

The yard facilities at Hoboken Terminal are located immediately west of the train shed and passenger platforms. The yard is bordered by Observer Highway to the north, 18th Street to the south, Henderson Street (Marin Boulevard) to the west and the Hudson River on the east. Currently, the southern boundary of the functioning rail yard terminates at the north side of Long Slip.

The yard provides for inbound and outbound train movements and contains facilities for storage of locomotive and cars for running repairs, train washing and other equipment servicing functions. Five main tracks in the yard feed into 18 platform tracks and yard storage tracks. The slip, 100 feet wide and 2000 feet long from the bulkhead line, handles the discharge of stormwater and combined sewerage overflows but is not used for any rail or marine purposes.

The Long Slip Habitat Creation Project will convert Long Slip from a water use to a land use. The Long Slip is the only substantially unused piece of property within the existing yard boundaries. Long Slip was formerly used by lighters or barges in the loading and unloading of materials by crane as part of the former freight operations of the Delaware, Lackawanna & Western Railroad.

Long Slip currently exhibits the characteristics of a dead or "negative habitat". There is no resident aquatic life nor any evidence of spawning populations. The major Jersey City combined sewer overflow enters the Long Slip at its western end. The effluent receives only gradual tidal flushing, unaffected by the hydraulic flow of the Hudson River.

The Long Slip Canal Habitat Creation Project would create a new habitat for diverse fish species at the canal entrance area, control point pollution (CSO) sources by eliminating Hoboken outfalls into the canal and improving the Jersey City outfall, control non-point pollution (storm drainage) sources, create public access consistent with the Hudson Waterfront Walkway. To offset project costs, dredged material would be accepted in a confined disposal facility (CDF).

It is the conclusion of this report that Long Slip, formerly an integral component of the DL&W Hoboken Freight Terminal, is not eligible for listing on the National Register of Historic Places. This conclusion is based on the fact that the Hoboken Freight Terminal has suffered a loss of integrity because almost all the Freight Terminal and Yard piers, buildings, track, machinery and equipment, i.e., its contributing resources, have been demolished.

Due to this loss of integrity, Long Slip is not a contributing resource to the Southern Hoboken Historic District or to the Erie-Lackawanna Railroad and Ferry Terminal, nor is it eligible as a contributing resource to the Old Main Delaware, Lackawanna & Western Railroad Historic District.

II. INVOLVEMENT OF AGENCIES

The following agencies and organizations are involved in this project:

Thomas Ryan
Regional Administrator
Eastern Region
Federal Transit Administration
26 Federal Plaza, Suite 2940
New York, NY 10278

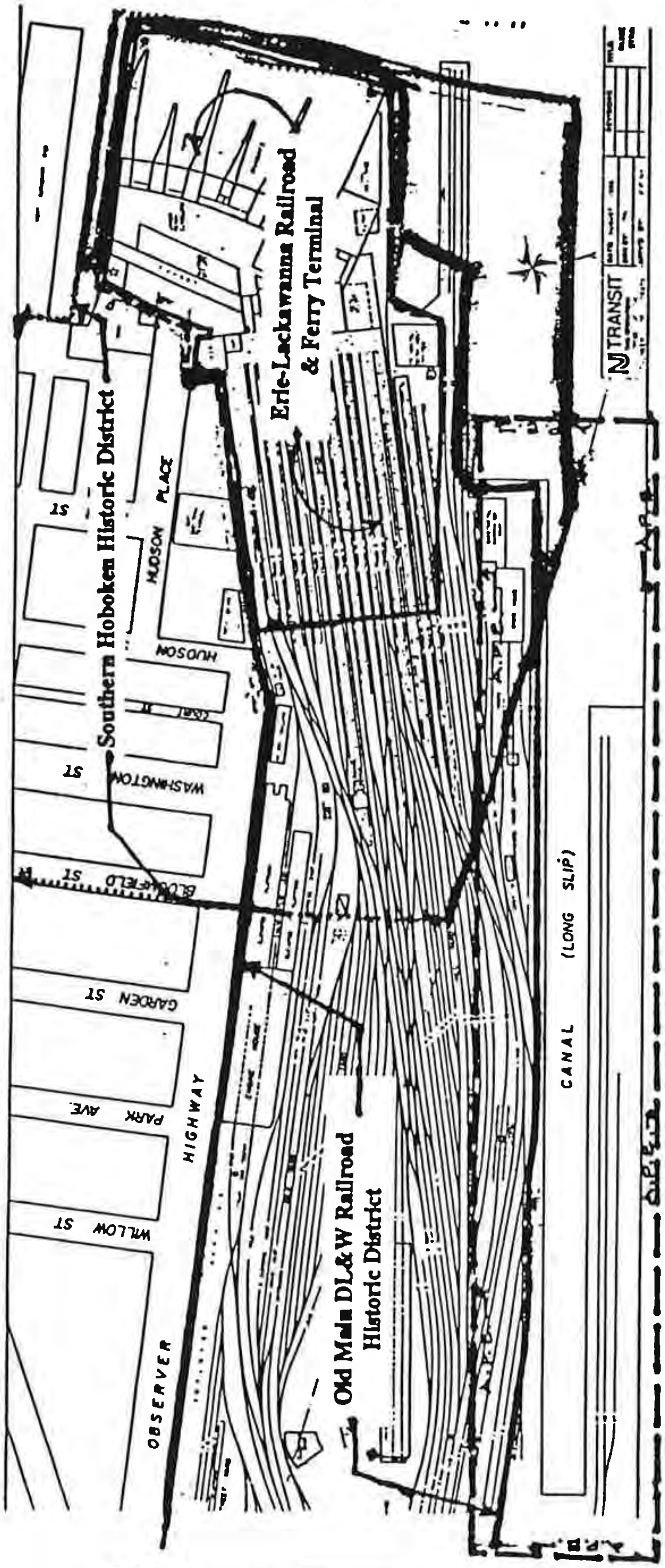
Steve Jurow
Manager, Environmental Services
NJ TRANSIT
One Penn Plaza East
Newark, NJ 07105-2246
(201) 491-7000

Theresa Castellanos
Hoboken Historic Preservation Commission
City Hall 94 Washington Street
Hoboken, NJ 07080
(201) 420-2068

Robert Bush
Executive Director
Advisory Council on Historic Preservation
1100 Pennsylvania Avenue, N.W., Suite 809
Washington, DC 20004
(202) 606-8503

Dorothy P. Guzzo
Deputy State Historic Preservation Officer
State Historic Preservation Office
501 East State Street, CN 404
Trenton, NJ 08625-0404
(609) 292-2023

Constantine Tsentas
Project Director
Dames & Moore
12 Commerce Drive
Cranford, NJ 07016
(908) 709-3920



Historic Resources in the Area of Potential Effect

Figure 1

Rick James
Chairman
Jersey City Historic Preservation Commission
226 Fifth Street
Jersey City, NJ 07302

Bob Foster
President
Hoboken Historic Museum
P.O. Box 1944
Hoboken, NJ 07030

III. DEFINITION OF THE AREA OF POTENTIAL EFFECT

The "area of potential effect"(APE) is defined as the area in which the proposed project is most likely to have impacts on cultural resources. The APE includes the area that may be affected by direct physical impacts, such as demolition or alteration of a resource, or by indirect contextual impacts such as changes in the visual character of the surrounding neighborhood or in the view from a resource. The potential effects of temporary project actions (i.e., construction noise, dust and vibration) were also considered in the determination of the area of potential effect.

The Long Slip Canal Habitat Creation Project area is approximately 2,000 feet long and 100 feet wide. The area of potential effect includes the project area and the area surrounding the project to a distance of approximately 150 feet. The APE includes the Erie-Lackawanna Railroad and Ferry Terminal, the Southern Hoboken Historic District and the Old Main Delaware, Lackawanna & Western Railroad Historic District (Figure 1).

IV. NEW JERSEY REGISTER AND NATIONAL REGISTER LISTED PROPERTIES IN THE APE: DESCRIPTION AND SIGNIFICANCE

A. Erie-Lackawanna (Hoboken) Railroad and Ferry Terminal

The Erie-Lackawanna Railroad and Ferry Terminal (NJ TRANSIT Hoboken Terminal) is listed on the State and National Registers of Historic Places (NR:7/24/73)(SR:6/13/73).

The Erie-Lackawanna Railroad and Ferry Terminal was constructed by the Delaware, Lackawanna & Western Railroad (DL&W) in 1907 to accommodate a growing freight and passenger business. The previous railroad and ferry terminal on this site had become outmoded and was slated for replacement when it was destroyed by fire in 1905. The current terminal complex, with over 750 feet of frontage on the Hudson River, consists of four interconnected structures: the Delaware, Lackawanna & Western Railroad Terminal, the Ferry Passenger Terminal, the Train Shed and the YMCA (currently the NJ TRANSIT Dispatch Center). All of the buildings, except the Train Shed, were designed by Kenneth M. Murchison (1872-1938), a noted architect of rail stations and ferry terminals. The Train Shed was designed by DL&W Chief Engineer Lincoln Bush.

The original Delaware, Lackawanna & Western Terminal and the Train Shed are largely intact and have been in continuous use for railroad operations since 1907. The Ferry Passenger Terminal is the only portion of the original complex that is not currently used for transportation purposes. Although ferry service has recently been reinstated at Hoboken Terminal, ferries do not utilize the original Ferry Passenger Terminal.

The Erie-Lackawanna Railroad and Ferry Terminal (NJ TRANSIT Hoboken Terminal) is a contributing resource to the Southern Hoboken Historic District and to the Old Main Delaware, Lackawanna & Western Railroad Historic District.

B. Southern Hoboken Historic District

The Southern Hoboken Historic District has a SHPO Opinion of Eligibility dated 1/3/80 and a Determination of Eligibility dated 4/25/80. The District is also a Certified Local District governed by an Historic Preservation Commission (CLG:12/19/81).

The Southern Hoboken Historic District has been determined eligible for listing on the National Register under Criteria A and C. The district is significant as a cohesive urban neighborhood of commercial, residential and institutional buildings dating from the peak of Hoboken's prosperity. The character-defining features of the district are uniformly-scaled three-and-four-story streetscapes of rowhouses and commercial structures that date from the last half of the nineteenth century and are excellent examples of Greek Revival, Italianate, Victorian Gothic, Beaux Arts Classicism and Art Moderne styles. The Erie-Lackawanna Railroad and Ferry Terminal is a key contributing resource in the Southern Hoboken Historic District; a portion of the Old Main Delaware, Lackawanna & Western Railroad Historic District is located in the Southern Hoboken Historic Disitrict.

C. Old Main Delaware, Lackawanna & Western Railroad Historic District

Long Slip borders the Erie-Lackawanna Railroad and Ferry (Hoboken) Terminal, a contributing resource to the Old Main Delaware, Lackawanna & Western Railroad Historic District. The Old Main Delaware, Lackawanna & Western Railroad Historic District has a SHPO Opinion of Eligibility for listing on the National Register of Historic Places dated 9/24/96. The District is eligible for listing under Criteria A and C for its associations with suburbanization, commuter and passenger traffic, freight traffic, engineering and architecture. The District extends from Hoboken Terminal to the Delaware River.

V. DESCRIPTION OF LONG SLIP

The Long Slip Canal is a man-made canal slip located in the Hoboken Terminal Rail Yard in Hudson County, New Jersey. The canal, its eastern end bisected by the municipal boundaries of Jersey City and Hoboken, extends west from the Hudson River to approximately 150 feet east of Henderson Street, Jersey City. Long Slip measures approximately 100 feet wide by 2,000 feet long.

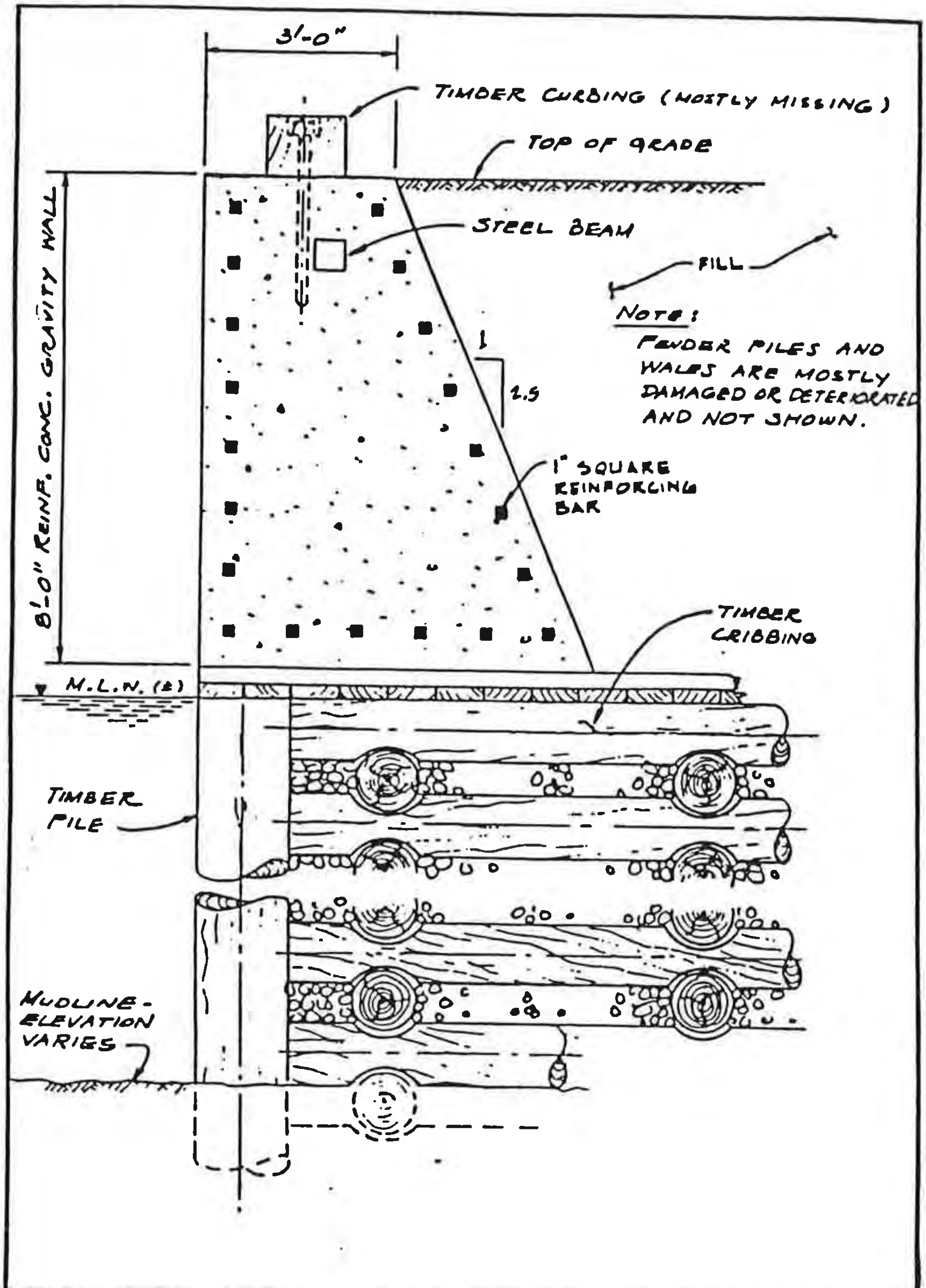
Constructed ca. 1870 by the Delaware Lackawanna & Western Railroad (DL&W), the slip consists of a timber crib at approximately 21 feet below mean sea level with a concrete gravity wall constructed ca. 1930. A typical example of the construction is shown in Figure 2.

As described in the *Stability Analysis and Environmental Findings, Parcel No. 1 Bulkhead at Newport City, Jersey City, New Jersey, Dravo Van Houten, Inc., for Vollmer Associates, New York, NY, 1986,* "This type of crib would have been built and floated over a previously prepared bed which had been dredged to firm material or, if firm material was too deep, as on the east end of Long Slip, the bed would have been overdredged and backfilled to the design depth. The crib would then be filled with stone ballast and sunk".

A 1917 publication, *Wharves and Piers: Their Design, Construction and Equipment*, by Carleton Green, describes a stone-filled timber crib as one of the most common forms of a retaining structure:

> "This crib wall construction, as built by the Central Railroad of New Jersey at Communipaw, Jersey City, consists of "large round-log cribs that are from 30 to 50 feet deep and are founded on hardpan (Figure 3). In these cribs, vertical logs were placed in the corners of the pockets to prevent vertical shrinkage and the floored pockets are continuous from front to rear... Where it was expected that mud would flow into the trench, stone filling was deposited as soon as the dredging was completed and the crib placed on this layer of stone".

Cast iron mooring cleats, formerly used to moor the lighters that serviced Long Slip, remain intact along the concrete gravity wall. Sections of rusting steel reinforcement rods jut out from the concrete wall. The southern side of the slip, formerly Pier 5 and later changed to Pier 3, is now unused with several old freight cars and other pieces of deteriorated rail equipment. The southern border is demarcated by a chain link fence beyond which is 18th Street, Jersey City. Several large retail stores and Newport City, a multi-story apartment complex, have been constructed on the portion of the freight yard that extended south of 18th Street to 12th Street. North of Long Slip, at the former location of Pier 4 (later renamed Pier 2), is a single abandoned track with several unused rail passenger cars and an abandoned snow plow engine. (See Photos 1- 14 on the following pages).



Typical Bulkhead Section **Figure 2**
Source: Stability Analysis and Environmental Findings Parcel No. 1 Bulkhead. Dravo Van Houten/1986

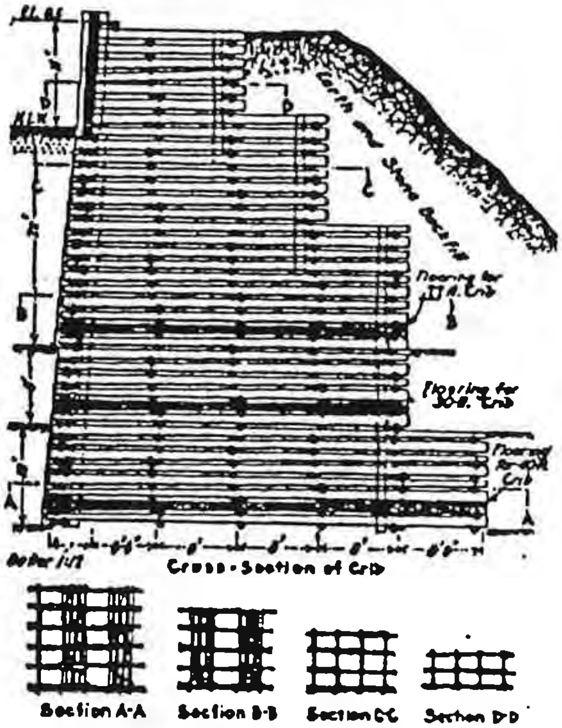
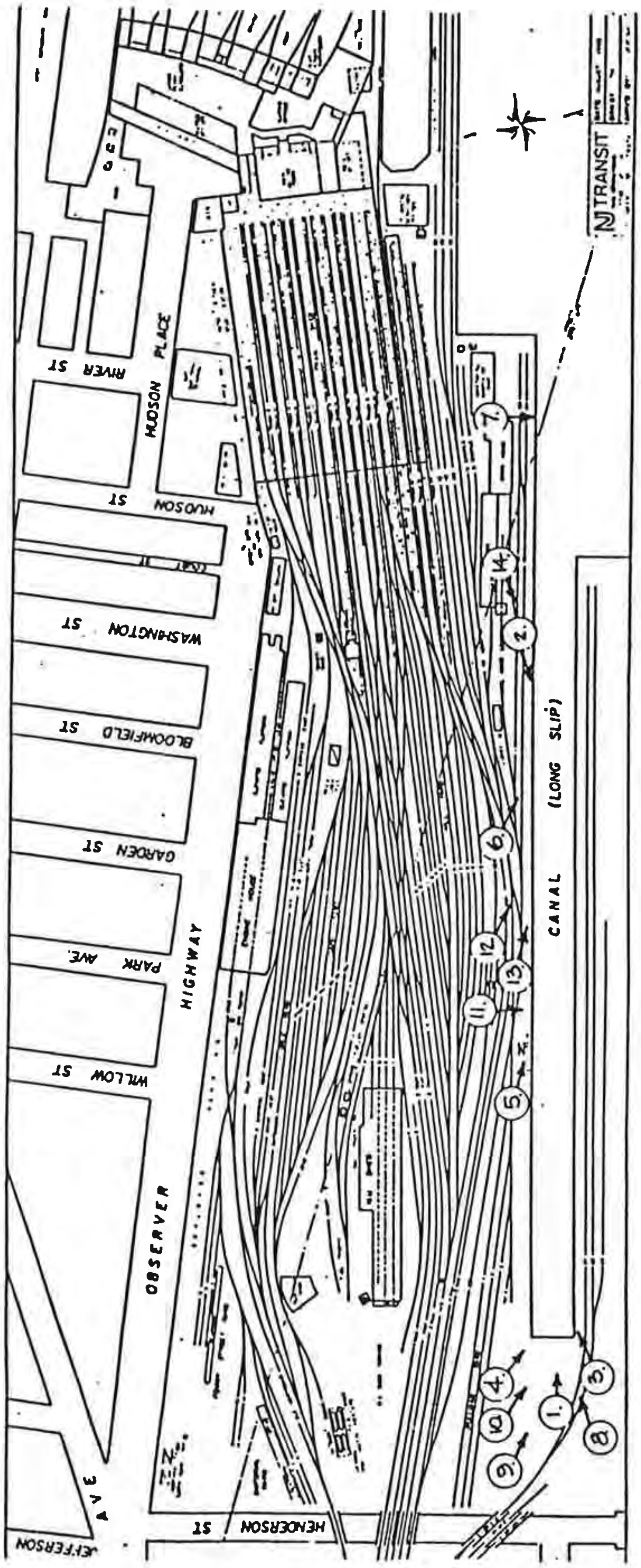


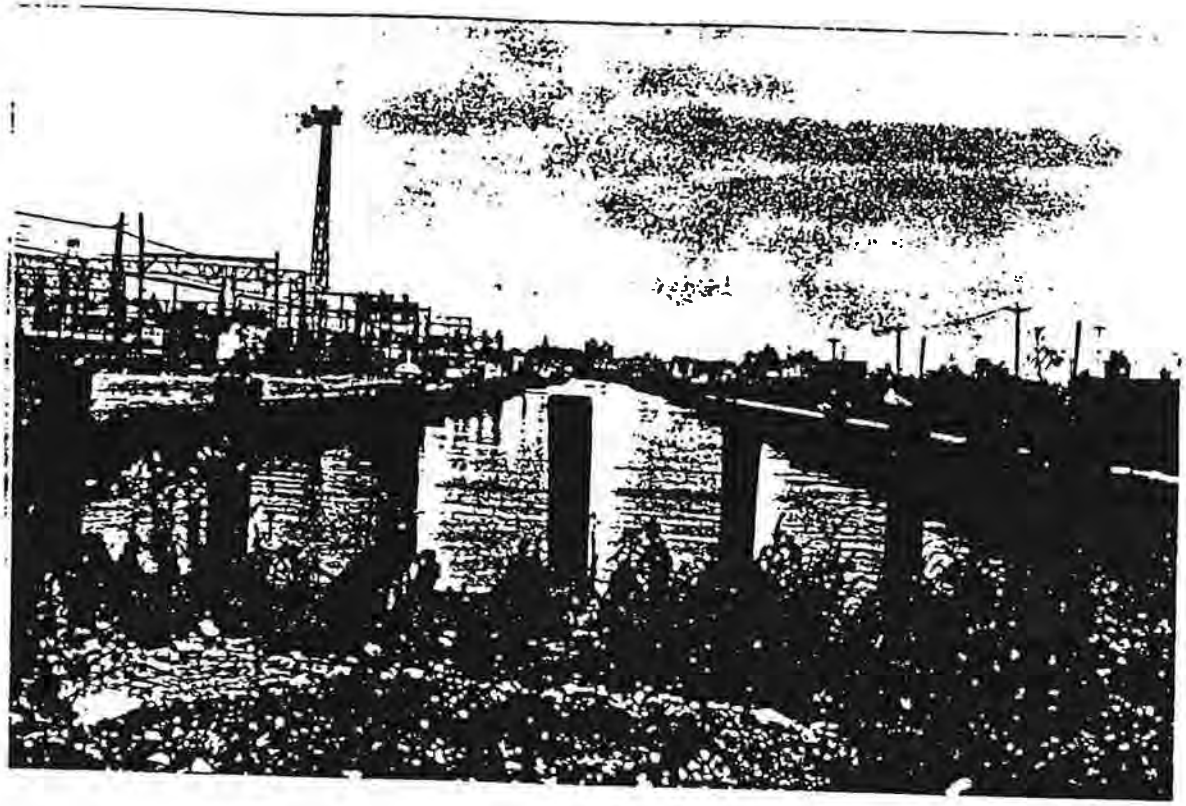
Fig. 11. Crib Wall of Round Logs, C. R. R. of N. J., Jersey City, N. J.

Typical Crib Wall **Figure 3**

Source: *Carleton Greene.* *Wharves and Piers: Their Design, Construction and Equipment.*

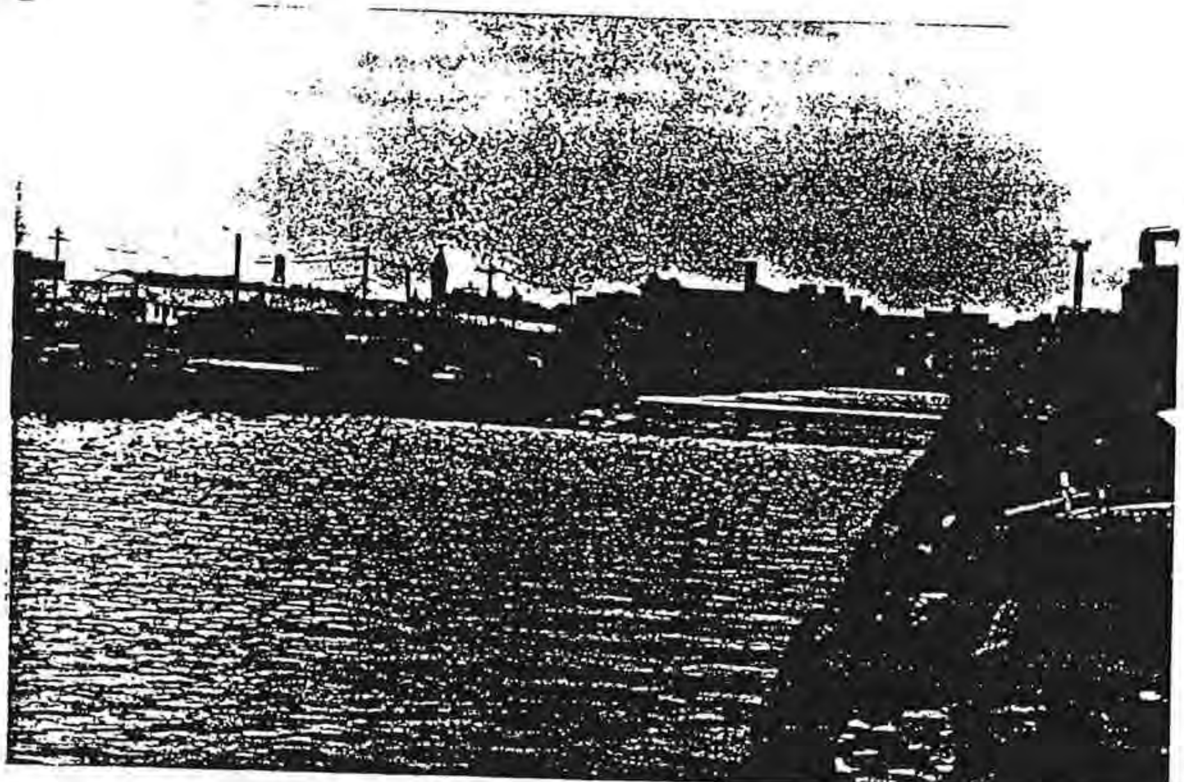


Photograph Key



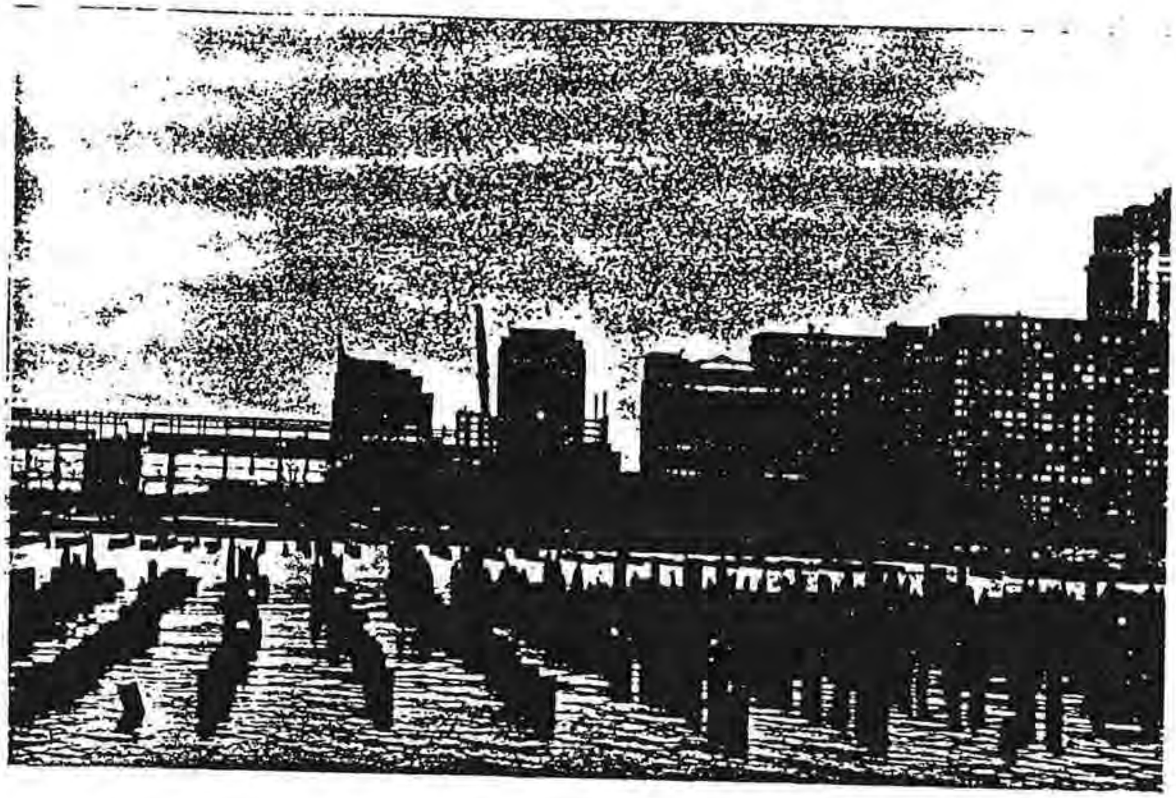
Long Slip
Facing East, 11/96

Photo No. 1.



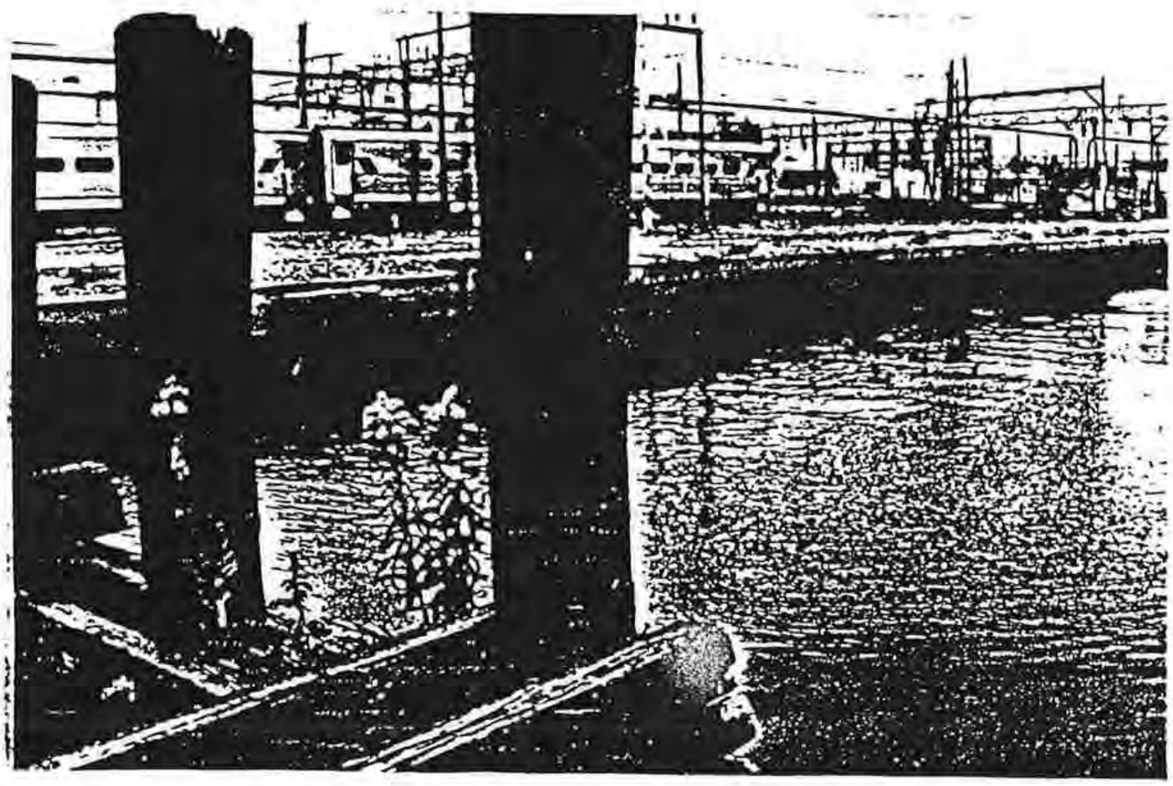
Long Slip
Erie-Lackawanna Freight Terminal Warehouse in Background
Facing Southwest, 11/96

Photo No. 2.



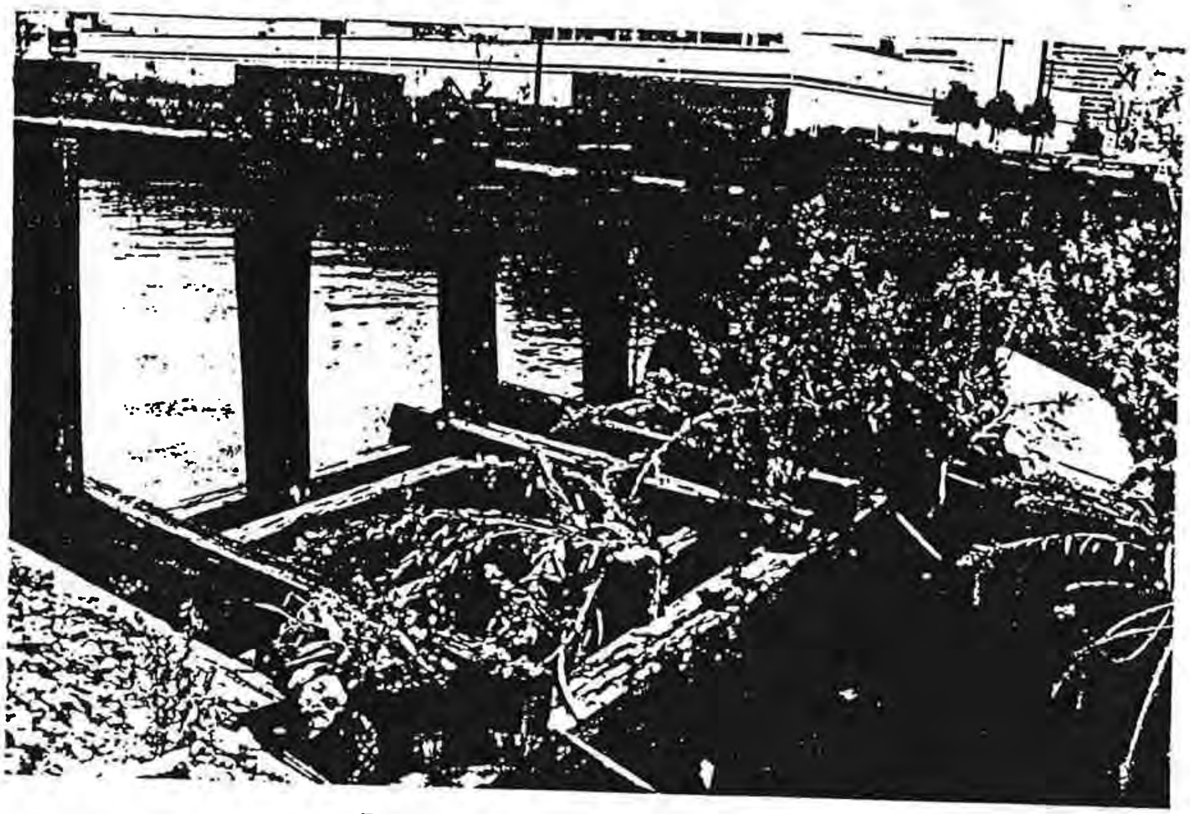
Long Slip
Facing South, 11/96

Photo No. 7.



Long Slip: Concrete Gravity Wall
Facing Northeast, 11/96

Photo No. 8.

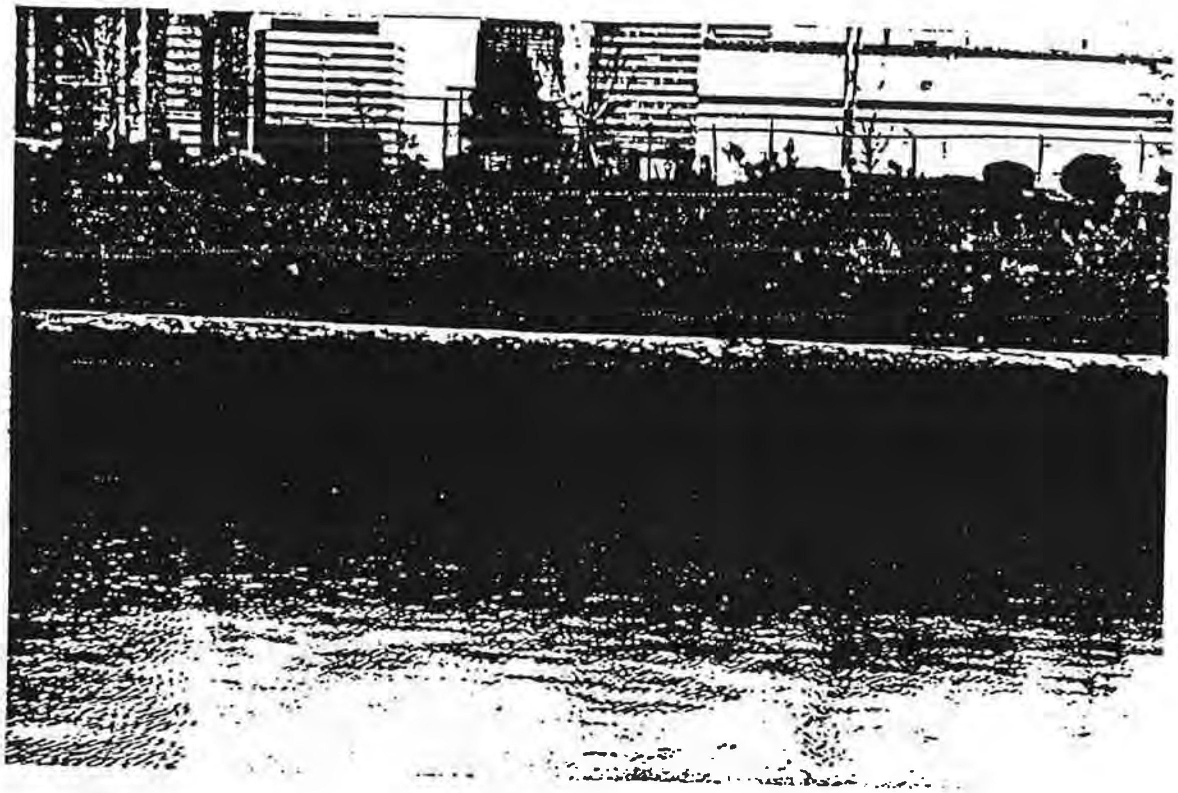


Long Slip: Western Terminus
Facing Southeast, 11/96

Photo No. 9.

Long Slip: Jersey City Sewage Outlet
Facing West, 11/96

Photo No. 10.

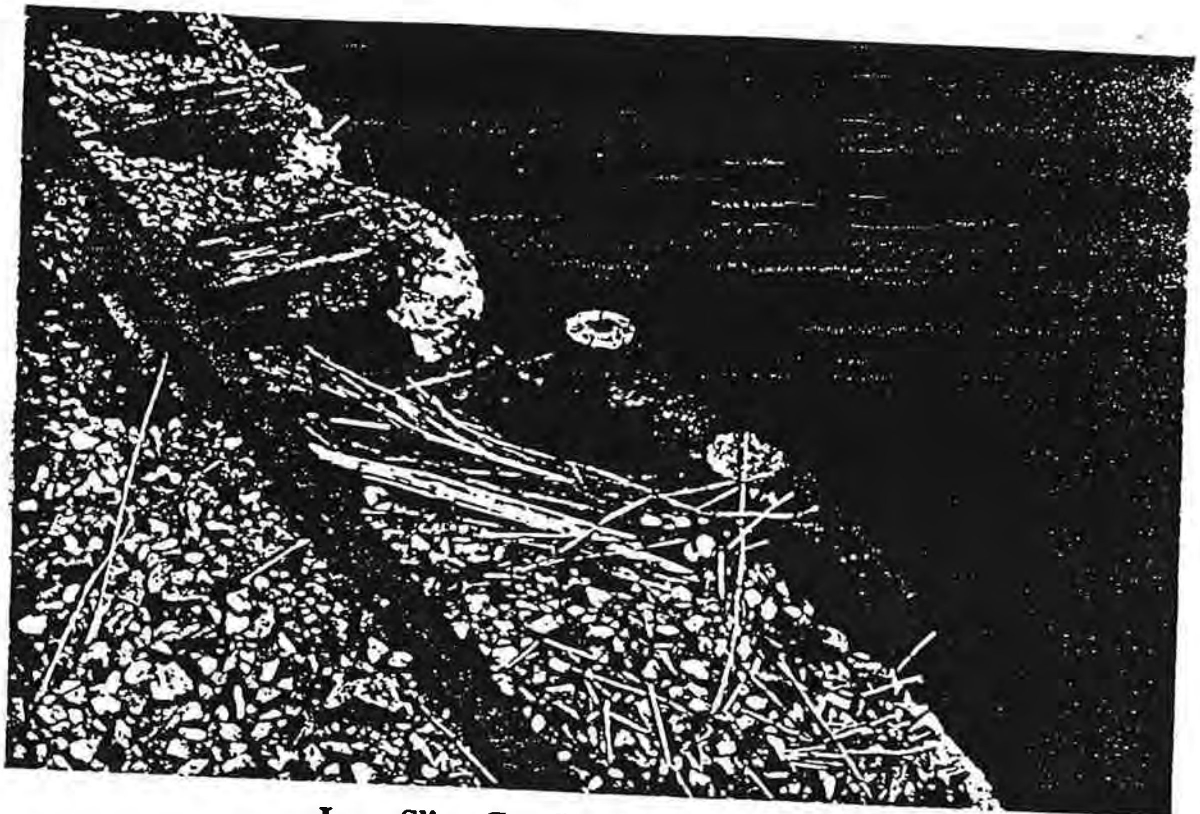


Long Slip: South Wall
Current "Freight Yard" Boundary
Facing South, 11/96

Photo No. 11.

Long Slip: Exposed Reinforcing Rods
Facing Southwest, 11/96

Photo No. 12.



Long Slip: Cast Iron Mooring Cleat **Photo No. 13.**
Facing Southeast, 11/96

Long Slip: Abandoned Snow Plow Engine **Photo No. 14.**
Facing Southwest, 11/96

VI. HISTORICAL BACKGROUND AND SIGNIFICANCE

A. Introduction

Long Slip, a man-made channel of water that extends from the Hudson River to several feet east of the western boundary of the Hoboken Rail Yard, was formerly a major component of the Delaware, Lackawanna & Western Railroad Hoboken Freight Terminal. The Freight Terminal and its Yards were one of the finest rail freight complexes west of the Hudson River between 1902 and 1912. Long Slip is one of the last remnants of the former Hoboken Freight Terminal which, at its peak of operations, extended south to 12th Street, Jersey City.

Long Slip was significant for its critical role in facilitating the transfer of goods from lighters[1] to freight cars. Large manufactured items that required a crane were unloaded at Long Slip; smaller items not requiring a crane were unloaded into one of the covered piers to await the availability of the exporting ship. Long Slip, which was served by two sixty-ton gantry cranes used to transfer heavy export freight, was a major factor in the success of the DL&W's export freight traffic. The Slip, owned by NJ TRANSIT, is not currently used for any navigational or railroad purposes. It is used to handle the discharge of stormwater and combined sewage overflows.

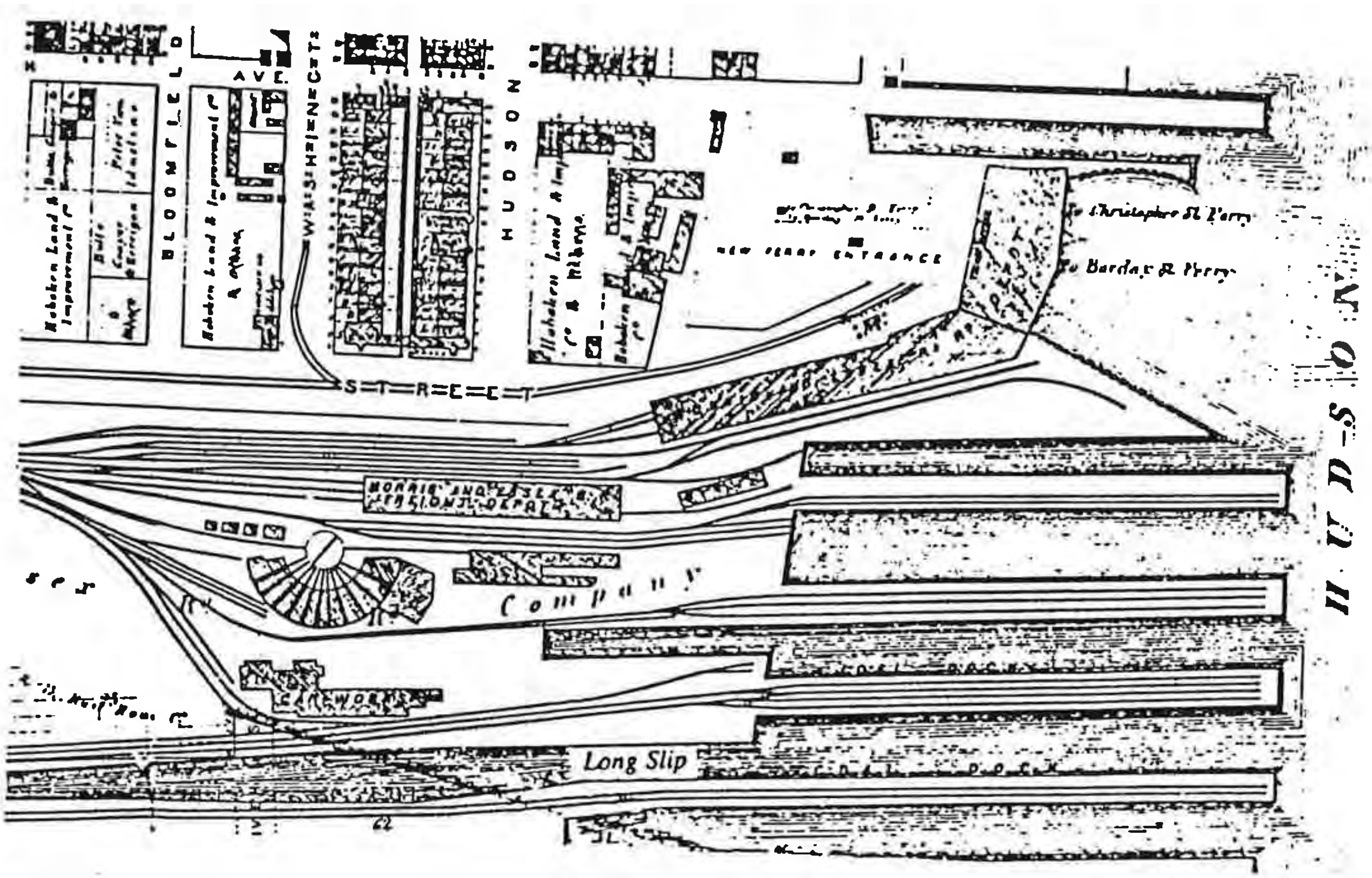
The Hoboken Freight Terminal was located southwest of the DL&W Hoboken Passenger Rail and Ferry Terminal. In the late 1980s, a major portion of the Hoboken Freight Terminal was demolished by Newport Development Associates to construct Newport City - a high-rise apartment complex. Following the construction of Newport City, several retail establishments were also constructed on the former Freight Yard site. Newport Development Associates also facilitated the construction of 18th Street east of Henderson Street, a new roadway that extends along the current southern border of the Yard.

B. Historical Development of the Hoboken Freight Terminal Yard

1. 19th Century Development

The Hoboken Freight Terminal was originally constructed to be used almost exclusively for coal. The freight yard was begun in the early 1870s below the Hoboken Ferry, requiring the filling of the northern shore of Harsimus Cove. By 1873, as indicated by Figure 4, the Freight Yard extended south to 16th Street with four coal piers located within the yard. Long Slip, located between Piers 4 and 5, was about two-thirds of its current length, extending only to a point west of Garden Street, Hoboken. By 1873, the cove between 12th and 16th Streets had also been filled and was largely under the control of the Jersey Shore Improvement Company.

[1] Lighters: A flat-bottomed unpowered barge used in unloading or transporting goods short distances.



Morris & Essex Hoboken Terminal, 1873	**Figure 4**
Source: G.M. Hopkins, Combined Atlas of the State of New Jersey and the County of Hudson, 1873	

By 1875, the railroads of Jersey City (the DL&W, the Erie and the Pennsylvania Railroads) were handling 90% percent of all export rail freight that passed through New York Harbor. The DL&W continued the southward development of their freight yard to 15th Street. Land between 12th and 15th Street was owned by the Jersey Shore Improvement Company, who in 1881 received a riparian grant for their property. Shortly after, they sold this tract to the DL&W who required still more acreage for their huge coal trade. In 1888, the DL&W received a riparian grant for their holdings north of 15th Street.

By the 1890s, the DL&W's expanded yard extended south to 12th Street, Jersey City, and included 12 freight piers, half of which were elevated for coal (Figure 5). Pier No. 1 was used for passenger trains to transport immigrants who arrived by ferry from Ellis Island. Pier No. 2 was a covered pier for westbound freight merchandise. Two car float transfer bridges were located between Piers 2 and 3.

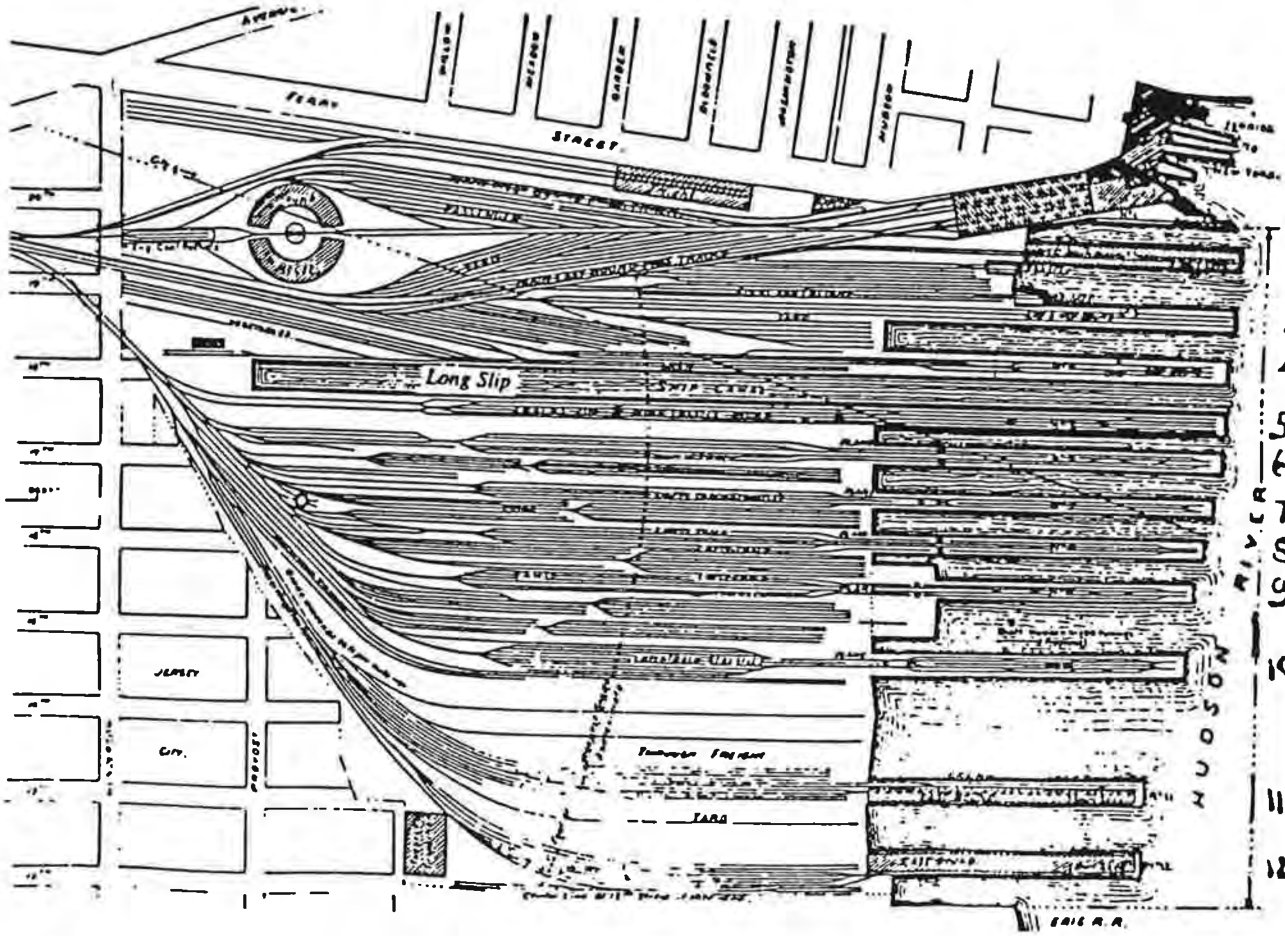
Long Slip had been extended at least two blocks further west to the western alignment of Provost Street, Jersey City. Piers 4 and 5, located on either side of Long Slip, were used for general freight transferred to or from lighters onto freight cars. Piers 6-10 were elevated and used for unloading coal. Pier No. 11 was used for grain and Pier No. 12 for merchandise. In the late 1890s, the car float transfer bridges were relocated between Piers No. 10 and No. 11.

2. 20th Century Expansion

The expansion of the DL&W Freight Terminal and Yard continued into the twentieth century as the railroad's freight business continued to expand. The expansion was largely precipitated by four forces: a major fire in 1904 that resulted in the destruction of the southern third of the yard; the purchase of John Starin's marine operations business in 1904; another major fire in 1905 that resulted in the complete destruction of the DL&W Rail and Ferry Terminal; and, by the enlightened vision of DL&W President William Haynes Truesdale.

William Haynes Truesdale served as President of the DL&W from 1899 through 1925. During his 26 years as President of the DL&W, known as the "Golden Years", he completely rebuilt the railroad, creating the most highly developed railroad in the country. Under President Truesdale's administration, thousands of miles of track were constructed, an unprecedented grade crossing elimination program was implemented, over 160 passenger stations were built and seven new freight yards were purchased. Under Truesdale's direction, the Hoboken Freight Terminal reached its peak of operations.

President Truesdale was contemplating a major reworking of the Hoboken Freight Terminal when a disastrous fire struck the yards. On May 29, 1904, a barge tied to Pier 12 caught fire and, aided by northerly winds, destroyed Piers 9 to 12 along with several other float barges. The fire destroyed the southern third of the freight yard.



DL&W Hoboken Terminal, ca. 1890 **Figure 5**

Source: Thomas Townsend Taber, The Delaware, Lackawanna & Western Railroad in the Twentieth Century, 1899-1960, p. 424

Following the fire, Chief Engineer Lincoln Bush developed plans to completely rebuild the freight yard. Lincoln Bush (1860-1940) served as Chief Engineer of the Delaware, Lackawanna and Western Railroad from 1903 - 1908. Bush was an innovative designer best known for his patent of the Bush Train Shed at Hoboken Terminal. At the north end of the yard, Bush constructed piers for handling bulky freight such as lumber and machinery, a coal dumping pier and a coal yard that could contain 600 loaded and empty coal cars. To the south was a distribution yard for 1,000 cars, with one of the piers designed for fruit and produce and several piers for merchandise freight to be delivered to New York City. A separate pier was constructed to receive merchandise to be shipped west by the railroad.

The acquisition of John H. Starin's marine operations in December of 1904 was another factor that precipitated massive changes in the Hoboken Freight Terminal Yard. Starin handled all of the DL&W's marine freight operations under a long-term contract with the railroad. Upon the expiration of his contract, the DL&W purchased all of Starin's equipment and entered the marine business. The marine operations of the DL&W proved to be successful and handled most of the freight delivered into Hoboken until the early 1920s when private competitors took a substantial share of the business.

On August 8, 1905, before construction of the new yard was substantially underway, the passenger station and the ferry slips caught fire from a blaze that originated on the passenger ferry boat *Hopatcong,* moored in a slip in the Ferry Terminal. The terminal and the northern portion of the rail yards were completely destroyed. The DL&W commissioned Kenneth R. Murchison, a well-known ferry terminal architect, to design a new fireproof terminal that was completed in 1907. This new (current) Terminal was greatly enlarged from the previous passenger terminal and encompassed the area that was previously Piers 1 and 2. The former Piers 3 and 4 were renumbered as Piers 1 and 2.

The 1905 fire, combined with the newly acquired and expanding marine operations division, precipitated unprecedented expansion and rebuilding of the Hoboken Freight Terminal. Between 1905 and 1906, a number of new piers were constructed: Pier 2, an open pier; Pier 4, an enclosed pier; Pier 5 was rebuilt with a new coal dumper and an old coal dumper from Pier 10 that was salvaged from the fire. These new piers, which gave the yard considerable facilities both for open and enclosed freight handling, were among the largest in the harbor at the time.

The Hoboken Freight Yard continued its expansion with the addition of four float bridges (later increased to six) in 1908. The only high pier in the new yard, Pier 6, was used for grain and the gravity unloading of coal cars. By 1908, the DL&W Yard also included several structures, largely small yard operations buildings such as the brick hoisting engine house and the Freight Terminal Office Building (both demolished). The final piers to be erected were Piers 7 and 8 in 1908 and 1909, and Pier 9 in 1912. Pier 1 was completely reconstructed in 1910. Piers 7 and 9 were used for food and covered merchandise barges while Pier 8 was an open pier, intended for berthing small freight such as scrap iron. The completion of the yard in 1912 gave the DL&W the finest yard west of the Hudson.

The completion of the Hoboken Freight Terminal and Yard hallmarked the DL&W Railroad's transition from basically a coal and local freight carrier to a large-scale freight carrier shipping to New York City, New England and overseas. Huge gantry cranes (called Mac Miler Cranes) used at Long Slip could transfer and load the largest manufactured products; covered pierside freighthouses protected smaller freight.

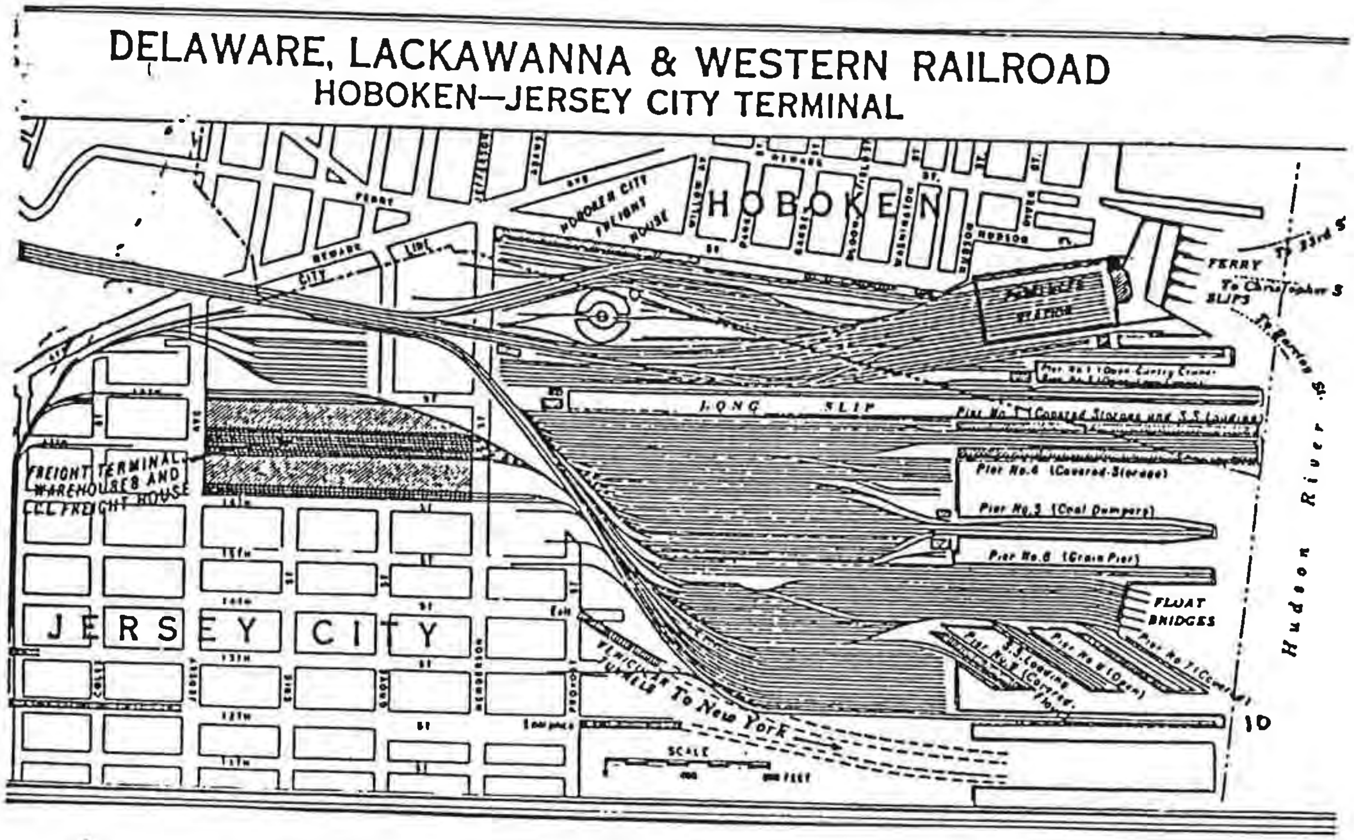
After 1912, changes to the Freight Terminal and Yard were largely made to accommodate the transition from steam locomotion to electrification and to provide additional capacity for expanding passenger service. A new brick power house and a tall brick chimney stack (demolished), designed by DL&W Chief Engineer George L. Ray and Architect Frank Nies, were constructed at the foot of Long Slip in 1920. Pier No. 10 was constructed in 1929 for the direct loading of freighters and the Erie-Lackawanna Freight Terminal Warehouse was constructed in 1930 between Grove Street and Jersey Avenue (extant). The railroad reached its peak in the 1930s (Figure 6) with the Depression striking the first direct blow to operations. However, World War II and the associated economic recovery that ensued brought a burst of prosperity that lasted over a decade.

Figure 7 is an aerial view of the Erie-Lackawanna Hoboken Terminal in the late 1940s. The Freight Terminal and Yards are intact and the piers are active. Ferries are approaching and departing the six-slip ferry terminal, which at that time serviced three Manhattan ferry terminals. Tugboats are in the first slip south of the Ferry Terminal; nine lighters are in the next slip and thirty are in Long Slip. The covered piers south of Long Slip are Pier Nos. 3 and 4; about 23 coal barges are moored at Pier 5. Three car floats are at Pier 6; Piers 7, 8 and 9 are active and Pier 10 is not being used.

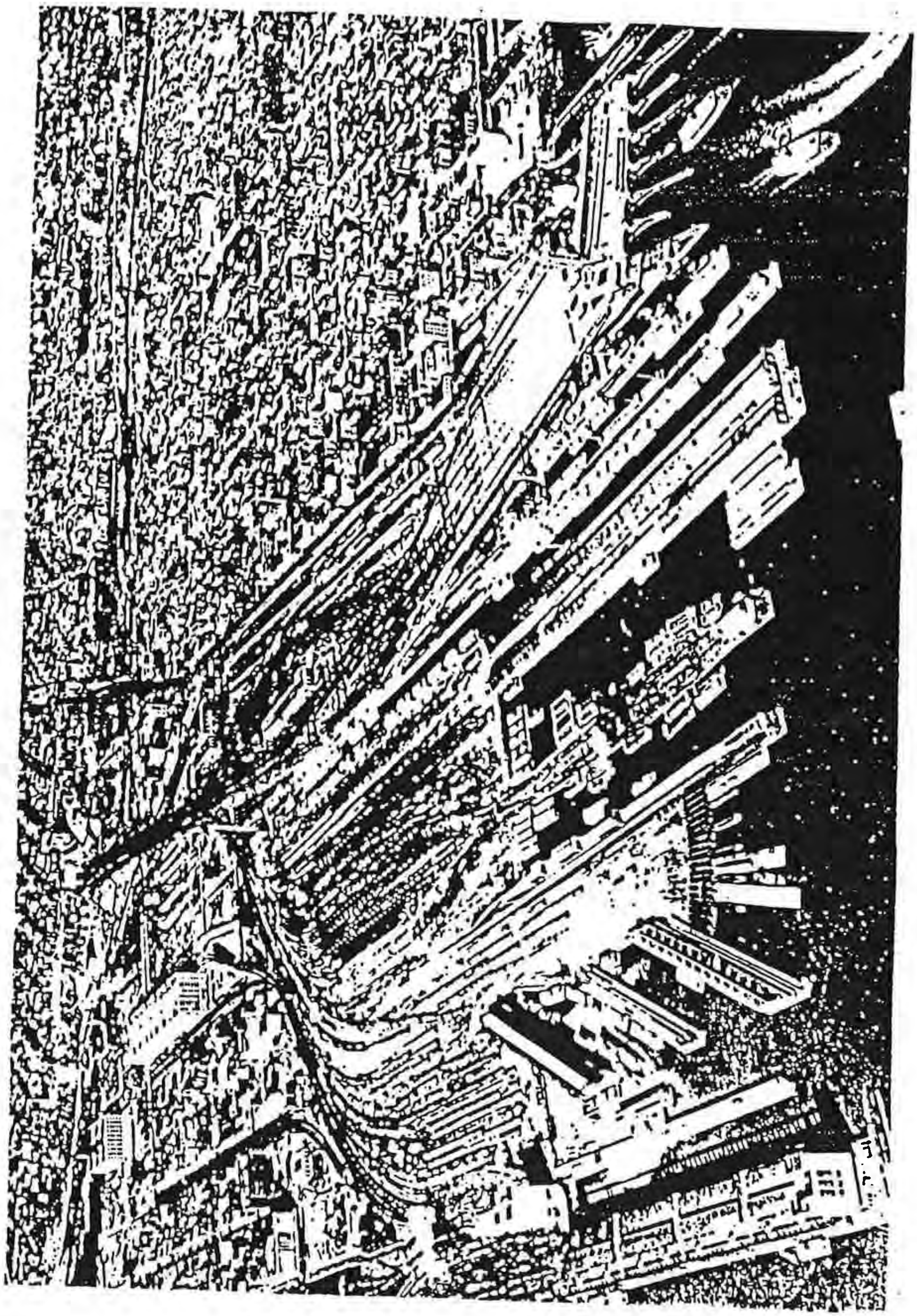
Figure 8 is a photograph of Long Slip in the 1950s illustrating the sixty-ton Mac Miler gantry cranes that were used to move heavy freight. The storage area is completely filled with freight and two rows of gondolas and flat cars are under the crane waiting to be unloaded. The brick power house and chimney stack built in the 1920s can be seen at the western end of Long Slip.

3. The Demise of the Hoboken Freight Terminal

The mid-1950s saw a dramatic change in the marine and railroad freight operations in the New York Harbor area. Containerization grew rapidly and diverted freight traffic to Port Newark where large open areas could store and transport the enormous containers. Powerplants and buildings switched from coal to oil eliminating coal traffic from the Hudson River. The St. Lawrence Seaway, opened in 1957, provided a direct inland route to the plains area and as a result, captured grain traffic away from both the DL&W and the New York Central. The construction and expansion of super highways promoted the transport of freight merchandise by private trucking companies.



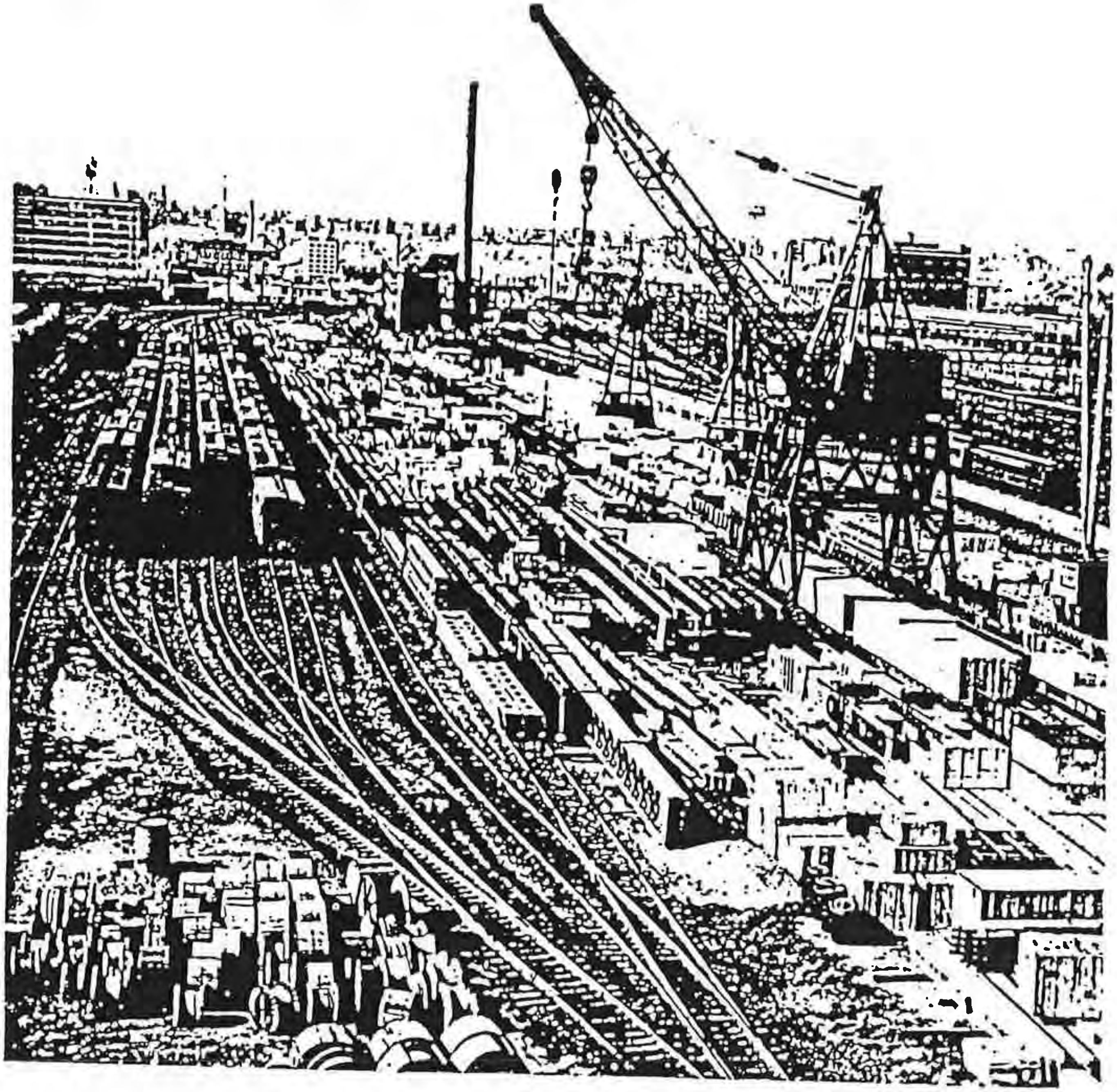
Delaware, Lackawanna & Western Railroad Hoboken-Jersey City Terminal *Source: Thomas Townsend Taber, The Delaware, Lackawanna & Western Railroad in the Twentieth Century, 1899-1960, p. 427*	**Figure 6**



Aerial View of Erie-Lackawanna Hoboken Terminal, ca. 1945

Figure 7

Source: Thomas Townsend Taber, The Delaware, Lackawanna & Western Railroad in the Twentieth Century, 1899-1960, p. 426



Long Slip, Facing West, ca. 1950 **Figure 8**

Source: Thomas Townsend Taber, The Delaware, Lackawanna & Western Railroad in the Twentieth Century, 1899-1960, p. 426

In 1960, the DL&W and the Erie Railroad, both in dire financial straits, merged to form the Erie-Lackawanna. However, the railroads continued to decline and the old DL&W Yard south of 18th Street was closed. Freight business continued to be diverted from the railroads through the 1960s and by the 1970s, the remaining Erie-Lackawanna freight traffic was transferred to the Pennsylvania Rail Yards.

In the 1980s, almost the entire Hoboken Freight Terminal, from 18th Street south to 12th Street, Jersey City, was sold to Newport Development Associates. This resulted in the demolition of all of the Terminal and Yard structures south of Long Slip in addition to the demolition of Piers 3 - 10. NJ TRANSIT demolished the power house and smokestack located at the foot of Long Slip. In 1995, the Hoboken Freight Terminal Office Building at the foot of Pier One was demolished.

VII. CONCLUSION

A. National Register Criteria

The eligibility of Long Slip was evaluated in accordance with the National Register Criteria for eligibility. The Criteria is as follows:

"The quality of significance in American history, architecture, archaeology, engineering, and culture that is present in districts, buildings, structures, and objects that possess integrity of location, design, setting, materials, workmanship, feeling, and

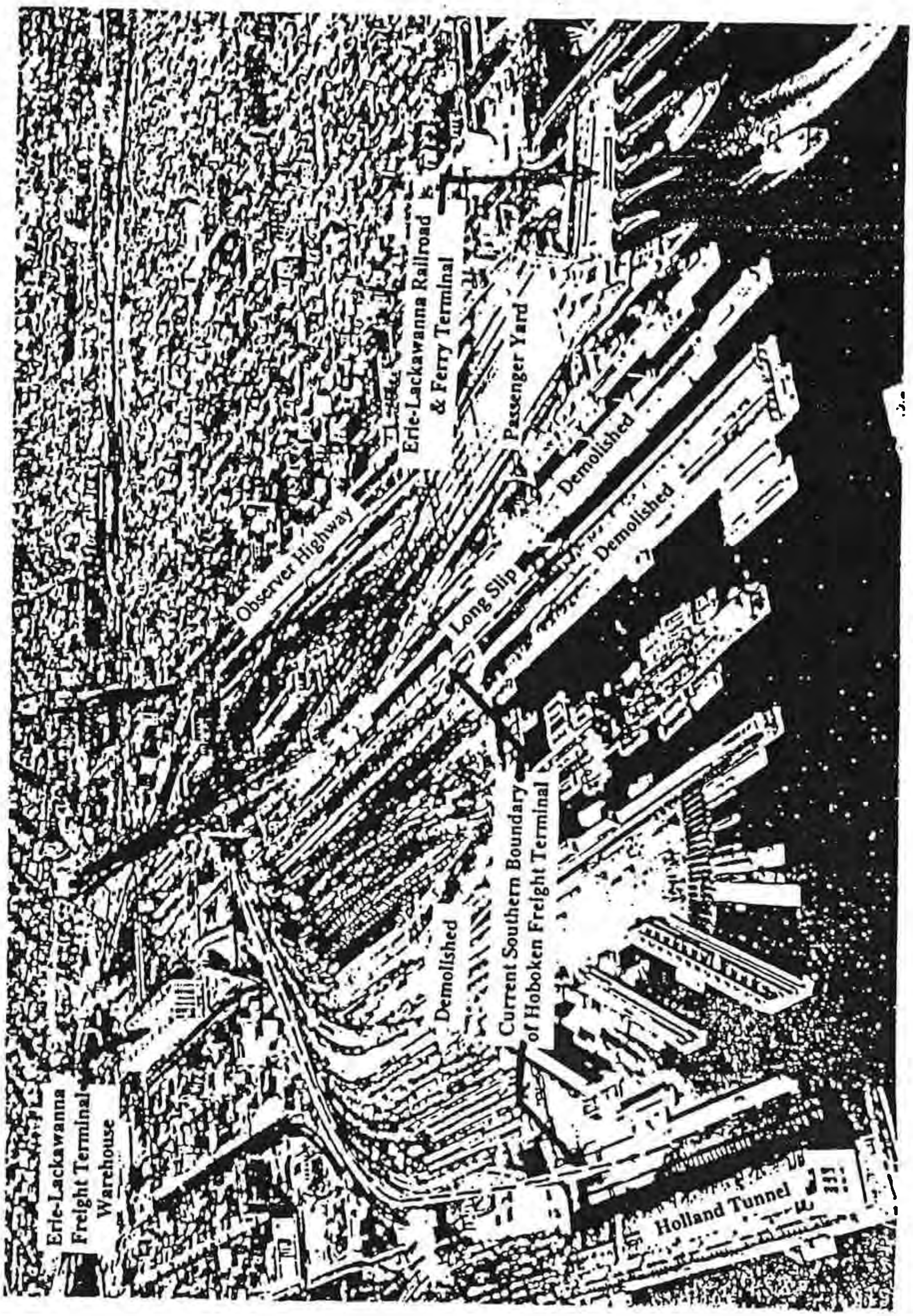
> **Criterion A:** That are associated with events that have made a significant contribution to the broad patterns of our history;
>
> **Criterion B:** That are associated with the lives of persons significant in our past;
>
> **Criterion C:** That embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction; and,
>
> **Criterion D:** That have yielded, or may be likely to yield, information important in prehistory or history."

B. NJ TRANSIT Opinion of Eligibility

It is the opinion of NJ TRANSIT that Long Slip, formerly an integral component of the DL&W Hoboken Freight Terminal, is not eligible for listing on the National Register of Historic Places. The Erie-Lackawanna Railroad and Ferry Terminal Yard was given a SHPO Opinion of Eligibility for listing on the National Register on 9/1/78 and 7/24/73. The Opinion of Eligibility was reversed by the SHPO on 11/23/83 due to a lack of "sufficient integrity".

It is the opinion of NJ TRANSIT that the Hoboken Freight Terminal has suffered a loss of integrity because almost all of the Freight Terminal and Yard piers, buildings, track, machinery and equipment, i.e., its contributing resources, have been demolished (Figure 9). The former Freight Terminal site has completely lost its integrity; roadways, large-scale retail establishments and a modern high-rise apartment tower now comprise the former Freight Terminal site south of 18th Street. Former Freight Terminal structures directly associated with Long Slip - the power house and the chimney stack - were demolished in the 1980s.

It is also the opinion of NJ TRANSIT that Long Slip is not a contributing resource to the Southern Hoboken Historic District or to the Erie-Lackawanna Railroad and Ferry Terminal, nor is it eligible as a contributing resource to the Old Main Delaware, Lackawanna & Western Railroad Historic District. Long Slip is not eligible for listing as a contributing resource to these three associated resources due to a loss of integrity caused by the demolition of the Freight Terminal and Yard and due to the lack of contributing resources that date from the period of significance. Long Slip does not have the integrity of location, setting, design, feeling or association. Substantial changes have been made to the original design and setting of Long Slip and the Hoboken Freight Terminal; these changes have impaired Long Slip's ability to convey its appearance and function during the period of significance.



Aerial View of Erie-Lackawanna Hoboken Terminal, ca. 1945 Illustrating Loss of Integrity to Hoboken Freight Terminal **Figure 9**

Source: *Thomas Townsend Taber, The Delaware, Lackawanna & Western Railroad in the Twentieth Century, 1899-1960, p. 426*

BIBLIOGRAPHY

AmerCom Corp., Consulting Engineers, for Frederick R. Harris, Inc. *Inspection & Stability Analysis for the Long Slip Canal, Jersey City & Hoboken, New Jersey*. Parsippany, NJ. July 1994.

Beyer, Blinder, Belle, for NJ TRANSIT. *Hoboken Terminal and Yard Preservation Plan, Final Draft*. New York, NY. December 11, 1996.

Dames & Moore, for NJ TRANSIT. *Hoboken Rail Yard, Long Slip Canal Habitat Creation Project, Fact Sheet*. Pearl River, NY.

Dravo Van Houten, Inc., for Vollmer Associates. *Stability Analysis and Environmental Findings, Parcel No. 1 Bulkhead at Newport City, Jersey City, New Jersey*. New York, NY. 1986.

Correspondence from Helen C. Fenske, *Deputy State Historic Preservation Officer*, to Mark Munley, *Director, Department of Housing & Economic Development, Jersey City, NJ*, regarding reversal of SHPO Opinion of Eligibility (09/01/78) for the Jersey City section of the Erie-Lackawanna Railroad and Ferry Terminal Yard Complex. November 23, 1983.

Geismar & Calamari, P.C., Consulting Engineers, for The Newport Associates Development Corp. *Long Slip Canal Study*. Englewood, NJ. 1986.

Greene, Carleton. Wharves and Piers: Their Design, Construction and Equipment. New York, NY: McGraw-Hill Book Company, Inc. 1917.

Louis Berger & Associates, Inc. *An Archaeological Assessment of Soil Borings from the Newport City Project Area, Jersey City, New Jersey*. East Orange, NJ. October 1983.

Louis Berger & Associates, Inc., for Desdner Associates. *Environmental Technical Report: Analysis of Cultural Resources, Newport City Development Site, Jersey City, New Jersey*. East Orange, NJ. May 1983.

Louis Berger & Associates, Inc., for Desdner Associates. *Hudson and Manhattan Railroad Erie Station/PATH Pavonia Station, Jersey City, New Jersey*. East Orange, NJ. November 1983.

New Jersey & National Registers of Historic Places as of December 31, 1988. Trenton, NJ: Office of New Jersey Heritage, Division of Parks and Forestry, New Jersey Department of Environmental Protection. 1988.

Scull, Theodore W. Hoboken's Lackawanna Terminal. New York, NY: Quadrant Press, Inc. 1987.

Taber, Thomas Townsend. The Delaware, Lackawanna & Western Railroad in the Nineteenth Century, 1828-1899. Muncy, PA: Thomas Townsend Taber III. 1977.

Taber, Thomas Townsend, and Thomas Townsend Taber III. <u>The Delaware, Lackawanna & Western Railroad in the Twentieth Century, 1899-1960</u>. Vol. 1 and 2. Muncy, PA: Thomas Townsend Taber III. 1980.

Oral Interview with Ed Thoden, former *Director, Structures Department, NJ TRANSIT.* November 4, 1996.

16th Street Area Sewer Project. *Drawings*, by Gerard Engineering Inc. for the City of Jersey City, Hudson County, New Jersey. (Drawings not dated).

APPENDIX D: COORDINATION AND CORRESPONDENCE

Steve Juran

United States Department of the Interior

OFFICE OF THE SECRETARY
WASHINGTON, D.C. 20240

ER-98/419

AUG 14 1998

AUG 1998
Capital Funding Department
#4721

Ms. Letita Thompson
Regional Administrator
Federal Transit Administration
U. S. Department of Transportation
26 Federal Plaza, Suite 2940
New York, New York 10278-0194

Dear Ms. Thompson:

This is in response to the request for the Department of the Interior's comments on the Draft Section 4(f) Evaluation for the Long Slip Habitat Creation Project at Hoboken, Hudson County, New Jersey.

SECTION 4(f) EVALUATION COMMENTS

We concur that there is no prudent and feasible alternative to the proposed project, if project objectives are to be met. We also concur with the proposed measures to minimize harm to the Old Main Delaware, Lackawanna and Western Railroad Historic District, as detailed in the proposed Memorandum of Agreement (MOA) in Appendix B. A signed copy of the MOA should be included in the Final Section 4(f) Evaluation.

FISH AND WILDLIFE COORDINATION ACT

The above Section 4(f) Evaluation comments do not preclude additional and separate evaluation and comment by the U.S. Fish and Wildlife Service (FWS), pursuant to the Fish and Wildlife Coordination Act (48 Stat. 401, 16 U.S.C. 661-667 *et seq.*) if project implementation involves modification of any stream or other body of water under Federal permit or license. In the FWS's review for such permit or license, the FWS may concur, with or without stipulation, or object to the proposed work depending on the magnitude or project-related adverse impacts to Federal trust fish and wildlife resources and their supporting habitats. The FWS is available to provide technical assistance to the Federal Transit Administration regarding further project evaluation and assessment through its New Jersey Field Office, 927 North Main Street, Building D-l, Pleasantville, NJ, 08232, telephone 609-646-9310.

SUMMARY COMMENTS

The Department of the Interior has no objection to Section 4(f) approval of this project by the Department of Transportation.

We appreciate the opportunity to provide these comments.

Sincerely,

Willie R. Taylor
Director, Office of Environmental
Policy and Compliance

cc: Ms. Catherine Regan-DeCicco
Senior Director of Capital Funding
New Jersey Transit
One Penn Plaza East
Newark, New Jersey 07105-2246

U.S. Department of Transportation
Federal Transit Administration

REGION II
Connecticut
New Jersey
New York
Virgin Islands

One Bowling Green
Room 429
New York, NY 10004-1415
212-668-2170
212-668-2136 (Fax)

JUN 1999
Capital Funding Department
#5021

JUN 15

June 1, 1999

Ms. Catherine Regan-DeCicco
Senior Director, Capital Funding
NJ Transit Corporation
One Penn Plaza East
Newark, NJ 07105-2246

Re: Long Slip Canal Memorandum of Agreement

Dear Ms. Regan:

Please find enclosed for your records a fully executed original of the Long Slip Canal Memorandum of Agreement. With this action, all steps required to comply with Section106 of the National Historic Preservation Act are completed. Please note that the implementation of this program should be consistent with the conditions stipulated in the Agreement.

Should you have any questions, please contact Ms. Carmen G. Orta, community planner, at (212) 668-2170.

Sincerely

Anthony G. Carr
Anthony G. Carr
Deputy Regional Administrator

Enclosure

cc: S. Jurow, NTC
Section 106 File

pm/carmen/njt_longslipmoa

NJ TRANSIT
The Way To Go.

March 23, 1998

Mr. Anthony G. Carr, Director
Office of Planning and Program Development
Federal Transit Administration
26 Federal Plaza, Suite 2940
New York, New York 10278-0'94

Re: Hoboken Yard Long Slip Canal Habitat Creation Project

Dear Mr. Carr:

Enclosed for your review and transmittal to the Advisory Council on Historic Preservation are copies of the draft Memorandum of Agreement (MOA), the State Historic Preservation Officer's (SHPO) May 8, 1997 consultation comments, and the reports, **NJ Transit Long Slip Habitat Creation Project: Archeological Assessment of the Long Slip Canal** and **NJ Transit Long Slip Habitat Creation Project: Request for a Determination of Eligibility for Long Slip.**

NJ Transit owns the 2,000 foot long and 100 foot wide Long Slip Canal and is proposing to fill the waterway as part of the Long Slip Canal Habitat Creation Project. The Project will create a new habitat for diverse fish species at the canal entrance area, control point pollution sources by eliminating Hoboken outfalls into the canal and improving the Jersey City outfall, control non-point pollution (storm drainage) sources, create public access consistent with the Hudson Waterfront Walkway, and accept dredged material in a confined disposal facility to offset project costs.

The Long Slip Canal Habitat Creation Project is a key element of NJ Transit's Hoboken Terminal Expansion and Rehabilitation Project. The Long Slip Canal covers approximately five acres and splits the yard into two unequal sections. All passenger and train activity occurs on a 400-foot wide segment lying to the north; the southern section, which is 80 feet wide, is unused. It is NJ Transit's intention to expand the useable rail yard area by approximately ten acres by filling Long Slip Canal. On October 18, 1995, I sent you copies of the report, **Long Slip Canal Engineering Study**, which was funded by grant NJ-90-X037. The study effort examined the condition and various alternatives for utilizing the canal.

As stated in the enclosed letter, the SHPO opined that the filling of Long Slip Canal will have no effect on the Southern Hoboken Historic District, no adverse effect on the Erie-Lackawanna (Hoboken) Railroad and Ferry Terminal, and an adverse effect on the Old Main Delaware, Lackawanna, and Western Railroad Historic District. NJ Transit has agreed to the SHPO's stipulations in the MOA, which include written and photographic documentation relating to the history and function of the Long Slip Canal in the HABS/HAER documentation of Hoboken Yard and to create an interpretive exhibit describing the history and significance of the Canal and adjacent passenger and freight yards.

It is critical that the Section 106 process be completed promptly so that our pending application to the U.S. Army Corps of Engineers for a fill permit under Section 404 of the Clean Water Act may proceed. The permit is needed by June in order to include the filling in the Hudson-Bergen Light Rail Transit System design for the northern portion of the Initial Operating Segment.

Should you or your staff have any questions concerning the enclosed documents or require additional information, please call me at (973) 491-7839.

Sincerely,

Kay Regan-DeCicco

Catherine Regan-DeCicco
Senior Director of Capital Funding

Copy w/enclosures to: Maisie Grace, FTA

FUND FOR A BETTER WATERFRONT
P.O. BOX 1965
HOBOKEN, NEW JERSEY 07030
201-217-0500

February 23, 1998

Mr. Steve Jurow
Manager of Environmental Services
NJ Transit
NJ Transit Headquarters
One Penn Plaza East
Newark, New Jersey 07105-2246

Dear Mr. Jurow:

Thank you for the meeting on January 30 concerning NJT's plans for the Hoboken Railyard Rehabilitation Project. I have reviewed your permit application to the NJDEP and U.S. Army Corps of Engineers with the assistance of a professional landscape architect and have also consulted with members of our organization.

We have no problems with the basic program proposed by NJT for the Long Slip Canal Habitat Creation Project. We would, in fact, be very supportive of your application to the NJDEP and Army Corps. Our concerns are focused solely on the design for the Hudson River Waterfront Walkway. We would like to work closely with NJT as you begin to develop the final walkway plan. Our intent is to optimize the walkway as public linear park at this exceptional location which provides an important connector between Hoboken's south waterfront and Jersey City. This letter first deals with several general responses to your proposed project and then several specific comments regarding details of the proposed walkway.

First, it is important, from our point of view, that mitigation be completed at the Hoboken Train Terminal and not off-site. Improving the water quality and habitat in the Hudson River directly in front of the public walkway will provide for a more attractive and inviting setting for the many people who will be utilizing the walkway at this location. Any additional mitigation measures should include maximizing the amount of public open space and landscaped areas along the walkway area on this site. Any retail opportunities should be confined to the Hoboken Terminal area.

To optimize the potential of this site, it is important to begin the design process not with the details but with the over-all concept for the Hudson River Waterfront Walkway. Design experts need to think through the special requirements of this project and undertake a design process. A coherent, thoughtful conceptual design is a critical starting point that will then allow the details to fall into place more easily.

The design concept could be accomplished in several ways. It could involve assembling a team (planners, architects, landscape architects, etc.) or inviting a competition for schematic plans. But to realize the potential for this state-owned property it is important that this not be something that is simply engineered.

A number of details for the walkway area are described in your application to NJDEP and the Army Corps. Although some of these details are based on NJDEP guidelines, it is important to note that these NJDEP guidelines are simply recommendations and not design requirements. There are three items that we recommend for reconsideration as follows:

1) **Plantings.** Many of the NJDEP guidelines are geared toward New Jersey's Atlantic shoreline and less populated areas. The special requirements of urban areas have been neglected. In an urban setting close to a tidal river, it is of utmost importance to plant species that will survive. This could include native species, but not necessarily. The planting methods suggested in your application also need to be evaluated by someone with expertise in this area. The "pipe" method does not promote healthy, long-term growth for larger plants and there are better ways to prevent roots from buckling the paving.

2) **Paving.** We would recommend the use of attractive, traditional paving materials for the walkway such as cobbles, brick or concrete pavers. The design for the South Waterfront at Hoboken makes good use of these materials all of which were approved by the NJDEP. Broomed concrete surfaces would be less desirable.

3) **Lighting.** It is important not to overlight the walkway. Drawings in NJT's application show lighting on 20' centers. We believe that the best lighting consultants would recommend 1 fc which meets the EIS standards. Overlighting would tend to degrade views of Manhattan and make other adequately lit areas appear by contrast dark. Perhaps NJT should utilize a lighting consultant to assist with this. A firm that we can recommend is H.M. Brandston & Partners in New York who are considered one of the best lighting consultants in the world.

This letter is intended to open up a dialogue on these issues. We are interested in being involved with NJT on an on-going basis as the walkway design continues. The Fund for a Better Waterfront has played a constructive role elsewhere and would like to do the same at the Hoboken Terminal. We look forward to your response and thank you for this opportunity to participate on this important project.

Sincerely yours,

Ron Hine

Ron Hine
Administrator

cc: Herman Volk
Mark Gordon

NJ TRANSIT
The Way To Go.

January 27, 1998

Carl Nordstrum
Deputy Director
State Parks & Forestry
New Jersey Department of Environmental Protection
501 East State Street
P.O. Box 404
Trenton, N.J. 08625-404

Dear Carl:

Integral to our application to NJDEP for a Waterfront Development Permit with which to fill the Long Slip canal penetrating the Hoboken rail yard in Hoboken, we have offered a suite of mitigations including the enhancing or creation of tidal salt marsh wetlands at Liberty State Park. In the course of meetings leading up to the filing of the application, I had gathered from various regulators and members of the environmental community that such an action, in combination with other elements of the project, would be looked upon favorably in mitigating the elimination of 4.5+ acres of surface water, and would in fact be easier to accommodate in the context of the necessary permits than some of the more unconventional mitigations offered in association with the project. Consequently, I called you to discuss the reality of a Liberty State Park wetlands initiative under the sponsorship of the Long Slip fill project.

As we begin formal permit review in February (presuming findings of completeness by NJDEP and the U.S. Army Corps of Engineers), it will be necessary to understand more precisely what opportunities are truly available, the acreage at issue, and the approximate costs of either enhancing/improving or creating new wetlands at the Park. For creation of new uplands the mitigation requirement is typically 1:1; we would therefore need to create approximately 4-5 acres. For the improvement of existing poor quality wetlands the mitigation requirement is usually worked out between 2:1 and 3:1, so we need to find approximately 8-12 acres. Or some combination of 1-2 new acres and 4-8 improved acres.

My instinct is that the project budget can withstand around $1 million for this kind of mitigation, if it is accepted completely as an alternative to our other main habitat-related mitigation, the creation by dredging of a deep water fish habitat at the mouth of the Slip and the inter-pier area within the shoaled area inside the pierhead line. Some regulators and environmental community participants were concerned that such an initiative, while interesting and progressive, might be difficult to accord permanent mitigation credits, due in part to the possibility that it would eventually infill again, and in part to the unusual nature of the proposal, relative to precedent.

Please let me know how we might proceed to pin down with greater precision the Liberty State Park options, so that we can resolve final mitigation agreements with the relevant regulators. The complexities of the project, which involves construction of a riverfront pedestrian walkway, extension and upgrading of two combined sewers, creation of the proposed fin-fish habitat and/or wetlands creation at the Park, make the need to resolve the specific mitigations especially critical before we move into engineering design.

You can reach me at the below address or at 973-491-7210. Thank you for your attention to this issue. Speak with Rob P el about the application specifics; he has a copy should you need to review pertinent sections.

Sincerely,

Steve Jurow

cc: J. Porrovecchio, N. Valente, V. Truncellito

NJ TRANSIT
The Way To Go.

January 21, 1998

Mr. Fred Pocci
Executive Director
North Hudson Sewerage Authority
1600 Adams Street
Hoboken, New Jersey 07030

Dear Mr. Pocci:

This letter is to confirm our interagency intentions regarding the upgrading and equipping of Hoboken sewers contingent on NJ TRANSIT gaining permission from regulatory agencies to fill the Long Slip canal. Should we acquire the necessary permits, we would intend to commence work in late 1998, necessitating the extension of the Park Street sewer to a new outfall at or beyond the bulkhead line. Depending on the nature of required mitigations, we may also need to extend your Outfall 01, which traverses the Hoboken rail yard from Washington Street south and eastward under the tracks and trainshed, currently terminating at the corner of the mail pier and the bulkhead line. (Although a historical map indicates the extension of this sewer along the mail pier several hundred feet further into the Hudson River "interpier" area, water quality monitoring we conducted in 1995 indicated a signicant fresh water plume emanating from the corner, suggesting either that the sewer was never extended or that the piping or connection has ruptured at or near the corner.)

In preparing the permit applications for filling Long Slip, we met with you and your consultant in 1997 and determined that a number of improvements to the Hoboken sewers under the rail yard would be either required or desirable, specifically:

- Extend the Park Street sewer through the proposed fill area (required because of NJ TRANSIT's project);
- Reline and clean the Park Street sewer under Hoboken Yard (desirable for North Hudson);
- Extend the Regulator 01 sewer lateral southeastward (may be required by NJ TRANSIT's project);
- Equip any existing or extended sewer(s) affected by the project with netting facilities (required with or without NJ TRANSIT's project).

The purpose of this letter is to establish the responsibilities of our respective agencies funding, locating, designing, constructing, and operating the improvements.

Funding -- NJ TRANSIT will fund the design and construction of any necessary sewer extensions. NJ TRANSIT will contribute up to $700,000 toward the cost of relining and cleaning the Park Street sewer and equipping any sewers affected by the project with netting facilities.

North Hudson Sewerage Authority will fund any costs of the Park Street relining and netting facilities not covered by the above NJ Transit contribution.

Location -- During site walks with your consultant, we evaluated two options for netting installations, for each of the sewers in question. For both the Park Street and Regulator 01 sewers, we identified one opportunity in the bed of the Observer Highway service road, and a second location under a parking lot intended to be constructed as part of the Hoboken rail yard rehabilitation. In both cases, NJ TRANSIT greatly favors the Observer Highway locations off NJ TRANSIT property, as they would permit routine servicing of the netting installation by the North Hudson Sewerage Authority without involvement of NJ TRANSIT rail employees or interference with operations.

Design -- NJ TRANSIT will pay for and accomplish, pursuant to North Hudson Sewerage Authority approvals, design of the necessary sewer extension(s) as part of its overall project design. If the netting installations are to be accomplished under Observer Highway, we would anticipate North Hudson Sewerage Authority paying for and accomplishing these improvements. Should the netting facility(ies) need to be located within the confines of the Long Slip fill project corridor, however, NJ TRANSIT would prefer to include their design in the overall project design package, to avoid conflicts and ensure integration of all project elements.

Construction -- NJ TRANSIT will be responsible for implementing any necessary sewer extensions, as part of the overall Fill project North Hudson Sewerage Authority will be responsible for the relining and cleaning of the Park Street sewer and the retrofitting of sewers with netting installations under Observer Highway. (NJ TRANSIT would reimburse North Hudson as costs are incurred up to the above limit.) Should the netting facility(ies) need to be located within the confines of the Long Slip fill project corridor, however, NJ TRANSIT would expect to incorporate their construction into the overall fill project, to avoid conflicts among project elements during construction. To quickly resolve this question, North Hudson Sewerage Authority needs to determin as early as possible whether the Observer Highway or other off-NJ TRANSIT property opportunities for the netting facilities meet its requirements, and to let NJ TRANSIT know whether the Fill project will or will not need to make provisions for such facilities on NJ TRANSIT property.

Operation -- North Hudson Sewerage Authority will maintain and operate the extended sewers and netting installations at no cost to NJ TRANSIT, except as provided in the original easement agreements.

We believe the above allocations are appropriate in light of already existing obligations and the changes we are creating with the Long Slip Fill project. If you agree with the above, please indicate by countersigning this letter and returning it to me. It is our intent to include this letter as an addendum to our permit applications to demonstrate that the sewer improvements are a part of the mitigation plan.

Should you have any questions concerning our position on this matter, please let me or Steve Jurow know, at the below address or by phone (973-491-7163 or 7210) or by fax (973-491-7461).

Thank you for your cooperation to date.

Sincerely,

for

Rick Richmond, AED
Engineering, Development & Construction

Concurrence by:

________________________ Dated: ____________________

Fred Pocci, Executive Director
North Hudson Sewerage Commission

cc: P. Saklas, S. Jurow

Newport

January 20, 1998

New Jersey Department of Environmental Protection
Land Use Regulation Program
CN 401
5 Station Plaza
Trenton, New Jersey 08625

Attention: Hudson County Section Chief

Re: Waterfront Development Permit Application
Long Slip Canal Habitat Creation Project
Hoboken / Jersey City, New Jersey

Dear Sir of Madam:

We are pleased to offer comments on the referenced application in accordance with Dames & Moore's December 24, 1997 letter sent to us, an adjacent property owner, pursuant to N.J.S.A. 12:5-3.

We have the following comments on the limited information sent along with the Dames & Moore letter noted above and ongoing discussions with New Jersey Transit's (NJT) staff:

1. In May 1988 Newport submitted to NJDEP the Long Slip Canal Study done by their consultant, Geismar & Calamari, to satisfy Condition A-2 of their Waterfront Development Permit 85-044601. We find the information provided with the current application to be consistent with that study. We believe that filling the canal along with the other work proposed is an environmental bonus for the area's users, i.e. eliminating the stagnant and odorous waters of the canal.

2. The plans filed with the application show the extended 10' x 10' Jersey City combined overflow sewer outfall on NJT property. It is our understanding that NJT is studying several sewer alignment alternatives, one of which would put the sewer through Newport's property from 18th Street toward the existing bulkhead. This option, if implemented, would require a 20' wide by 900 foot long easement along Newport's north property line as shown on the enclosed SK-1 from NJT (not a part of the permit application). Although we do not believe the easement would be a major problem,

☒ Newport
2 Sixth Street
Jersey City, N.J. 07310
Telephone (201) 626-2010
Fax (201) 626-2015

☐ Newport Real Estate Dev. Corp.
97-77 Queens Blvd.
Rego Park, N.Y. 11374
Telephone (718) 459-9021

☐ SNP, Inc.
One Merchants Plaza
155 West Washington Street
P.O. Box 7033
Indianapolis, Indiana 46207

we prefer the sewer be kept on NJT's property as shown in the application documents. In any event, as outlined in the plans and fact sheet portions of the application, the outlet of the outfall must be extended to past the riprap dike into an area where river circulation is sufficient to provide an adequate mixing zone to disperse the effluent. **The extension of the sewers to deep water must be a condition of this waterfront development permit.**

3. The Fact Sheet description of the Project Site states "...fecal coliform counts are high, and the area is beset by decomposition gasses releasing sediment trapped oils into the water column." and " The CSO discharge waters are neither well-dispersed nor well-oxygenated as they are discharged into waters already oxygen-depleted by anaerobic bottom sediment decomposition." [1]. Paragraph #5 of the Proposed Program section states "Species populations and diversity also will benefit from the removal of biohazards now accessible to bottom-dwelling and spawning aquatic populations." The Project Site section also states "Canal sediments are suitable for land based disposal, under NJ soil cleanup standards." This statement may be true, but the soil cleanup standards do not consider biohazards or odor as criteria. **Permitting the re-use of the sediments must consider the potential biohazards in the sediments. Additionally, this waterfront development permit must require the implementation of odor control procedures during the dredge and fill operations.**

The Newport development in Jersey City has more than 200,000 square feet of retail development within 250 feet of the Long Slip Canal. These stores attract thousands of customers on a daily basis. By the end of 1998 Newport will have 2,736 residential apartments occupied by more than 5,000 people that will live less than one third of a mile from the canal. Moreover, the northeast quadrant of Newport, which abuts the proposed expanded transit yard, is zoned and currently being marketed for residential development. This will eventually put another 10,000 residents within 1/4 mile of the canal. The application does provide for at least 18" of clean cover material over the "fill" which should provide a permanent control of the odors. **This waterfront development permit must require NJT to maintain these institutional controls to safeguard against any potential exposure of area occupants or users to contaminants, including biohazards, and odors.**

---

1. Two combined overflow sewers are noted in the application: a 120" square sewer entering the canal at its west end and an 85" by 72" sewer entering 700 feet from the west end. Thus maximizing the amount of sewerage settlement in the canal. We note the canal also contains six additional drain pipes: two 12"Ø ejector drains from the PATH Tunnels, two 1"Ø steam drains from the rail yard and one 10"Ø and one 12"Ø cast iron pipe from the rail yard whose source is apparently unknown.

4. The Background and Objectives sections of the Fact Sheet indicates that land created by filling the canal will be for expansion of the rail yard. As such, the active part of the rail yards for the light rail trains and storage of passenger trains will be moved closer to all of the above described developments at Newport. As part of a negotiated amendment to the Newport/NJT Transit Agreement, NJT will install a decorative fence along the north side of 18th Street adjacent to their light rail Acquisition Parcel 31. NJT should continue the decorative screen fence from 18th Street to the eastern end of their yard at the proposed walkway along the existing bulkhead. Given the size of the expanded transit facility and nature and significance of the adjacent developments, we firmly believe that, in addition to the fence, a landscaped buffer that provides both visual screening and mitigation of potential air and noise pollution from the rail yard should also be provided. **This waterfront development permit must require NJT to, at minimum, provide a decorative screen fence and landscaped buffer along the southern end of the expanded rail yard.** We also believe that access to the expanded portion of the rail yard by the general public would be in conflict with the project's objectives stated in the Fact Sheet. **This waterfront development permit should prohibit NJT from constructing a roadway from the transit yard to 18th Street for use by the general public.**.

Please call me at (201) 626-2010 if you have any questions.

Very truly yours,

William F. Wissemann, P.E.
Project Engineer, NADC

WFW/wfw (depnjtp1.doc)
Enclosures
cc: M. Boyle
J. Stallsmith
V. Morrison, Esq.
S. Jurow (NJTransit)
File

NJ TRANSIT
The Way To Go.
15th ANNIVERSARY

MEMORANDUM

TO: Record

FROM: Steve Jurow

DATE: January 20, 1998

SUBJECT: Meeting with Betty Kearns, Chair, Jersey City Municipal Environmental Council

Attendees:

Betty Kearns, Chair, Jersey City Municipal Environmental Council
Vinnie Truncellito, NJ Transit Planning
Steve Jurow, NJ Transit Manager of Environmental Services

At Jerry Neissen's suggestion, we met today with Betty Kearns, Chair of Jersey City's Municipal Environmental Council, to inform her that our application for a permit to fill the Long Slip had been filed with both the Army Corps (December 29) and with NJDEP (January 2), and to explain the project, its benefits, and the proposed mitigations, and ascertain her concerns.

Betty indicated no concerns with the project, and general support for the improved rail service that would follow upon the yard being modernized. She expressed some desire for the inclusion of historical railroad elements into the design of the pedestrian walkway, and/or public displays of railroad history on story boards incorporated into the pedestrian walkway bridging the Slip. She suggested that the bridge structure itself be drawn from available railroad bridge remains to highlight the Deleware Lackawanna and Western history of the yard. She also noted an interest in some kind of remembrance of the penny trolley service that used to run through Jersey City.

Distribution

NJ Transit attendees

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NJ TRANSIT
The Way To Go.

15th ANNIVERSARY

MEMORANDUM

TO: Record

FROM: Steve Jurow

DATE: January 16, 1998

SUBJECT: Meeting with Bob Janizcewski

Attendees:

Robert Janiscewski, Hudson County Executive
Suzanne Mack, Jersey City Chief Engineer
Herman Volk, NJ Transit Community Relations
Vinnie Truncellito, NJ Transit Planning
Steve Jurow, NJ Transit Manager of Environmental Services
Janiscewski Legislative Aide

We met today with Bob Janiscewski to inform him that our application for a permit to fill the Long Slip had been filed (December 29) with both the Army Corps and with NJDEP, and to explain the project, its benefits, and the proposed mitigations, and ascertain his concerns.

Herman explained the project purpose and scope, budget and schedule. I outlined the linkage between the Long Slip fill project and the Hudson-Bergen Light Rail Line. I indicated that the HBLRT project might be paying for the Long Slip fill project, at which both Bob and Suzanne indicated some concern that the HBLRT had been unwilling to fund certain enhancements and amenities which Jersey City wanted, claiming insufficient funding, and they wondered how come there was money to do this but not the things they sought. (The reason is that the funding is to be front-ended -- loaned -- to the Long Slip fill project, but then repaid out of Hoboken rail yard enhancement project monies granted later.)

Bob indicated no major concerns with the project, and general support for the improved rail service that would follow upon the yard being modernized. He indicated that his major preoccupation was the light rail line.

Steve noted that the Long Slip fill project could involve dredge material from other river dredging projects; Bob commented that he would have to look at that, but that it raised no major concerns.

Distribution

NJ Transit attendees

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THE JERSEY CITY SEWERAGE AUTHORITY

555 ROUTE #440 • JERSEY CITY, NEW JERSEY 07305
TEL: (201) 432-1150 • FAX: (201) 432-1578

November 17, 1997

Mr. Steven Jurow
NEW JERSEY TRANSIT
One Penn Plaza East
Newark, New Jersey 07105

RE: LONG SLIP CANAL

Dear Mr. Jurow:

The Jersey City Sewerage Authority's (JCSA) Eighteenth Street regulator presently discharges its Combined Sewer Overflow (CSO) into the Long Slip Canal.

New Jersey Transit (NJT) plans to fill the Long Slip Canal as part of the Hoboken Rail Yard Rehabilitation Project. To effectuate this filling of the Long Slip, NJT proposes to relocate the CSO outfall and extend said outfall to, at a minimum, the bulkhead line. The final alignment of the outfall extension must still be determined with input from all affected parties, including the City of Jersey City. As part of this extension, NJT plans to install netting facilities and sedimentation basins to insure that the CSO discharge meets or exceeds the USEPA nine minimum control requirements.

NJT will be responsible for the design of these outfall improvements, either through their own engineers or through agreement with the JCSA, and for construction of the improvements as part of the HBLRTS project.

Upon completion of the construction of these improvements, in accordance with a properly completed design and in accordance with all local, state and federal laws and regulations, it is proposed that the JCSA, through agreement with NJT, will accept ownership of the improvements and perform all operations and maintenance of said improvements.

The JCSA believes that this proposal, as herein described, is an acceptable way to accomplish the goals of both agencies and we endorse your efforts to improve water quality. An agreement, however must be approved by resolution of the JCSA Board of Commissioners.

Very truly yours,

William A. Macchi
Executive Director

JFB/ljl
cc: Honorable Board of Commissioners
Joseph F. Beckmeyer, P.E., Chief Engineer
Brian C. Doherty, Esq, General Counsel
Mark Del Bova, Malcolm Pirnie

THE JERSEY CITY SEWERAGE AUTHORITY

555 ROUTE #440 • JERSEY CITY, NEW JERSEY 07305

TEL: (201) 432-1150 • FAX: (201) 432-1576

November 17, 1997

Mr. Steven Jurow
NEW JERSEY TRANSIT
One Penn Plaza East
Newark, New Jersey 07105

RE: LONG SLIP CANAL

Dear Mr. Jurow:

The Jersey City Sewerage Authority's (JCSA) Eighteenth Street regulator presently discharges its Combined Sewer Overflow (CSO) into the Long Slip Canal.

New Jersey Transit (NJT) plans to fill the Long Slip Canal as part of the Hoboken Rail Yard Rehabilitation Project. To effectuate this filling of the Long Slip, NJT proposes to relocate the CSO outfall and extend said outfall to, at a minimum, the bulkhead line. The final alignment of the outfall extension must still be determined with input from all affected parties, including the City of Jersey City. As part of this extension, NJT plans to install netting facilities and sedimentation basins to insure that the CSO discharge meets or exceeds the USEPA nine minimum control requirements.

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Upon completion of the construction of these improvements, in accordance with a properly completed design and in accordance with all local, state and federal laws and regulations, it is proposed that the JCSA, through agreement with NJT, will accept ownership of the improvements and perform all operations and maintenance of said improvements.

The JCSA believes that this proposal, as herein described, is an acceptable way to accomplish the goals of both agencies and we endorse your efforts to improve water quality. An agreement, however must be approved by resolution of the JCSA Board of Commissioners.

Very truly yours,

William A. Macchi
William A. Macchi
Executive Director

JFB/ljl

cc: Honorable Board of Commissioners
Joseph F. Beckmeyer, P.E., Chief Engineer
Brian C. Doherty, Esq, General Counsel
Mark Del Bove, Malcolm Pirnie

DAMES & MOORE

A DAMES & MOORE GROUP COMPANY

Pearl River, NY
Phone (914) 735-1200
Fax (914) 735-1240

Meeting Summary

Long Slip Canal Habitat Creation Project

Date: October 31, 1997

Subject: Jersey City CSO ext nsion

Place: Jersey City Sewage Authority

Attendees: J. Beckmeyer, M. Lescavage, Jersey City Sewer Authority
S. Jurow, NJ Transit
M. Del Bova, J. Minnett, Malcolm Pirnie
E. Peck, J. Porroveochio, D & M

Summary Prepared by: E. Peck on: November 5, 1997

1. Jurow presented a draft letter of initial agreement between NJ Transit and Jersey City Sewage Authority (JCSA) regarding the design and siting of improvements to the combined sewer outfall of the Eighteenth Street regulator (RE-19).

2. In summary, NJ Transit accepts responsibility to design and construct the necessary system improvements to JCSA specifications. Upon completion of construction, JCSA agrees to accept the ownership of the system improvements.

3. Beckmeyer agreed in principle, but indicated that it would be necessary for his agency and to review the draft letter and develop appropriate language.

DAMES & MOORE

A DAMES & MOORE GROUP COMPANY

Pearl River, NY
Phone (914) 735-1200
Fax (914) 735-1240

Meeting Summary

Long Slip Canal Habitat Creation Project

Date: September 29, 1997

Subject: Eighteenth Street regulator and outfall

Place: Jersey City Sewer Authority office

Attendees: J. Beckmeyer, M. Lescavage, Jersey City Sewer Authority
A. Safi, Jersey City Engineering Department
S. Jurow, N. Valente, V. Truncellito, NJ Transit
M. Del Bova, J. Minnett, Malcolm Pirnie
E. Peck, J. Porroveochio, D & M

Summary Prepared by: E. Peck on: October 1, 1997

The purpose of this meeting was to begin negotiations with the Jersey City Sewer Authority towards approval of the modifications to the 18th Street regular and outfall required by the Long Slip and light rail projects, specifically the extension, an alternate route, Dry weather flows and floatables controls a settling basin and maintenance.

1. SJ presented the project and the stated the likely need for a settling tank as mitigation.

2. MDB thought that the capture and treatment of an annual event will not be enough. Malcolm Pirnie (MP) has collected flow data from the regulator and outfall and will provide to D&M, but noted that the SWMM model is still in the conceptual stage.

3. JB agreed that the extension, net and settling tank could be removed from the NJ Transit yard and would consider alternative routes and configurations.

4. Three potential extension routes were discussed included through the canal, in Yard A, and along Eighteenth Street. Choice of a route depends on several factors still under discussion such as the walkway configuration, the yard reorganization, the HBLRT, the size and location of a settling tank and the net, and the maintenance requirements. MDB suggested that the planned access road under the reconfigured railyard scheme might be the most promising route.

5. MP is modeling the degree that existing flows exceed existing capacity. At least 100,000 gal of storage will not eliminate dry weather flows (DWO). Storage is not being considered. The two options being considered to eliminate DWO are increasing the interceptor and reconstructing or modifying the regulator.

DAMES & MOORE
A DAMES & MOORE GROUP COMPANY

Pearl River, NY
Phone (914) 735-1200
Fax (914) 735-1240

Meeting Summary

Long Slip Canal

Date: August 28, 1997

Subject: Coordination of Corps permit with HBLRT

Place: NY District office

Attendees: G. Nieves, J. Cannon, COE
S. Jurow, V. Troncellito, T. Murtha, NJ Transit
E. Peck, D&M
S. Sarkar, PBQ&D

Summary Prepared by: E. Peck on: 8/29/97

1. The purpose of the meeting was to address the Corps question of why two applications are needed for the projects by the same proponent over the same footprint.

2. SJ described the need to not risk procedural delays of the LRT by issues that may be raised over the fill required from the Long Slip project. The LRT permit will be filed within 4 to 6 weeks. The Long Slip permit will be filed after October 15.

3. GN and JC questioned the need for the LRT terminal siting over open water and whether the quality of the open water enclosed by the pile-supported structure would be adversely impacted. GN was also concerned about the Hoboken sewer discharge to that area. The LRT application must address siting alternatives and impacts to wetlands, particularly water quality.

4. There was no comment on the adequacy of the mitigation proposed for the LRT. GN suggested that Pier 2 be considered for the proposed fishing pier rather than the planned extension from the walkway. GN did not believe that the purchase of Hackensack wetlands would be sufficient mitigation for either project.

5. VT and EP described the philosophy behind the mitigation package proposed for the Long Slip project. SJ indicated that NJTransit is "backing-off" walkway 3 in favor of a modified walkway 2 primarily because of comments received from the environmentalists. GN indicated that the environmentalists should "not be elevated" to regulator status.

6. Both applications need to reference each other and justify how they are separate and distinct. The effects of each upon the other also must be described. JC could not give any indication of whether the Long Slip application was administratively complete or whether there were any apparent impediments to a FONSI. SJ suggested scheduling a public meeting as part of the public notice. GN said he will make that determination once the application is received.

6. MP suggested that the tank should have the dimensions of 15 ft. X 30 ft. X 50 ft. JP suggested that the tank be oversized an l combined with the net to simplify construction, operations and maintenance.

7. Regarding the location of the tank, JSCA originally envisioned a the net on the end of the pipe. SJ indicated that a vacant pa rcel upstream would be a better location. JB agreed and indicated the need for land-based servi ces to maintain the facility. He also stated the need to check on the status of potential sites r garding planned uses or other constraints.

8. JB raised the question of how a settling tank would viewed by NJDEP under their existing permit. Would the tank requ ire an individual permit? Would the tank be considered a treatment facility? Samples should be taken to determine whether tank sediment is likely to be considered sediment or sludge. In addition, there are questions as to how this sediment should be disposed pumped back to the treatment plant or in a landfill.

9. JB indicated there was at pr sent no estimate of the how frequently the net and the tank would have to be serviced.

10. Action Items:

    1. MP to provide flow data to D&M
    2. D&M will advance route concepts
    3. JCSA, NJT, MP, and D&M will meet following the JCSA meeting with NJDEP.

DAMES & MOORE
A DAMES & MOORE GROUP COMPANY

Pearl River, NY
Phone (914) 735-1200
Fax (914) 735-1240

Meeting Summary

Long Slip Canal

Date: August 11, 1997

Subject: Pre-application meeting

Place: Sandy Hook, NJ

Attendees:
Andrew Willner, Baykeeper
Cindy Zipf, COA
Steve Barnes, Baykeeper office
Dr. V. Guida, Lehigh University
S. Jurow, NJ Transit
J. Porrovecchio, D&M
E. Peck, D&M
M. Stewart, D&M

Summary Prepared by: E. Peck on: August 12, 1997

1. Jurow, J. Porrovecchio, and E. Peck presented the project.
2. Andrew Willner (AW) indicated that the CSO should be abated; it appears to be just extended. The CSO also should be improved to comply with the nine minimum controls specified by the 1995 U.S. Environmental Protection Agency Final CSO Control Policy. J. Porrovecchio (JP) replied that that work is underway. The Long slip project will include floatables and sediment removal, in-line storage, and will address dry weather overflows.
3. Long slip canal serves as a sediment settling basin and as such provides a service to the river. JP and EP noted that the value of this service is negative because organics, metals and other CSO pollutants also stored in the canal have created conditions that continuously degrade adjacent river waters.
4. Mitigation plan does not propose in-kind mitigation for areas filled. AW does not consider the habitat creation or sewer sufficient mitigation. AW and CZ do not believe the excavation can be counted as mitigation. AW will be seeking a 2-3 to 1 ratio mitigation area. This may include the purchase of wetlands elsewhere in the estuary.
5. AW and CZ indicated a concern over who will maintain the sewer trash net and the in-line settling tank.

State of New Jersey
Department of Environmental Protection

Christine Todd Whitman
Governor

Robert C. Shinn, Jr.
Commissioner

Bur. of Tidelands Management
CN-401, Trenton, NJ 08625
609-292-2573

6/25/96

Joseph Porrovecchio
Dames & Moore
One Blue Hill Plaza -- Suite 530
Pearl River, NY 10965

RE: "Long Slip Canal" (part of Lot 7, Block 19), Jersey City, Hudson Co., NJ

FILE: 0906-96

Dear Mr. Porrovecchio,

In reply to your 6/24/96 faxed inquiry, any tidelands ownership interest the State may have had in the above referenced canal seems to have been conveyed by a riparian grant dated April 14, 1888 to the Morris and Essex Rail Road Company. We are assuming that the grant was valid and that all its terms and conditions have been fulfilled. You might consider showing the exact limits of that grant on plans you prepare for the overall project site.

This position is not really "official" or legally binding on the State. The only official determination that the State has no tidelands title interest in any property is made upon delivery of a fully signed "Statement of No Interest."

If necessary, a copy of the prior grant may be obtained from this office. Such a request should include a check for $10.00 (payable to the Treasurer, State of N.J.) and reference our Liber G, page 168.

Yours truly,

Jo Ann Cubberley
Manager, Bureau of
Tidelands Management

JAC/DAH/dh

APPENDIX 7

AGENCY/STAKEHOLDER CONTACTS

CONTENTS:

DEPARTMENT OF THE ARMY

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

REPLY TO
ATTENTION OF

04 MAY 2000

Regulatory Branch

SUBJECT: Department of the Army Permit No. 1998-02350
by New Jersey Transit Corporation

New Jersey Transit Corporation
c/o Mr. Joseph Porrovecchio
Dames & Moore
1515 Broadway, 35th Floor
New York, New York 10036

Dear Mr. Porrovecchio:

Enclosed is a Department of the Army permit for your work.

You are required to submit to this office the dates of commencement and completion of your work. Enclosed are two forms for you to use to submit the required dates.

For permits authorizing construction and/or installation of pile supported or floating structures, the permittee hereby recognizes the possibility that the structure permitted herein may be subject to damage by wave wash from passing vessels. The issuance of this permit does not relieve the permittee from taking all proper steps to insure the integrity of the structure permitted herein and the safety of boats moored thereto from damage by wave wash, and the permittee shall not hold the United States liable for any such damage. Passing vessels will not be required to alter their current procedures to reduce the wake caused by their operation, which may impact the structure authorized by this permit.

If for any reason, a change in your plans or construction methods is found necessary, please contact us immediately to discuss modification of your permit. Any changes must be approved before they are undertaken.

Sincerely,

Joseph J. Seebode
Chief, Regulatory Branch

6/01 May 00
TOWER ELF
SEEBODE

Enclosure

DEPARTMENT OF THE ARMY PERMIT

Permittee: **New Jersey Transit Corporation**
1 Penn Plaza East
Newark, New Jersey 07105-2250
(973) 491-7210

Permit No.: **1998-02350**

Issuing Office: **New York District Corps of Engineers**

NOTE: The term "you" and its derivatives, as used in this permit, means the permittee or any future transferee. The term "this office" refers to the appropriate district or division office of the Corps of Engineers having jurisdiction over the permitted activity or the appropriate official of that office acting under the authority of the commanding officer.

You are authorized to perform work in accordance with the terms and conditions specified below.

Project Description:

The following work is authorized by this permit:

Dredge approximately 80,000 cubic yards of sediment, by hydraulic dredge, from a 750 foot long by 250 foot wide area within the Long Slip Canal entrance, with subsequent placement of the resulting dredged material into Long Slip Canal, behind the containment berm, with return flow to the waterway. The dredging will restore depths between 10 and 30 feet below mean low water, with two feet of allowable overdepth.

Discharge approximately 70,000 cubic yards of clean fill material or dredged material from sources within New York Harbor into approximately 4.6 acres of waters of the United States (Long Slip Canal): construct and install a 100 foot long by 50 foot wide containment berm with associated rock riprap and a public waterfront walkway. Relocate an existing combined sewage overflow outfall (to discharge to the Long Slip Canal entrance) with a solid and floatable control facility.

All work authorized by this permit shall be accomplished in accordance with the attached drawings and Special Conditions (A) through (K) of this permit.

Project Location: **IN: Long Slip Canal, Hudson River**

AT: Cities of Hoboken and Jersey City, Hudson County, New Jersey

Permit Conditions:

General Conditions:

1. The time limit for completing the work authorized ends on May 4, 2003. If you find that you need more time to complete the authorized activity, submit your request for a time extension to this office for consideration at least one month before the above date is reached.

2. You must maintain the activity authorized by this permit in good condition and in conformance with the terms and conditions of this permit. You are not relieved of this requirement if you abandon the permitted activity, although you may make a good faith transfer to a third party in compliance with General Condition 4 below. Should you wish to cease to maintain the authorized activity or should you desire to abandon it without a good faith transfer, you must obtain a modification of this permit from this office, which may require restoration of the area.

3. If you discover any previously unknown historic or archeological remains while accomplishing the activity authorized by this permit, you must immediately notify this office of what you have found. We will initiate the Federal and state coordination required to determine if the remains warrant a recovery effort or if the site is eligible for listing in the National Register of Historic Places.

1145-2-303b(Hudson River/New Jersey Transit Corp./discharge fill into open waters (Long Slip Canal)/dredge with placement in Long Slip Canal)

4. If you sell the property associated with this permit, you must obtain the signature of the new owner in the space provided and forward a copy of the permit to this office to validate the transfer of this authorization.

5. If a conditioned water quality certification has been issued for your project, you must comply with the conditions specified in the certification as special conditions to this permit. For your convenience, a copy of the certification is attached if it contains such conditions.

6. You must allow representatives from this office to inspect the authorized activity at any time deemed necessary to ensure that it is being or has been accomplished in accordance with the terms and conditions of your permit.

Special Conditions:

SPECIAL CONDITIONS

(A) By June 15, 2000, the permittee shall provide the New York District Corps of Engineers written verification that 9.2 credit acres have been purchased from the Marsh Resources Inc. wetland mitigation bank. Two copies of this verification document shall be submitted to the following address:

Chief, Regulatory Branch
New York District US Army Corps of Engineers
Jacob K. Javits Federal Building
New York, New York 10278-0090

(B) By July 15, 2000 and prior to the initiation of dredging under this permit, four engineering-size, certified and sealed copies and one electronic file copy containing digital data in State Plane coordinates (NAD83/feet[MLW]) of pre-dredge surveys of all areas to be dredged, shall be provided to the New York District Corps of Engineers by the permittee. These surveys must have the authorized and actual dredge areas outlined, and a calculation of the total volume of dredged material to be removed. The surveys shall be delivered via express mail service or hand delivered to the same address that appears in Special Condition (A).

(C) By December 15, 2001, the permittee shall submit four, engineering size, certified and sealed copies and one electronic file copy containing digital data in State Plane coordinates (NAD83/feet[MLW]) of post-dredge surveys to the New York District Corps of Engineers. These surveys must have the authorized and actual dredged areas outlined, and an exact calculation of the volume of dredged material that was removed from the canal entrance and placed within Long Slip Canal. These surveys shall be delivered via express mail service or hand delivered to the same address that appears in Special Condition (A).

(D) The permittee shall <u>not</u> undertake any dredging activities between November 15 and April 15 of any year for the duration of the permit.

(E) The permittee shall submit evidence to the New York District Corps of Engineers, that the United States Coast Guard office (USCG) has been notified of the start and completion dates of the dredging activities within the Long Slip Canal entrance, and that an announcement of this work has been placed in the "Notice to Mariners" prior to the start of work. The required USCG notification and submission to the Notice to Mariners will contain the commencement and completion dates of work, as well as the hours of the work, and will be sent to Commander (oan), First Coast Guard District (oan), 408 Atlantic Avenue Boston, MA 02111-3350 or phoned to (717) 223-8047.

(F) All dredging activities shall be undertaken in such a manner as to avoid large refuse piles, ridges across the bed of the waterway or deep holes that may have a tendency to cause injury to adjacent channels or wharves.

(G) The permittee shall respond to all reasonable requests for information form the New York District Corps of Engineers, and shall provide necessary field support during field investigations and permit compliance inspections.

(H) The permittee shall comply with all of the conditions and stipulations contained within the attached Memorandum of Agreement among the Federal Transit Administration, the New Jersey State Historic Preservation Office, the New Jersey Transit Corporation, the New York District Corps of Engineers and the Advisory Council on Historic Preservation regarding the Long Slip Habitat Creation Project at Hoboken Yard.

(I) The permittee shall display a copy of this permit on all vessels engaged in dredging, transporting and disposal of dredged material authorized by this permit.

(J) The permittee shall submit copies of all water quality monitoring reports and fisheries studies regarding the canal entrance area, per the New Jersey Department of Environmental Protection authorization, to the New York District at the address indicated in special condition (A) and to the Attention of Mr. Stanley Gorski of the National Marine Fisheries Services at McGruder Road, Building 74, Sandy Hook Laboratory, Highlands, New Jersey, 07732.

(K) The permittee shall comply with all of the conditions and stipulations contained within the attached New Jersey Department of Environmental Protection Water Quality Certificate dated December 1, 1999 (Permit No. 0905-95-0003.5) and amended February 23, 2000 (Permit No. 0905-95-0003.5).

Further Information:

1. Congressional Authorities: You have been authorized to undertake the activity described above pursuant to:

(X) Section 10 of the Rivers and Harbors Act of 1899 (33 U.S. Code 403).

(X) Section 404 of the Clean Water Act (33 U.S. Code 1344).

( ) Section 103 of the Marine Protection, Research and Sanctuaries Act of 1972 (33 U.S.C. 1413).

2. Limits of this authorization:

a. This permit does not obviate the need to obtain other Federal, state, or local authorizations required by law.

b. This permit does not grant any property rights or exclusive privileges.
c. This permit does not authorize any injury to the property or rights of others.

d. This permit does not authorize interference with any existing or proposed Federal project.

3. Limits of Federal Liability: In issuing this permit, the Federal Government does not assume any liability for the following:

a. Damages to the permitted project or uses thereof as a result of other permitted or unpermitted activities or from natural causes.

b. Damages to the permitted project or uses thereof as a result of current or future activities undertaken by or on behalf of the United States in the public interest.

c. Damages to persons, property, or to other permitted or unpermitted activities or structures caused by the activity authorized by this permit.

d. Design or construction deficiencies associated with the permitted work.

e. Damage claims associated with any future modification, suspension, or revocation of this permit.

4. Reliance on Applicant's Data: The determination of this office that issuance of this permit is not contrary to the public interest was made in reliance on the information you provided.

5. Reevaluation of Permit Decision: This office may reevaluate its decision on this permit at any time the circumstances warrant. Circumstances that could require a reevaluation include, but are not limited to, the following:

a. You fail to comply with the terms and conditions of this permit.

b. The information provided by you in support of your permit application proves to have been false, incomplete, or inaccurate (See 4 above).

c. Significant new information surfaces which this office did not consider in reaching the original public interest decision.

Such a reevaluation may result in a determination that it is appropriate to use the suspension, modification, and revocation procedures contained in 33 CFR 325.7 or enforcement procedures such as those contained in 33 CFR 326.4 and 326.5. The referenced enforcement procedures provide for the issuance of an administrative order requiring you to comply with the terms and conditions of your permit and for the initiation of legal action where appropriate. You will be required to pay for

PERMITTEE: New Jersey Transit Corporation
PERMIT NO.: 1998-02350

any corrective measures ordered by this office, and if you fail to comply with such directive, this office may in certain situations (such as those specified in 33 CFR 209.170) accomplish the corrective measures by contract or otherwise and bill you for the cost.

6. Extensions: General Condition 1 establishes a time limit for the completion of the activity authorized by this permit. Unless there are circumstances requiring either a prompt completion of the authorized activity or a reevaluation of the public interest decision, the Corps will normally give favorable consideration to a request for an extension of this time limit.

Your signature below, as permittee, indicates that you accept and agree to comply with the terms and conditions of this permit.

(PERMITTEE) (DATE) 4/27/00

New Jersey Transit Corporation

This permit becomes effective when the Federal official, designated to act for the Secretary of the Army, has signed below.

(DISTRICT ENGINEER) (DATE) 04 MAY 2000

"For and in behalf of"

William H. Pearce
Colonel, Corps of Engineers
District Engineer

When the structures or work authorized by this permit are still in existence at the time the property is transferred, the terms and conditions of this permit will continue to be binding on the new owner(s) of the property. To validate the transfer of this permit and the associated liabilities associated with compliance with its terms and conditions, have the transferee sign and date below. A copy of the permit signed by the transferee should be sent to this office.

(TRANSFEREE) (DATE)

State of New Jersey

Christine Todd Whitman
Governor

Department of Environmental Protection
Site Remediation Program
Office of Dredging and Sediment Technology
P.O. Box 028
Trenton, NJ 08625
(609) 292-1250
FAX (609) 777-1914

Robert C. Shinn, Jr.
Commissioner

Mr. Steve Jurow
Manager, Environmental Services
New Jersey Transit
One Penn Plaza East
Newark, NJ 07105-2246

December 1, 1999

RE: Waterfront Development Permit/Water Quality Certificate,
Acceptable Use Determination (AUD)
Application No: 0905-95-0003.5
Project: Long Slip Canal – Hoboken Terminal

Dear Mr. Jurow:

Enclosed, please find an approved Waterfront Development Permit/Water Quality Certificate/Acceptable Use Determination (AUD) for the above referenced project. Please review this permit and note any conditions which may have been imposed, and promptly complete and return the enclosed "Acceptance of Revocable Construction Permit/s" form to the Department at the above address. This approval is valid for five years from the date of the permit and all terms and conditions of the permit's are detailed therein. Please note that the permittee must give notice of initiation of construction using the enclosed "Construction Report" form. Notice must be given at least 14 days prior to initiation of construction. Upon completion of construction, the "Completion Report" form must also be completed and submitted to the above address.

Any person who considers himself and herself aggrieved by this permit decision may request a hearing by addressing a written request for such hearing to the following address: Office of Legal Affairs, Department of Environmental Protection, P.O. Box 402, Trenton, New Jersey 08625-0402, Attention Adjudicatory Hearing Requests. This written request must include a completed copy of the attached Administrative Hearing Request Checklist and all information identified in Section III of that list.

In order to promote inter-governmental cooperation in the management of our natural resources, a copy of this decision shall be shared with appropriate local and federal agencies. Should you have any questions in this regard, please do not hesitate to contact Suzanne Dietrick at (609) 292-9203.

Sincerely,

Lawrence J. Baier

Lawrence J. Baier, Chief
Office of Dredging and Sediment Technology
Site Remediation Program

Enclosures
C: James Cannon, New York District Corps of Engineers (w/ plans and Decision Summary Report)
Scott Douglas, NJ Maritime Resources
Carol Grubart, DRPSR, BSCM
Charles Jenkins, DWQ, BECPN (w/plans)
William Neyenhouse, DFGW

STATE OF NEW JERSEY
DEPARTMENT OF ENVIRONMENTAL PROTECTION

(See Issuing Division below)

PERMIT*

The New Jersey Department of Environmental Protection grants this permit in accordance with your application, attachment accompanying same application, and applicable laws and regulations. This permit is also subject to the further conditions and stipulations enumerated in the supporting documents which are agreed to by the permittee upon acceptance of the permit.

Permit No. 0905-95-0003.5	Application No. 0905-95-0003.5

IssuanceDate **DECEMBER 1, 1999**	Effective Date **DECEMBER 1, 1999**	Expiration Date **DECEMBER 1, 2004**
Name and Address of Applicant NJTRANSIT Corporation One Penn Plaza East Newark, NJ 07015	Name and Address of Owner Same As Applicant	Name and Address of Operator
Location of Activity/Facility *(Street Address)* Long Slip Canal – NJTRANSIT Hoboken Terminal Observer Highway, Hoboken/Jersey City Hudson County Lot: (See Below) Block: (See Below)	Issuing Division Office of Dredging and Sediment Technology	Statute(s) NJSA 58:10A NJSA 12:5-3

Type of Permit Waterfront Development Permit Water Quality Certificate/Acceptable Use Determination	Maximum Approved Capacity, if applicable

This permit grants permission to:

The project consists of the filling of 4.6 acres of open water (Long Slip Canal) for the expansion of the existing rail yard by approximately 10 acres. The fill material will consist of dredged material from the entrance canal basin, un-amended or amended dredged material from the NY/NY Harbor Complex, or clean fill material. The filling of the canal will require the relocation of the three CSO's that discharge directly into the canal, or the entrance canal basin. The applicant proposes to extend the Jersey City CSO into the entrance canal basin, and construct a solid and floatables control facility for this CSO. The facility will be contained within a 30 ft by 40 ft concrete chamber and will consist of a ½ bar screen, netting facility, tide flex valves, and a 10 ft by 12 ft box culvert. The remaining two CSO discharges will be eliminated by the applicant at the regulators within Observer Highway, and addressed by the sewage authority under a separate independent project. A 100' long by 50' wide berm will be constructed to an elevation of 5 feet NGVD at the opening of Long Slip Canal in order to facilitate the filling of the canal. Approximately 800 feet of the Hudson River Waterfront Walkway will be constructed along the waterfront portion of the project site. The applicant proposes to excavate 4.1 acres of the entrance canal basin to enhance aquatic habitat by improving water quality and tidal circulation in the basin. The dredged material will be removed using hydraulic dredging. This excavation will result in approximately 80,000 cubic yards of dredged material to be used as fill material in Long Slip Canal.

The project is located at: Block 139, Lots 1.1, 1.2, 1.3 and 3 (Hoboken)
Block 19, Lots A5, A6 and A9 (Jersey City)

Prepared By: Suzanne U. Dietrick 12/1/99
Suzanne U.Dietrick Date

(See Page 8 of 14 pages for Chief's signature.)

Revised Date	Approved by the Department of Environmental Protection Name (Print or Type) ______ Title ______ Signature ______ Date

**The word permit means "approval, certification, registration, etc."* *(General Conditions are on Page Two)*

State of New Jersey
Department of Environmental Protection
Site Remediation Program
Office of Dredging and Sediment Technology
P.O. Box 028
Trenton, NJ 08625
(609) 292-1250
FAX (609) 777-1914

Christine Todd Whitman
Governor

Robert C. Shinn, Jr.
Commissioner

February 23, 2000

Mr. Steve Jurow
Manager, Environmental Services
New Jersey Transit
One Penn Plaza East
Newark, NJ 07105-2246

RE: Waterfront Development Permit/Water Quality Certificate/
Acceptable Use Determination (AUD)
Application No: 0905-95-0003.5
Project: Long Slip Canal – Hoboken Terminal

Dear Mr. Jurow:

This letter serves as a MODIFICATION of the existing Waterfront Development Permit/Water Quality Certificate/AUD issued December 1, 1999 to reflect a change in the mitigation requirements imposed in the permit. Specifically, the permit required that the permittee mitigate for the loss of 4.6 acres of open water through the creation of 4.6 acres of estuarine wetlands at an off-site location within the same estuary as the project site. However, a a suitable off-site location within the Hudson River estuary is not feasible which would also meet NJTRANSIT's time constraints. Accordingly, in a letter, dated January 11, 2000, NJTRANSIT requested approval to purchase compensatory wetlands credits at the Marsh Resources, Inc. mitigation bank located in the Hackensack Meadowlands District (HMD). Accordingly, the existing permit is hereby modified to allow for the mitigation for the loss of 4.6 acres of open water through the purchase of mitigation credits at the Marsh Resources, Inc. mitigation bank. Please find attached revised mitigation requirements permit language to replace the requirements in the existing permit. All other conditions of the permit issued December 1, 1999 remain in full force and effect.

In order to promote inter-governmental cooperation in the management of our natural resources, a copy of this decision shall be shared with appropriate local and federal agencies. Should you have any questions in this regard, please do not hesitate to contact Suzanne Dietrick at (609) 292-9203.

Sincerely,

Lawrence J. Baier

Lawrence J. Baier, Chief
Office of Dredging and Sediment Technology
Site Remediation Program

Mitigation Requirements

1. Within 60 days of the effective date of the permit, the permittee shall submit a workplan, for review and approval by the NJDEP, for ongoing water quality monitoring and fisheries studies within the enhanced habitat area. The NJDEP will use the results of ongoing monitoring to evaluate the effectiveness of the proposed mitigation within the entrance canal basin.

2. The permittee shall mitigate for the loss of 4.6 acres of open water through the purchase of mitigation credits at the Marsh Resources, Inc. mitigation bank located in the Hackensack Meadowlands District (HMD). The actual mitigation credits purchased will be based upon review and approval of an appropriate mitigation ratio by the Meadowlands Interagency Mitigation Advisory Committee (MIMAC).

    a) The permittee must submit proof of the purchase of the appropriate mitigation credit to Virginia Kop'Kash, from the Land Use Regulation Program, before the authorized construction may begin. If the permittee waits more than sixty days to make that purchase she/he must first contact Virginia Kop'Kash, from the Land Use Regulation Program at (609) 984-0194 to determine if the mitigation credits are still available for sale.

Distribution of Long Slip Canal Habitat Creation Project Permit Application

	Volume I (Color)	Volume I (Blk/ Wht)	Volume II (Appendices)	Plans Fact Sheet Disk Copy
NJDEP Robert Piel Land Use Regulation Program CN 401 Trenton, NJ 08625	7 bound	3 bound	1 bound 1 unbound	15 plans
US Army Corps of Engineers George Nieves/ Jim Cannon Regulatory Branch 26 Federal Plaza New York, NY 10278-0090	3 bound	1 unbound	1 bound 1 unbound	3 plans 1 disk copy
NJ Transit Steve Jurow One Penn Plaza East, 8th Fl. Newark, NJ 07105-2246	2 bound	1 unbound	1 bound 1 unbound	1 plans 1 fact sheet 1 disk copy
The Municipal Planning Board of Jersey City Robert Cotter City Planning Division 30 Montgomery St. 4th fl., Rm. 416 Jersey City, NJ 07302	1 bound		1 bound	1 plans
The Municipal Planning Board of Hoboken Thomas Mooney Chairman of Planning Board City Hall of Hoboken 94 Washington St. Hoboken, NJ 07030	1 bound		1 bound	1 plans
The Municipal Clerks of Jersey City Adaline Costello City Hall Clerks 280 Grove Street Jersey City, NJ 07302	1 bound		1 bound	1 plans
The Municipal Clerks of Hoboken James Farina City Hall of Hoboken 94 Washington Street Hoboken, NJ 07030	1 bound		1 bound	1 plans
The Municipal Environmental Commission of Jersey City Elizabeth Kearns Division of Engineering 280 Grove Street Jersey City, NJ 07302	1 bound		1 bound	1 plans

Distribution of Long Slip Canal Habitat Creation Project Permit Application (continued)

	Volume I (Color)	Volume I (Blk/ Wht)	Volume II (Appendices)	Plans Fact Sheet Disk Copy
The Hudson County Planning Board John Conners Hudson County Planning Board 547 Duncan Ave. Jersey City, NJ 07306				1 plans 1 fact sheet
The Hudson County Environmental Commission Robert Ferraiuolo Director of Environmental Commission Meadow View Campus 595 County Ave., Bldg. One Secaucus, NJ 07094				1 plans 1 fact sheet
Adjacent Property Owner William Wisseman. P.E. Chief Engineer **Newport Associates Development Corporation** 2 Sixth Street Jersey City, NJ 07310				1 plans 1 fact sheet
Adjacent Property Owner Francis J. Lombardi. P.E. **Port Authority of NY & NJ** One World Trade Center New York. NY 10048				1 plans 1 fact sheet
Dames & Moore, Cranford, NJ Connie Tsentas	1 bound		1 bound	1 plans 1 fact sheet
Remaining	Original 3 bound	1 unbound	Original	Reproducible plans & fact sheet 2 disk copies

DAMES & MOORE

A DAMES & MOORE GROUP COMPANY

Pearl River, NY
Phone (914) 735-1200
Fax (914) 735-1240

Meeting Summary

Long Slip Canal Habitat Creation Project

Date: July 8, 1997

Subject: Pre-application Meeting

Place: 26 Federal Plaza, NY, NY

Attendees: J. Cannon, COE
V. Truncellito, NJ Transit
J. Porrovecchio, E. Peck, R. Johnston, C. Tsentas, D&M

Summary Prepared by: E. Peck on: August 2, 1997

JP presented project.

Comments from J. Cannon:

- Alternatives to the project need to be well-considered and their rejection in favor of the proposed project compelling.
- Jersey City Sewage Authority needs to sign-off on CSO extension and design; maintenance agreement also needed.
- Monitoring of post-construction water quality might be required.
- He expressed confusion over the relationship between the Long Slip project and the Hudson-Bergen Light Rail project.
- NJ Transit should hold additional pre-application meetings with all other reviewing agencies and incorporate those comments into the final project.

DAMES & MOORE
A DAMES & MOORE GROUP COMPANY

One Blue Hill Plaza, Suite 530
Pearl River, New York 10965-
914 735 1200 Tel
914 623 8797 Fax

July 21, 1997

Mr. Larry Baier
New Jersey Department of Environmental Protection
Land Use Regulation Program
501 E. State Street
CN-401
Trenton, New Jersey 08625-0401

RE: Pre-application meeting
Long Slip Canal Habitat Creation Project,
Hoboken/Jersey City, New Jersey

Dear Mr. Baier:

On behalf of New Jersey Transit, thank you for your time and attention to this project at the July 17, pre-application meeting. It is NJ Transit's objective to identify and correct any administrative or informational deficiencies prior to filing, so that project review can be completed favorably within the 90-day limit. I appreciated the opportunity to present this complex and unique project, and to receive your comments.

As we discussed, this project is of considerable importance to regional transportation for its cost-effective expansion of existing Hoboken rail yard facilities that will allow NJ Transit to meet capacity demands and improve operational efficiency. The project mitigation plan is based on an ecosystem approach aimed creating a self-sustaining reversal of the existing conditions that preclude the use of the canal and the entrance basin as fish habitat. Proposed is a plan for marked improvements to water quality optimized by 3-D numerical modeling. By the isolation from the ecosystem of flowed lands not realistically redeemable, over 20-acres of interpier nursery habitat for commercial species such as stripped bass will be created

We understand the following to be the results of this meeting:

- The NJDEP and the US Fish and Wildlife Service support the filling of Long Slip Canal.

- The US Fish and Wildlife Service believes that the measures proposed to improve the quality of the CSO discharge (i.e., relocation of the outfall to deeper water, the removal of floatables, the removal of dry weather overflows, and reduced discharges of sediment) will be sufficient mitigation.

- The isolation of dredged material not suitable for ocean disposal within a storage facility is a short-term benefit. To be considered as mitigation acreage by NJDEP, the dredged material needs to be associated with habitat improvement essentially unrelated to navigation.

- Perpendicular access to the proposed walkway needs to be provided.

- The relationship between this project and the Hudson-Bergen Light Rail Transit project needs to be identified.

- The application should contain:
  - An agreement or evidence of a substantial dialog with the Cities of Jersey City and Hoboken towards the CSO improvements;
  - Description of dredging history and sedimentation rates within the canal entrance basin;
  - Description of sediment testing and results;
  - Description of port use - past, present, and future; and,
  - Alternative analysis and statement of need for project.

These comments will be addressed in the final application. Thank you again for your assistance with this project.

Sincerely,

Eugene Peck
Permitting Manager

cc: J. Porrovecchio, C. Tsentas, D&M
S. Jurow, V. Truncellito, N. Valente, N.J. Transit
P. Benjamin, USFWS
J. Cannon, COE

NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION

MEETING ATTENDANCE SHEET

SUBJECT: Long Slip Canal

DATE: 7/17/97

MEETING LOCATION: 501 E. STATE ST.

GROUP(S) ATTENDING:

DEPE PROGRAM OR UNIT: Land Use Regulation

NOTE: The guidance provided at a preapplication meeting is not binding upon the Department. (In accordance with NJAC 7 .10.4(c), 7:13-1.1 and 7:7-3.1). Therfore, the Department shall in no way commit itself to approval or rejection of a proposal pr as a result of these discussions. By attending this meeting all acknowledge this standard.

SIGNATURE	TITLE	PHONE/EXT	AFFILIATION
Lawrence J. Baier	Section Chief Hudson-Essex, Passaic	609 633-9277	Land Use Reg.
Michael Hoikman	Project Review Officer	609 984-0288	Land Use Reg
[illegible]	Proj Mgr.	914 735-1200	Dames & Moore
Vincent Truncellito	Mgr. Project Planning	973 491-7810	NJ TRANSIT
Steve Juerow	Mgr. Environmental	973-491-7210	"
Joe Porrovecchio	~~[illegible]~~	914-735-1200	Dames/Moore
[illegible]	[illegible]	[illegible]	U.S. [illegible]
TOM STAPF	HBLRTS CIVIL FACILITIES MGR	201-648-8700	PARSONS BRINCKERH.
Michael J. Brady	HBLRTS Envir. Consultant	201-301-0078 x 122	BEM Systems, I
Kinney Clark	DEP Historic Pres. Spclst.	609-777-1865	DEP-HPO
Joe Porrovecchio	D & Moore	914 735 1200	NJ Transit Consu

DAMES & MOORE
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Pearl River, NY
Phone (914) 735-1200
Fax (914) 735-1240

Meeting Summary
Long Slip Canal Habitat Creation Project

Date: August 7, 1997

Subject: Pre-application meeting with EPA, NMFS

Place: EPA Region 2 office

Attendees: Eric Stern, Mario Paula, EPA
Karen Greene, NMFS
V. Guida, Lehigh University
S. Jurow, V. Truncellito, NJ Transit
J. Porrovecchio, E. Peck, D&M

Summary prepared by: E. Peck on: 8/8/97

The project was presented by Jurow, Truncellito, Porrovecchio, and Peck. The following comments were received.

1. The EPA and NMFS both stated that there are no objections to filling the canal. Filling behind the walkway is most likely acceptable, however that component of the project particularly must be well supported by the assessment of alternatives, needs, and impact minimization.

2. Karen Greene (KG) and Mario Paula (MP) liked the ecosystem approach used in the design of the project and mitigation. They did not believe that the walkway fill could be counted as mitigation acreage.

3. A walkway will not be sufficient mitigation for the HBLRT. Other Section 404 concerns raised by KG and MP about the HBLRT project centered on the need for the terminal to be located offshore, measures taken to minimize impacts, and the alternatives evaluated.

4. KG objected to describing the project as habitat "creation" and suggested "restoration" or "improvement".

5. KG considered a potential fish pier off the walkway as a project impact, since NMFS is not concerned with public access.

6. KG and MP indicated that post-construction monitoring may not be necessary.

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Meeting Summary

Long Slip Canal

Date: August 11, 1997

Subject: Pre-application meeting

Place: Sandy Hook, NJ

Attendees: Andrew Willner, Baykeeper
Cindy Zipf, COA
Steve Barnes, Baykeeper office
Dr. V. Guida, Lehigh University
S. Jurow, NJ Transit
J. Porrovecchio, D&M
E. Peck, D&M
M. Stewart, D&M

Summary Prepared by: E. Peck on: August 12, 1997

1. Jurow, J. Porrovecchio, and E. Peck presented the project.

2. Andrew Willner (AW) indicated that the CSO should be abated; it appears to be just extended. The CSO also should be improved to comply with the nine minimum controls specified by the 1995 U.S. Environmental Protection Agency Final CSO Control Policy. J. Porrovecchio (JP) replied that that work is underway. The Long slip project will include floatables and sediment removal, in-line storage, and will address dry weather overflows.

3. Long slip canal serves as a sediment settling basin and as such provides a service to the river. JP and EP noted that the value of this service is negative because organics, metals and other CSO pollutants also stored in the canal have created conditions that continuously degrade adjacent river waters.

4. Mitigation plan does not propose in-kind mitigation for areas filled. AW does not consider the habitat creation or sewer sufficient mitigation. AW and CZ do not believe the excavation can be counted as mitigation. AW will be seeking a 2-3 to 1 ratio mitigation area. This may include the purchase of wetlands elsewhere in the estuary.

5. AW and CZ indicated a concern over who will maintain the sewer trash net and the in-line settling tank.

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Meeting Summary

Long Slip Canal

Date: August 28, 1997

Subject: Coordination of Corps permit with HBLRT

Place: NY District office

Attendees: G. Nieves, J. Cannon, COE
S. Jurow, V. Truncellito, T. Murtha, NJ Transit
E. Peck, D&M
S. Sarkar, PBQ&D

Summary Prepared by: E. Peck on: 8/29/97

1. The purpose of the meeting was to address the Corps question of why two applications are needed for the projects by the same proponent over the same footprint.

2. SJ described the need to not risk procedural delays of the LRT by issues that may be raised over the fill required from the Long Slip project. The LRT permit will be filed within 4 to 6 weeks. The Long Slip permit will be filed after October 15.

3. GN and JC questioned the need for the LRT terminal siting over open water and whether the quality of the open water enclosed by the pile-supported structure would be adversely impacted. GN was also concerned about the Hoboken sewer discharge to that area. The LRT application must address siting alternatives and impacts to wetlands, particularly water quality.

4. There was no comment on the adequacy of the mitigation proposed for the LRT. GN suggested that Pier 2 be considered for the proposed fishing pier rather than the planned extension from the walkway. GN did not believe that the purchase of Hackensack wetlands would be sufficient mitigation for either project.

5. VT and EP described the philosophy behind the mitigation package proposed for the Long Slip project. SJ indicated that NJTransit is "backing-off" walkway 3 in favor of a modified walkway 2 primarily because of comments received from the environmentalists. GN indicated that the environmentalists should "not be elevated" to regulator status.

6. Both applications need to reference each other and justify how they are separate and distinct. The effects of each upon the other also must be described. JC could not give any indication of whether the Long Slip application was administratively complete or whether there were any apparent impediments to a FONSI. SJ suggested scheduling a public meeting as part of the public notice. GN said he will make that determination once the application is received.

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Phone (914) 735-1200
Fax (914) 735-1240

Meeting Summary

Long Slip Canal Habitat Creation Project

Date: September 29, 1997

Subject: Eighteenth Street regulator and outfall

Place: Jersey City Sewer Authority office

Attendees: J. Beckmeyer, M. Lescavage, Jersey City Sewer Authority
A. Safi, Jersey City Engineering Department
S. Jurow, N. Valente, V. Truncellito, NJ Transit
M. Del Bova, J. Minnett, Malcolm Pirnie
E. Peck, J. Porrovecchio, D & M

Summary Prepared by: E. Peck on: October 1, 1997

The purpose of this meeting was to begin negotiations with the Jersey City Sewer Authority towards approval of the modifications to the 18th Street regular and outfall required by the Long Slip and light rail projects, specifically the extension, an alternate route, Dry weather flows and floatables controls a settling basin and maintenance.

1. SJ presented the project and the stated the likely need for a settling tank as mitigation.

2. MDB thought that the capture and treatment of an annual event will not be enough. Malcolm Pirnie (MP) has collected flow data from the regulator and outfall and will provide to D&M, but noted that the SWMM model is still in the conceptual stage.

3. JB agreed that the extension, net, and settling tank could be removed from the NJ Transit yard and would consider alternative routes and configurations.

4. Three potential extension routes were discussed included through the canal, in Yard A, and along Eighteenth Street. Choice of a route depends on several factors still under discussion such as the walkway configuration, the yard reorganization, the HBLRT, the size and location of a settling tank and the net, and the maintenance requirements. MDB suggested that the planned access road under the reconfigured railyard scheme might be the most promising route.

5. MP is modeling the degree that existing flows exceed existing capacity. At least 100,000 gal of storage will not eliminate dry weather flows (DWO). Storage is not being considered. The two options being considered to eliminate DWO are increasing the interceptor and reconstructing or modifying the regulator.

6. MP suggested that the tank should have the dimensions of 15 ft. X 30 ft. X 50 ft. JP suggested that the tank be oversized and combined with the net to simplify construction, operations and maintenance.

7. Regarding the location of the tank, JSCA originally envisioned a the net on the end of the pipe. SJ indicated that a vacant parcel upstream would be a better location. JB agreed and indicated the need for land-based services to maintain the facility. He also stated the need to check on the status of potential sites regarding planned uses or other constraints.

8. JB raised the question of how a settling tank would viewed by NJDEP under their existing permit. Would the tank require an individual permit? Would the tank be considered a treatment facility? Samples should be taken to determine whether tank sediment is likely to be considered sediment or sludge. In addition, there are questions as to how this sediment should be disposed pumped back to the treatment plant or in a landfill.

9. JB indicated there was at present no estimate of the how frequently the net and the tank would have to be serviced.

10. Action Items:

    1. MP to provide flow data to D&M
    2. D&M will advance route concepts
    3. JCSA, NJT, MP, and D&M will meet following the JCSA meeting with NJDEP.

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Meeting Summary

Long Slip Canal Habitat Creation Project

Date: October 31, 1997

Subject: Jersey City CSO extension

Place: Jersey City Sewage Authority

Attendees: J. Beckmeyer, M. Lescavage, Jersey City Sewer Authority
S. Jurow, NJ Transit
M. Del Bova, J. Minnett, Malcolm Pirnie
E. Peck, J. Porrovecchio, D & M

Summary Prepared by: E. Peck on: November 5, 1997

1. Jurow presented a draft letter of initial agreement between NJ Transit and Jersey City Sewage Authority (JCSA) regarding the design and siting of improvements to the combined sewer outfall of the Eighteenth Street regulator (RE-19).

2. In summary, NJ Transit accepts responsibility to design and construct the necessary system improvements to JCSA specifications. Upon completion of construction, JCSA agrees to accept the ownership of the system improvements.

3. Beckmeyer agreed in principle, but indicated that it would be necessary for his agency and to review the draft letter and develop appropriate language.

NJ TRANSIT The Way To Go. 15th ANNIVERSARY

MEMORANDUM

TO: Record

FROM: Steve Jurow

DATE: January 16, 1998

SUBJECT: **Meeting with Bob Janizcewski**

Attendees: Robert Janiscewski, Hudson County Executive
Suzanne Mack, Jersey City Chief Engineer
Herman Volk, NJ Transit Community Relations
Vinnie Truncellito, NJ Transit Planning
Steve Jurow, NJ Transit Manager of Environmental Services
Janiscewski Legislative Aide

We met today with Bob Janiscewski to inform him that our application for a permit to fill the Long Slip had been filed (December 29) with both the Army Corps and with NJDEP, and to explain the project, its benefits, and the proposed mitigations, and ascertain his concerns.

Herman explained the project purpose and scope, budget and schedule. I outlined the linkage between the Long Slip fill project and the Hudson-Bergen Light Rail Line. I indicated that the HBLRT project might be paying for the Long Slip fill project, at which both Bob and Suzanne indicated some concern that the HBLRT had been unwilling to fund certain enhancements and amenities which Jersey City wanted, claiming insufficient funding, and they wondered how come there was money to do this but not the things they sought. (The reason is that the funding is to be front-ended -- loaned -- to the Long Slip fill project, but then repaid out of Hoboken rail yard enhancement project monies granted later.)

Bob indicated no major concerns with the project, and general support for the improved rail service that would follow upon the yard being modernized. He indicated that his major preoccupation was the light rail line.

Steve noted that the Long Slip fill project could involve dredge material from other river dredging projects; Bob commented that he would have to look at that, but that it raised no major concerns.

Distribution

NJ Transit attendees

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NJ TRANSIT
The Way To Go.
15th ANNIVERSARY

MEMORANDUM

TO: Record

FROM: Steve Jurow

DATE: January 20, 1998

SUBJECT: **Meeting with Betty Kearns, Chair, Jersey City Municipal Environmental Council**

Attendees:
Betty Kearns, Chair, Jersey City Municipal Environmental Council
Vinnie Truncellito, NJ Transit Planning
Steve Jurow, NJ Transit Manager of Environmental Services

At Jerry Neissen's suggestion, we met today with Betty Kearns, Chair of Jersey City's Municipal Environmental Council, to inform her that our application for a permit to fill the Long Slip had been filed with both the Army Corps (December 29) and with NJDEP (January 2), and to explain the project, its benefits, and the proposed mitigations, and ascertain her concerns.

Betty indicated no concerns with the project, and general support for the improved rail service that would follow upon the yard being modernized. She expressed some desire for the inclusion of historical railroad elements into the design of the pedestrian walkway, and/or public displays of railroad history on story boards incorporated into the pedestrian walkway bridging the Slip. She suggested that the bridge structure itself be drawn from available railroad bridge remains to highlight the Deleware Lackawanna and Western history of the yard. She also noted an interest in some kind of remembrance of the penny trolley service that used to run through Jersey City.

Distribution

NJ Transit attendees

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(Special)

NJ TRANSIT
The Way To Go.

April 21, 1998

Mr. Fred Pocci
Executive Director
North Hudson Utility Authority
1600 Adams Street
Hoboken, New Jersey 07030

Dear Mr. Pocci:

This letter is to confirm our respective interagency intentions regarding the upgrading and equipping of Hoboken sewers contingent on NJ TRANSIT gaining permission from regulatory agencies to fill the Long Slip canal. Should we acquire the necessary permits, we would intend to commence work in late 1998, necessitating the extension of the Park Street sewer to a new outfall at or beyond the bulkhead line, as defined by the permit. If we are also permitted to fill beyond the bulkhead line at the apparent current terminus of the line off Regulator 01, we may also need to extend that line, which traverses the Hoboken rail yard from Washington Street south and eastward under the tracks and trainshed, currently terminating at the corner of the mail pier and the bulkhead line.[1]

In preparing the permit applications for filling Long Slip, we met with you and your consultant in 1997 and determined that a number of improvements to the Hoboken sewers under the rail yard would be either required or desirable, specifically:

- Extend the Park Street sewer through the proposed fill area;
- Reline and clean the Park Street sewer under Hoboken Yard;
- If required, extend the Regulator 01 sewer lateral southeastward;
- Equip the extended sewer(s) affected by the project with netting facilities.

The purpose of this letter is to establish the responsibilities of our respective agencies funding, locating, designing, constructing, and operating the improvements.

---

[1] Although a historical map indicates the extension of this sewer along the mail pier several hundred feet further into the Hudson River "interpier" area, water quality monitoring we conducted in 1995 indicated a signicant fresh water plume emanating from the corner, suggesting either that the sewer was never extended or that the piping or connection has ruptured at or near the corner.

Funding -- NJ TRANSIT will fund the design and construction of any necessary sewer extensions and of the netting facility. In addition, NJ TRANSIT will contribute up to $700,000 toward the cost of relining and cleaning the Park Street sewer. North Hudson Utility Authority will fund any costs of the Park Street relining not covered by NJ Transit's $700,000 contribution.

Location -- The netting installation will be an "end of pipe" design aimed at minimizing head loss impacts of the installation on system hydraulics, unless our consultant's discussions with your designer indicates an alternative to be preferred. If the end-of-pipe design emerges as preferred, NJ Transit will work closely with your designer to ensure a solution which can be routinely serviced from the planned pedestrian walkway which will pass over the pipe at the end of the extension.

Design and Construction -- NJ TRANSIT will be responsible for the design and construction of any necessary sewer extensions and the netting facility as part of the overall Fill project. North Hudson Utility Authority will be responsible for the relining and cleaning of the Park Street sewer. (NJ TRANSIT would reimburse North Hudson as costs are incurred up to the above limit.)

Operation -- North Hudson Utility Authority will maintain and operate the extended sewers and netting installation at no cost to NJ TRANSIT, except as provided in the original easement agreements.

We believe the above allocations are appropriate in light of already existing obligations and the changes we are creating with the Long Slip Fill project. If you agree with the above, please indicate by countersigning this letter and returning it to me. It is our intent to include this letter as an addendum to our permit applications to demonstrate that the sewer improvements are a part of the mitigation plan.

Should you have any questions concerning our position on this matter, please let me or Steve Jurow know, at the below address or by phone (973-491-7163 or 7210) or by fax (973-491-7461).

Thank you for your cooperation to date.

Very truly yours,

Rick Richmond

Rick Richmond, AED
Engineering, Development & Construction

Concurrence by:

________________________ Dated: __________________

Fred Pocci, Executive Director
North Hudson Utility Authority

THE PORT AUTHORITY OF NY & NJ

ONE WORLD TRADE CENTER
NEW YORK, NY 10048

(212) 435-7000
(201) 961-6600

May 19,1998

RECEIVED
MAY 28 1998
By________________

New Jersey Department of Environmental Protection
Land Use Regulation Program
CN401
Five Station Plaza
Trenton, NJ 08625

ATTENTION: HUDSON SECTION CHIEF

Dear Sir/Madam:

On January 15, 1998 we sent you a letter (copy enclosed) recommending against issuing a permit for New Jersey Transit (NJT) to fill in the Long Slip Canal, this was due to Port Authority of New York & New Jersey concerns of the potential negative structural impact of the fill on the Port Authority Trans-Hudson (PATH) tunnels. Subsequently, we have been working with NJT and their consultants to address and resolve these concerns, and are satisfied by their commitment to provide analyses showing the impact the fill will have on the tunnels and submit for PATH's review and approval their design prior to any work being performed in the vicinity of our tunnels.

Based on these commitments, we now have no objection to having the permit issued for this work provided that the permit is subject to NJT receiving approval from the Port Authority of New York & New Jersey / PATH for the design and construction of all work over and in the immediate vicinity of the PATH tunnels.

We appreciate your cooperation in this matter. If you have any questions or need additional information you can contact me at (212) 435-8930 or Edmond Chalom of my staff at (212) 435-8953.

Sincerely,

Peter L. Rinaldi, P.E.
Engineering Program Manager
Tunnels, Bridges, Terminals, & PATH

Copy To: J. DiSorbo, Port Authority of NY & NJ
S. Jurow - New Jersey Transit
F. Lombardi, Chief Engineer, Port Authority of NY & NJ
F. Smolar, New Jersey Transit

THE PORT AUTHORITY OF NY & NJ

ONE WORLD TRADE CENTER
NEW YORK, NY 10048

(212) 435-7000
(201) 961-6600

January 15, 1998

New Jersey Department of Environmental Protection
Land Use Regulation Program
CN401
Five Station Plaza
Trenton, NJ 08625

ATTENTION: Hudson Section Chief

Dear Sir/Madam:

I am responding to the attached December 24, 1997 letter from Joseph Porrovecchio of Dames & Moore to Mr. Francis J. Lombardi concerning the subject permit application. The Port Authority of New York and New Jersey has previously discussed and reviewed New Jersey Transit's/Dames & Moore's Work Plan, dated March 4, 1997, to perform geotechnical engineering and environmental investigative studies to determine the impact on adjacent properties of their proposed filling of the Long Slip Canal. Our PATH tunnels are directly below the canal and our tunnel drainage pumps discharge into the canal. A copy of our comments to Dames & Moore, dated April 22, 1997, is attached. The Port Authority has not received any of the information requested in our April 22, 1997 letter, and therefore have not been able to determine the impact of New Jersey Transit's proposal on our PATH facilities. Until the Port Authority's comments and concerns are satisfied by New Jersey Transit/Dames & Moore, New Jersey Transit's Permit for this project should be denied.

Sincerely,

Peter D. Rinaldi, P.E.
Engineering Program Manager
Tunnels, Bridges, Terminals, & PATH

Copy To: S. Jurow - New Jersey Transit
F. Lombardi, Chief Engineer, Port Authority of NY & NJ
F. Smolar, New Jersey Transit

Attachment

/gd

NJ TRANSIT
The Way To Go.

January 21, 1998

Mr. Fred Pocci
Executive Director
North Hudson Sewerage Authority
1600 Adams Street
Hoboken, New Jersey 07030

Dear Mr. Pocci:

This letter is to confirm our interagency intentions regarding the upgrading and equipping of Hoboken sewers contingent on NJ TRANSIT gaining permission from regulatory agencies to fill the Long Slip canal. Should we acquire the necessary permits, we would intend to commence work in late 1998, necessitating the extension of the Park Street sewer to a new outfall at or beyond the bulkhead line. Depending on the nature of required mitigations, we may also need to extend your Outfall 01, which traverses the Hoboken rail yard from Washington Street south and eastward under the tracks and trainshed, currently terminating at the corner of the mail pier and the bulkhead line. (Although a historical map indicates the extension of this sewer along the mail pier several hundred feet further into the Hudson River "interpier" area, water quality monitoring we conducted in 1995 indicated a signicant fresh water plume emanating from the corner, suggesting either that the sewer was never extended or that the piping or connection has ruptured at or near the corner.)

In preparing the permit applications for filling Long Slip, we met with you and your consultant in 1997 and determined that a number of improvements to the Hoboken sewers under the rail yard would be either required or desirable, specifically:

- Extend the Park Street sewer through the proposed fill area (required because of NJ TRANSIT's project);
- Reline and clean the Park Street sewer under Hoboken Yard (desirable for North Hudson);
- Extend the Regulator 01 sewer lateral southeastward (may be required by NJ TRANSIT's project);
- Equip any existing or extended sewer(s) affected by the project with netting facilities (required with or without NJ TRANSIT's project).

The purpose of this letter is to establish the responsibilities of our respective agencies funding, locating, designing, constructing, and operating the improvements.

Funding -- NJ TRANSIT will fund the design and construction of any necessary sewer extensions. NJ TRANSIT will contribute up to $700,000 toward the cost of relining and cleaning the Park Street sewer and equipping any sewers affected by the project with netting facilities.

North Hudson Sewerage Authority will fund any costs of the Park Street relining and netting facilities not covered by the above NJ Transit contribution.

Location -- During site walks with your consultant, we evaluated two options for netting installations, for each of the sewers in question. For both the Park Street and Regulator 01 sewers, we identified one opportunity in the bed of the Observer Highway service road, and a second location under a parking lot intended to be constructed as part of the Hoboken rail yard rehabilitation. In both cases, NJ TRANSIT greatly favors the Observer Highway locations off NJ TRANSIT property, as they would permit routine servicing of the netting installation by the North Hudson Sewerage Authority without involvement of NJ TRANSIT rail employees or interference with operations.

Design -- NJ TRANSIT will pay for and accomplish, pursuant to North Hudson Sewerage Authority approvals, design of the necessary sewer extension(s) as part of its overall project design. If the netting installations are to be accomplished under Observer Highway, we would anticipate North Hudson Sewerage Authority paying for and accomplishing these improvements. Should the netting facility(ies) need to be located within the confines of the Long Slip fill project corridor, however, NJ TRANSIT would prefer to include their design in the overall project design package, to avoid conflicts and ensure integration of all project elements.

Construction -- NJ TRANSIT will be responsible for implementing any necessary sewer extensions, as part of the overall Fill project. North Hudson Sewerage Authority will be responsible for the relining and cleaning of the Park Street sewer and the retrofitting of sewers with netting installations under Observer Highway. (NJ TRANSIT would reimburse North Hudson as costs are incurred up to the above limit.) Should the netting facility(ies) need to be located within the confines of the Long Slip fill project corridor, however, NJ TRANSIT would expect to incorporate their construction into the overall fill project, to avoid conflicts among project elements during construction. To quickly resolve this question, North Hudson Sewerage Authority needs to determin as early as possible whether the Observer Highway or other off-NJ TRANSIT property opportunities for the netting facilities meet its requirements, and to let NJ TRANSIT know whether the Fill project will or will not need to make provisions for such facilities on NJ TRANSIT property.

Operation -- North Hudson Sewerage Authority will maintain and operate the extended sewers and netting installations at no cost to NJ TRANSIT, except as provided in the original easement agreements.

We believe the above allocations are appropriate in light of already existing obligations and the changes we are creating with the Long Slip Fill project. If you agree with the above, please indicate by countersigning this letter and returning it to me. It is our intent to include this letter as an addendeum to our permit applications to demonstrate that the sewer improvements are a part of the mitigation plan.

Should you have any questions concerning our position on this matter, please let me or Steve Jurow know, at the below address or by phone (973-491-7163 or 7210) or by fax (973-491-7461).

Thank you for your cooperation to date.

Sincerely,

for

Rick Richmond, AED
Engineering, Development & Construction

Concurrence by:

________________________ Dated:____________________
Fred Pocci, Executive Director
North Hudson Sewerage Commission

cc: P. Saklas, S. Jurow

Newport

January 20, 1998

New Jersey Department of Environmental Protection
Land Use Regulation ~~Program~~
CN 401
5 Station Plaza
Trenton, New Jersey 08625

Attention: Hudson County Section Chief

Re: Waterfront Development Permit Application
Long Slip Canal Habitat Creation Project
Hoboken / Jersey City, New Jersey

Dear Sir of Madam:

We are pleased to offer comments on the referenced application in accordance with Dames & Moore's December 24, 1997 letter sent to us, an adjacent property owner, pursuant to N.J.S.A. 12:5-3.

We have the following comments on the limited information sent along with the Dames & Moore letter noted above and ongoing discussions with New Jersey Transit's (NJT) staff:

1. In May 1988 Newport submitted to NJDEP the Long Slip Canal Study done by their consultant, Geismar & Calamari, to satisfy Condition A-2 of their Waterfront Development Permit 85-044601. We find the information provided with the current application to be consistent with that study. We believe that filling the canal along with the other work proposed is an environmental bonus for the area's users, i.e. eliminating the stagnant and odorous waters of the canal.

2. The plans filed with the application show the extended 10' x 10' Jersey City combined overflow sewer outfall on NJT property. It is our understanding that NJT is studying several sewer alignment alternatives, one of which would put the sewer through Newport's property from 18th Street toward the existing bulkhead. This option, if implemented, would require a 20' wide by 900 foot long easement along Newport's north property line as shown on the enclosed SK-1 from NJT (not a part of the permit application). Although we do not believe the easement would be a major problem,

X Newport
2 Sixth Street
Jersey City, N.J. 07310
Telephone (201) 626-2010
Fax (201) 626-2015

☐ Newport Real Estate Dev. Corp.
97-77 Queens Blvd.
Rego Park, N.Y. 11374
Telephone (718) 459-9021

☐ SNP, Inc.
One Merchants Plaza
155 West Washington Street
P.O. Box 7033
Indianapolis, Indiana 46207
Telephone (317) 636-1600

we prefer the sewer be kept on NJT's property as shown in the application documents. In any event, as outlined in the plans and fact sheet portions of the application, the outlet of the outfall must be extended to past the riprap dike into an area where river circulation is sufficient to provide an adequate mixing zone to disperse the effluent. **The extension of the sewers to deep water must be a condition of this waterfront development permit.**

3. The Fact Sheet description of the Project Site states "...fecal coliform counts are high, and the area is beset by decomposition gasses releasing sediment trapped oils into the water column." and " The CSO discharge waters are neither well-dispersed nor well-oxygenated as they are discharged into waters already oxygen-depleted by anaerobic bottom sediment decomposition." [1]. Paragraph #5 of the Proposed Program section states "Species populations and diversity also will benefit from the removal of biohazards now accessible to bottom-dwelling and spawning aquatic populations." The Project Site section also states "Canal sediments are suitable for land based disposal, under NJ soil cleanup standards." This statement may be true, but the soil cleanup standards do not consider biohazards or odor as criteria. **Permitting the re-use of the sediments must consider the potential biohazards in the sediments. Additionally, this waterfront development permit must require the implementation of odor control procedures during the dredge and fill operations.**

The Newport development in Jersey City has more than 200,000 square feet of retail development within 250 feet of the Long Slip Canal. These stores attract thousands of customers on a daily basis. By the end of 1998 Newport will have 2,736 residential apartments occupied by more than 5,000 people that will live less than one third of a mile from the canal. Moreover, the northeast quadrant of Newport, which abuts the proposed expanded transit yard, is zoned and currently being marketed for residential development. This will eventually put another 10,000 residents within 1/4 mile of the canal. The application does provide for at least 18" of clean cover material over the "fill" which should provide a permanent control of the odors. **This waterfront development permit must require NJT to maintain these institutional controls to safeguard against any potential exposure of area occupants or users to contaminants, including biohazards, and odors.**

---

1. Two combined overflow sewers are noted in the application: a 120" square sewer entering the canal at its west end and an 85" by 72" sewer entering 700 feet from the west end. Thus maximizing the amount of sewerage settlement in the canal. We note the canal also contains six additional drain pipes: two 12"Ø ejector drains from the PATH Tunnels, two 1"Ø steam drains from the rail yard and one 10"Ø and one 12"Ø cast iron pipe from the rail yard whose source is apparently unknown.

4. The Background and Objectives sections of the Fact Sheet indicates that land created by filling the canal will be for expansion of the rail yard. As such, the active part of the rail yards for the light rail trains and storage of passenger trains will be moved closer to all of the above described developments at Newport. As part of a negotiated amendment to the Newport/NJT Transit Agreement, NJT will install a decorative fence along the north side of 18th Street adjacent to their light rail Acquisition Parcel 31. NJT should continue the decorative screen fence from 18th Street to the eastern end of their yard at the proposed walkway along the existing bulkhead. Given the size of the expanded transit facility and nature and significance of the adjacent developments, we firmly believe that, in addition to the fence, a landscaped buffer that provides both visual screening and mitigation of potential air and noise pollution from the rail yard should also be provided. **This waterfront development permit must require NJT to, at minimum, provide a decorative screen fence and landscaped buffer along the southern end of the expanded rail yard.** We also believe that access to the expanded portion of the rail yard by the general public would be in conflict with the project's objectives stated in the Fact Sheet. **This waterfront development permit should prohibit NJT from constructing a roadway from the transit yard to 18th Street for use by the general public..**

Please call me at (201) 626-2010 if you have any questions.

Very truly yours,

William F. Wissemann, P.E.
Project Engineer, NADC

WFW/wfw (depnjtp1.doc)
Enclosures
cc: M. Boyle
J. Stallsmith
V. Morrison, Esq.
S. Jurow (NJTransit)
File

FUND FOR A BETTER WATERFRONT
P.O. BOX 1965
HOBOKEN, NEW JERSEY 07030
201-217-0500

February 23, 1998

Mr. Steve Jurow
Manager of Environmental Services
NJ Transit
NJ Transit Headquarters
One Penn Plaza East
Newark, New Jersey 07105-2246

Dear Mr. Jurow:

Thank you for the meeting on January 30 concerning NJT's plans for the Hoboken Railyard Rehabilitation Project. I have reviewed your permit application to the NJDEP and U.S. Army Corps of Engineers with the assistance of a professional landscape architect and have also consulted with members of our organization.

We have no problems with the basic program proposed by NJT for the Long Slip Canal Habitat Creation Project. We would, in fact, be very supportive of your application to the NJDEP and Army Corps. Our concerns are focused solely on the design for the Hudson River Waterfront Walkway. We would like to work closely with NJT as you begin to develop the final walkway plan. Our intent is to optimize the walkway as public linear park at this exceptional location which provides an important connector between Hoboken's south waterfront and Jersey City. This letter first deals with several general responses to your proposed project and then several specific comments regarding details of the proposed walkway.

First, it is important, from our point of view, that mitigation be completed at the Hoboken Train Terminal and not off-site. Improving the water quality and habitat in the Hudson River directly in front of the public walkway will provide for a more attractive and inviting setting for the many people who will be utilizing the walkway at this location. Any additional mitigation measures should include maximizing the amount of public open space and landscaped areas along the walkway area on this site. Any retail opportunities should be confined to the Hoboken Terminal area.

To optimize the potential of this site, it is important to begin the design process not with the details but with the over-all concept for the Hudson River Waterfront Walkway. Design experts need to think through the special requirements of this project and undertake a design process. A coherent, thoughtful conceptual design is a critical starting point that will then allow the details to fall into place more easily.

The design concept could be accomplished in several ways. It could involve assembling a team (planners, architects, landscape architects, etc.) or inviting a competition for schematic plans. But to realize the potential for this state-owned property it is important that this not be something that is simply engineered.

A number of details for the walkway area are described in your application to NJDEP and the Army Corps. Although some of these details are based on NJDEP guidelines, it is important to note that these NJDEP guidelines are simply recommendations and not design requirements. There are three items that we recommend for reconsideration as follows:

1) **Plantings**. Many of the NJDEP guidelines are geared toward New Jersey's Atlantic shoreline and less populated areas. The special requirements of urban areas have been neglected. In an urban setting close to a tidal river, it is of utmost importance to plant species that will survive. This could include native species, but not necessarily. The planting methods suggested in your application also need to be evaluated by someone with expertise in this area. The "pipe" method does not promote healthy, long-term growth for larger plants and there are better ways to prevent roots from buckling the paving.

2) **Paving.** We would recommend the use of attractive, traditional paving materials for the walkway such as cobbles, brick or concrete pavers. The design for the South Waterfront at Hoboken makes good use of these materials all of which were approved by the NJDEP. Broomed concrete surfaces would be less desirable.

3) **Lighting.** It is important not to overlight the walkway. Drawings in NJT's application show lighting on 20' centers. We believe that the best lighting consultants would recommend 1 fc which meets the EIS standards. Overlighting would tend to degrade views of Manhattan and make other adequately lit areas appear by contrast dark. Perhaps NJT should utilize a lighting consultant to assist with this. A firm that we can recommend is H.M. Brandston & Partners in New York who are considered one of the best lighting consultants in the world.

This letter is intended to open up a dialogue on these issues. We are interested in being involved with NJT on an on-going basis as the walkway design continues. The Fund for a Better Waterfront has played a constructive role elsewhere and would like to do the same at the Hoboken Terminal. We look forward to your response and thank you for this opportunity to participate on this important project.

Sincerely yours,

Ron Hine

Ron Hine
Administrator

cc: Herman Volk
Mark Gordon

NJ TRANSIT
The Way To Go.

January 27, 1998

Carl Nordstrum
Deputy Director
State Parks & Forestry
New Jersey Department of Environmental Protection
501 East State Street
P.O. Box 404
Trenton, N.J. 08625-404

Dear Carl:

Integral to our application to NJDEP for a Waterfront Development Permit with which to fill the Long Slip canal penetrating the Hoboken rail yard in Hoboken, we have offered a suite of mitigations including the enhancing or creation of tidal salt marsh wetlands at Liberty State Park. In the course of meetings leading up to the filing of the application, I had gathered from various regulators and members of the environmental community that such an action, in combination with other elements of the project, would be looked upon favorably in mitigating the elimination of 4.5+ acres of surface water, and would in fact be easier to accommodate in the context of the necessary permits than some of the more unconventional mitigations offered in association with the project. Consequently, I called you to discuss the reality of a Liberty State Park wetlands initiative under the sponsorship of the Long Slip fill project.

As we begin formal permit review in February (presuming findings of completeness by NJDEP and the U.S. Army Corps of Engineers), it will be necessary to understand more precisely what opportunities are truly available, the acreage at issue, and the approximate costs of either enhancing/improving or creating new wetlands at the Park. For creation of new uplands the mitigation requirement is typically 1:1; we would therefore need to create approximately 4-5 acres. For the improvement of existing poor quality wetlands the mitigation requirement is usually worked out between 2:1 and 3:1, so we need to find approximately 8-12 acres. Or some combination of 1-2 new acres and 4-8 improved acres.

My instinct is that the project budget can withstand around $1 million for this kind of mitigation, if it is accepted completely as an alternative to our other main habitat-related mitigation, the creation by dredging of a deep water fish habitat at the mouth of the Slip and the inter-pier area within the shoaled area inside the pierhead line. Some regulators and environmental community participants were concerned that such an initiative, while interesting and progressive, might be difficult to accord permanent mitigation credits, due in part to the possibility that it would eventually infill again, and in part to the unusual nature of the proposal, relative to precedent.

One Penn Plaza East, Newark NJ 07105-2246 (201) 491-7000

Please let me know how we might proceed to pin down with greater precision the Liberty State Park options, so that we can resolve final mitigation agreements with the relevant regulators. The complexities or the project, which involves construction of a riverfront pedestrian walkway, extension and upgrading of two combined sewers, creation of the proposed fin-fish habitat and/or wetlands creation at the Park, make the need to resolve the specific mitigations especially critical before we move into engineering design.

You can reach me at the below address or at 973-491-7210. Thank you for your attention to this issue. Speak with Rob Piel about the application specifics; he has a copy should you need to review pertinent sections.

Sincerely,

Steve Jurow

cc: J. Porrovecchio, N. Valente, V. Truncellito

THE JERSEY CITY SEWERAGE AUTHORITY

555 ROUTE #440 · JERSEY CITY, NEW JERSEY 07305

TEL: (201) 432-1150 · FAX: (201) 432-1576

November 17, 1997

Mr. Steven Jurow
NEW JERSEY TRANSIT
One Penn Plaza East
Newark, New Jersey 07105

RE: LONG SLIP CANAL

Dear Mr. Jurow:

The Jersey City Sewerage Authority's (JCSA) Eighteenth Street regulator presently discharges its Combined Sewer Overflow (CSO) into the Long Slip Canal.

New Jersey Transit (NJT) plans to fill the Long Slip Canal as part of the Hoboken Rail Yard Rehabilitation Project. To effectuate this filling of the Long Slip, NJT proposes to relocate the CSO outfall and extend said outfall to, at a minimum, the bulkhead line. The final alignment of the outfall extension must still be determined with input from all affected parties, including the City of Jersey City. As part of this extension, NJT plans to install netting facilities and sedimentation basins to insure that the CSO discharge meets or exceeds the USEPA nine minimum control requirements.

NJT will be responsible for the design of these outfall improvements, either through their own engineers or through agreement with the JCSA, and for construction of the improvements as part of the HBLRTS project.

Upon completion of the construction of these improvements, in accordance with a properly completed design and in accordance with all local, state and federal laws and regulations, it is proposed that the JCSA, through agreement with NJT, will accept ownership of the improvements and perform all operations and maintenance of said improvements.

The JCSA believes that this proposal, as herein described, is an acceptable way to accomplish the goals of both agencies and we endorse your efforts to improve water quality. An agreement, however must be approved by resolution of the JCSA Board of Commissioners.

Very truly yours,

William A. Macchi
Executive Director

JFB/ljl

cc: Honorable Board of Commissioners
Joseph F. Beckmeyer, P.E., Chief Engineer
Brian C. Doherty, Esq, General Counsel
Mark Del Bove, Malcolm Pirnie

J Transit, Other community interests want to help

JPDATE

MIDTOWN MADNESS

PHOTOS BY RICHARD RASKA

Commuters on one of NJ Transit's Midtown Direct cars. Conductors often cannot get through the crowded aisles to collect tickets, and some passengers complain they can ride for weeks without being able to sit down.

NJ Transit tries to ease 'cattle cars'

By P.L. Wyckoff
STAR-LEDGER STAFF

With more people than ever hopping trains, NJ Transit has a tough problem to solve: It's way too popular.

Ridership on all NJ Transit lines is up a healthy 18 percent in the past five years and commuters complain of overcrowding and poor on-time performance on the most heavily used lines.

Those problems can't be solved by just adding cars or more lines, NJ Transit officials said. Instead, the agency is looking at some rather unusual alternatives, such as double-decker cars to haul more people down the track.

A regional planning group, Access to the Region's Core, has even suggested digging a new rail tunnel under the Hudson River that would allow trains from New Jersey to go into Grand Central Station, a multi-billion-dollar proposal that hasn't yet been reviewed by the agencies that would have to pay for it.

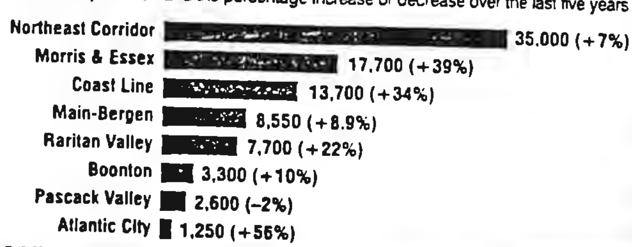
"We wish there was a simple solution, but there really isn't," said NJ Transit chief Shirley DeLibero. Platforms are too short on some routes to just add cars, and main train hubs can handle only so many trains per hour, officials explained. New York's Penn Station is overloaded but expansion there is years

PLEASE SEE TRAINS, PAGE 22

Riders wait to board Midtown Direct in New York's Penn Station. "They're putting two gallons of water in a one-gallon bottle," complains one passenger.

Ridership: A big bump on the rails

NJ Transit's average weekday peak-period train ridership (from 6:30 a.m. until a little after 9 a.m.) for 1997 and the percentage increase or decrease over the last five years



THE STAR-LEDGER SOURCE: NJ Transit

Trains

CONTINUED FROM PAGE ONE

Midtown Direct way too popular

away, they added.

Last week, the railroad hande out flyers explaining these and other logistical difficulties to disgruntled riders and DeLibero and other top N Transit execs gathered at New York Penn Station to answer commuter questions. On Monday, DeLibero and state Transportation Commissioner John J. Haley Jr. will meet with com muters there again in a roundtabl discussion.

Midtown Direct, a service intro duced 18 months ago, diverted some train traffic away from Hoboken an Newark's Penn Station, alleviatin crowding problems there, at least fo now.

But ridership on Midtown Direct is 200 percent more than was pr jected. Every weekday, it funne 7,600 people from Morris and Ess counties directly to the Manhatta train station's crowded platforms.

It has been standing room only many cars ar some rush-ho commuters clai they stand on the platform a let trains pass until one fina comes along wit enough room for them to cro in. So many pe ple stand aisles that conductors frequently ca not get through to collect tickets. As Maplewood lawyer Ellen Zimiles de scribed it, "It's sort of a cattle- feel."

DeLUCA

Like on other lines, people w get on early along the route can get a seat. But they have the same chance as anyone else crowding on for the turn trip.

Efforts to solve those proble on Midtown Direct are a case exam ple of how complex the task is.

Two weeks ago, NJ Transit add extra seats to rush-hour trains cre ing a total of 470 more places to sit

"It's the first time I've sat in a month," said Tracy Chestnutt, a pharmaceutical worker taking t 7:47 a.m. from Maplewood last wee

Standing a few cars ahead, Gus Frangos, an art designer, wasn't as lucky. "I haven't sat down in three weeks," he said.

Their train is always one of the most packed on the Midtown Direct runs, so NJ Transit added a ninth car. Each car can carry 113 to 130 passengers — except for the brand new cars recently bought by NJ Transit. They have larger bathrooms and other space designed to meet the requirements of the Americans with Disabilities Act. As a result, they can accommodate only 104 to 113 passengers.

The act requires those newer, smaller cars to be phased in on all routes as older cars are taken out of commission.

FRANGOS

Realizing that an extra car here and there wouldn't significantly reduce crowding, NJ Transit also shifted some of those newer but smaller cars off Midtown and brought back the older ones.

They couldn't continue to just add more cars. Space in New York's station, as well as in the New Jersey yards where trains are put together, limit the number of cars.

To solve crowding on Coast lines, extra cars were added. But those routes end at Newark's Penn Station, where long platforms can handle longer trains with no problem. The short platforms at Penn Station in New York limit how long trains stopping there can be, officials explained.

Also, trains originating in Dover can't be lengthened much because they would then block local streets at grade rail crossings. And the Gladstone storage yard is at capacity, so cars can't easily be added to trains starting there.

Those sorts of constraints have prompted the look at double-decker cars, Haley and DeLibero said. The MBTA, Boston's transit agency, has used them for several years and Haley said he wants to borrow one to test it here.

Ten of the cars also have been tested on Long Island Railroad's Port Jefferson line and the LIRR plans to buy 134 more over the next three years, officials there said.

The cars have two levels like a London bus, and passengers love them, Haley said. He said the testing idea is in the discussion stage and that numerous practical questions need to be answered first, including whether they would fit under the electric wires that serve the tracks.

The cars can cost up to $1.5 million apiece and its two levels can accommodate up to 150 people, about 40 more than the new cars NJ Transit has been phasing in.

However, most railroads have been setting up the seating plan for just 130 riders. But NJ Transit officials said even the gain of 10 seats, multiplied by how many cars a train has, significantly adds room.

"They may be part of a solution to the capacity issue," Haley said, but it probably would take 18 months to two years to get them if they turn out to be usable.

Some riders complain that crowding isn't the only problem NJ Transit needs to address. Trains don't run on time and don't run often enough, said commuter Deborah Greenberg of Maplewood.

"They need more service, not just more cars," she said.

NJ Transit added five minutes or more to Midtown Direct trains to give them a better shot at getting into Manhattan on time. But with the limited number of arrival "slots" available at Penn Station during rush hours, trains must "taxi" for position, stacking up like airplanes around Newark International Airport on a busy holiday weekend.

And when the train finally does pull in, the narrow platforms so jam with commuters that often the crowd is stuck shoulder-to-shoulder, trying to move.

"They're putting two gallons of water in a one-gallon bottle," complained Vic DeLuca of Maplewood as he and hundreds of others shuffled in a wriggling mass wedged between two trains.

DeLuca's morning train arrived

PLEASE SEE MIDTOWN, PAGE

Year-by-year growth

Average weekday peak-period ridership (from 6:30 a.m. until a little after 9 a.m.)

LINE	1992	1995	1996	1997	5 YR % INCREASE
Northeast Corridor	32,700	33,050	33,750	35,000	+7%
Coast Line	10,200	12,350	12,650	13,700	+34%
Morris & Essex	12,700	14,400	14,850	17,700	+39%
Raritan Valley	6,300	7,350	7,600	7,700	+22%
Main-Bergen	7,850	8,500	8,850	8,550	+8.9%
Boonton	3,000	3,350	3,400	3,300	+10%
Pascack Valley	2,650	2,650	2,700	2,600	-2%
Atlantic City	800	1,150	1,200	1,250	+56%

SOURCE: NJ Transit

Christine Todd Whitman
Governor

State of New Jersey

Department of Environmental Protection

Division of Parks and Forestry
PO Box 404
Trenton, NJ 08625-0404
Tel. #609-292-2733
Fax #609-984-0503

Robert C. Shinn, Jr.
Commissioner

March 13, 1998

Steve Jurow
NJ Transit
One Penn Plaza
Newark, NJ 07105-2246

Re: Potential Wetland Mitigation Sites – Liberty State Park

Dear Mr. Jurow:

I am writing to you in response to your correspondence of January 27, 1998 and our follow up discussions with the Department of Environmental Protection, Land Use Regulation Program (LURP) regarding the use of areas within Liberty State Park as mitigation for your project in the Hoboken Rail yard.

Please be advised that the Division of Parks and Forestry is receptive to meet and discuss this potential initiative with you providing the following criteria are met.

1. The enhancement and/or creation of wetlands within the park must be developed and integrated into our natural resource interpretive program at the park and allow for public access and wildlife habitat without restrictions. This would require the development of "clean" sites resolving all contamination exposure issues associated with their public use and use as wildlife habitat.

2. The mitigation sites to be considered are those north of the Liberty Science Center and the 35-40 acre site northeast of our existing interpretive center across Freedom Way.

3. The creation of the one-acre wetland mitigation site required by LURP for our development of the "Green Park" shall be constructed by NJ Transit in consideration for the use of Liberty State Park as a mitigation site for your Hoboken project.

15 acres
$ 100. 200 K/acre
1.5-3

.5
2-3.5

4. All plans for the development of such shall be reviewed and approved by the Division of Parks and Forestry prior to any construction activity.

Steve Jurow
Page 2
March 13, 1998

Please review and if the above noted conditions meet with your approval, I recommend you convene a meeting with representatives from the Division of Parks and Forestry, LURP and your consultant to initiate the design and permit process.

Thank you for your cooperation on this most worthwhile project and we await your response.

Sincerely,

Carl R. Nordstrom
Deputy Director

CRN/rm

c. Assistant Commissioner James Hall, DEP
Director Gregory A. Marshall, DPF
R. Barker, DPF
P. Sedor, DPF
P. Straw, DPF
A. Payne
R. Piel, LURP
L. Baier, LURP

Piel, Nordstrom
Danti & Hle

New Jersey Department of Environmental Protection
Land Use Regulation Program

Meeting Attendance Sheet

Date: 4-14-98 **Subject:** Waterfront Permit Application - Hoboken Terminal - Long Slip

Note: The guidance provided at a pre-application meeting is not binding upon the Department, in accordance with N.J.A.C. 7:7A-10; N.J.S.A. 58:16A-50 et.seq; and N.J.S.A. 12:5-3. Therefore, the Department shall in no way commit itself to approval or rejection of a proposed project as a result of these discussions. By attending this meeting all acknowledge this standard.

Name	Title	Telephone #	Affiliation
1. Jonathan D. Berg	Supv. Envl. Spec.	609 633-0737	Site Remediation BFCM
2. Joel A. Pecchioli	Principal Env. Specialist	(609) 292-2662	NJDEP - Program Coordination
3. Suzanne Dietrick	Prin. Env. Specialist	(609) 633-5577	NJDEP - LURP
4. Steve Jurow	Mgr. Environ.	973 491-7210	NJT - Environmental
5. Eugene Peck	Sr. Envir Scientist	914 735-1200	Dames & Moore
6. J Porrovecchio	Director Project Management	914 735 1200	Dames & Moore
7. R. Schneider	Site Planning & Engineering	908 272 8300	Dames & Moore
8. Vincent Truncellito	Mgr. Project Planning	973 491-7810	NJ Transit
9. Nick Valente	Supervisor	973-491-7211	NJT
10.			
11.			
12.			
13.			
14.			
15.			

NJ TRANSIT
The Way To Go.

April 28, 1998

Ms. Letitia Thompson
Regional Administrator
Federal Transit Administration
26 Federal Plaza, Suite 2940
New York, New York 10278-0194

Re: Long Slip Canal Habitat Creation Project

Dear Ms. Thompson:

As required by the U.S. Department of Transportation Act, I am enclosing three copies of the **Long Slip Canal Habitat Creation Project Section 4(f) Evaluation Report** for your review and transmittal to the U.S. Department of the Interior and the Advisory Council on Historic Preservation. This report was prepared to determine that all feasible and prudent alternatives to the adverse effect on Long Slip Canal were evaluated prior to implementation of the project. In accordance with the State Historic Preservation Officer's recommendations, a Memorandum of Agreement was drafted to mitigate the adverse effects of the filling of Long Slip Canal on the Old Main Delaware, Lackawanna and Western Railroad Historic District. The agreement was sent to your office for review on March 23, 1998.

The Long Slip Canal Habitat Creation Project is a component of the overall Hoboken terminal and rail yard rehabilitation effort, which includes restoration of the terminal, an interface with the Hudson-Bergen Light Rail Transit System, and rail yard expansion and infrastructure improvements. Although the impetus to fill the canal is due to the proposed yard expansion, the term "habitat creation" is used to indicate an ecosystem approach to comprehensively address local and regional water quality problems with the objective of creating a sustainable fish habitat where none could otherwise exist. Environmental benefits will include the restoration of inter-pier fisheries habitat and improved water quality. Commuters and local residents will benefit from the creation of up to three acres of new public access to the waterfront.

The primary objectives of this project are to increase the train storage capabilities and improve the efficiency of train operations at the Hoboken Terminal rail complex and upgrade obsolete, antiquated equipment and facilities that are expensive to maintain. Numerous alternatives were identified and evaluated on their ability to satisfy those objectives while avoiding or minimizing adverse environmental, social, or economic impacts. The primary objectives were not fully satisfied by most

One Penn Plaza East, Newark NJ 07105-2246 (201) 491-7000

of the alternatives considered, and only an alternative involving the filling of Long Slip Canal was concluded to effectively meet those objectives.

Should you or your staff have questions concerning the enclosed report or require additional information, please call me at (973) 491-7839.

Sincerely,

Kay Regan-DeCicco

Catherine Regan-DeCicco
Senior Director of Capital Funding

Copy w/enclosure to: Maisie Grace
Copy w/o enclosure to: Anthony G. Carr
Carmen Orta

PROJECT MEETING RECORD

Long Slip Canal - DEP Water Quality Model Review Meeting of 4/9/98

Prepared by N Valente, NJ Transit, 4/10/98. Attendance sheet attached.

1. Larry Baier's first concern over the application: He & Rob Piel are not convinced that filling outside the canal and dredging the basin area is an improvement or satisfactory mitigation. Unless convinced otherwise, vis-a-vis the response document and Suzanne Dietrick's review, he would rather see wetlands mitigation at Liberty State Park. Mitigation is permissible on public lands under the Coastal Wetlands Protection Act rules. It is legislatively prohibited by the Freshwater Wetlands Protection Act, but DEP is also considering or developing an internal policy that may permit publicly owned wetlands mitigation.

2. His second concern related to fill for public access where we used a walkway/public area argument to support filling the river and that this was an insufficient public need. He indicated that we have to emphasize yard & operating needs. Joe Porrovecchio also presented water quality concerns supporting the outer fill area and this was another item that could support the application. Baier noted DEP generally prefers a diminished water quality habitat to no habitat by filling so the water quality arguments have to be compelling. Joe P noted that Karen Green of NMFS supported the river fill option in Alt. #2 and that she will attend the DEP meeting of 4/14/98 so this can be discussed with Baier directly.

3. Valente showed a plan on how the pile supported walkway and LRT station effectively isolates water pockets in Alternative #1 and noted the expense of the 8 foot diameter caissons for the LRT pier. Baier was emphatic that we should not include the LRT in the needs analysis to fill the river, pointing out that the LRT Waterfront Development Permit showed that non-fill option existed with a pile supported structure. (Writer's note: The Corps on the other hand wants us to link the issues.) D&M will address the incremental cost benefits (and safety factor?) by constructing on fill vs piles (Schneider and Peck to resolve).

4. Dietrick emphasized the need to have Hoboken endorse the sewer extension plan. Valente reviewed the cost sharing negotiations and the need for Hoboken the sign the TWA. She also noted that L.U.R.P. will likely require NJ Transit to install the floatable control/netting system to gain immediate water quality improvements and some credit for impact mitigation.

5. Joel Peccioli indicated that wetland mitigation plans have required 5 year monitoring to assure compliance or the applicant must provide additional mitigation work. Valente affirmed that NJ Transit would do the water quality and fish monitoring but that we want to specify the contingency mitigation effort now to detail our project/cost requirements other than deal with open-ended commitments.

6. Dr. Gary Zarillo presented the WQ model. DEP's main concerns involved:

- including the Hoboken CSO's and use data from the CH2MHill reports;
- including the Malcolm Pirnie WQ data for the JCSA CSO;
- the model's prediction of current DO conditions with no fill and the CSO loads;
- the model's prediction of current DO with no fill and the CSO loads extended into the river;

Baier said he wanted to see the CSO extensions and whether it showed no impact (vs the impacts of filling in the river outside of Long Slip to improve water quality).

7. Porrovecchio & Zarillo further reviewed the model results and the conditions that were assessed. This lead to a consensus that some additional model runs were warranted to address:

- Existing conditions with the revised loading data;
- Existing conditions with the revised loading data and CSO extended to the river;
- HBLRT **pile** supported with 80,000 cu.yd.. of dredging to limit the disturbed footprint;
- HBLRT *fill* supported with 80,000 cu. yd. of dredging;
- HBLRT **pile** supported without any cut/dredging;
- HBLRT *fill* supported without any cut/dredging;
- Choose a selected case(s) and determine the impact of diffusers on the water quality.

This report was submitted in draft form to the NJT/D&M attendees on 4/10/98. If no comments are made by 4/15/98, then the record will stand as final.

Nicholas J. Valente, P.P.   Date   Draft   Final

Minutes of Meeting

Project: Long Slip Habitat Creation
Client: New Jersey Transit
D& M # : 14174-019
Location: North Hudson Sewerage Authority
Attending: Steve Jurow, Nick Valente,(NJT)
Rene' Schneider (D&M)
Michael Bennett, Michael Wilson, (CH2MHILL) for
North Hudson Sewerage Authority
Date: April 27, 1998
Time: 2:00PM-3:45PM
Issuance: April 30, 1998

1. Discussion regarding the reconstruction of the rail yard for the Long Slip Project by Steve & Nick and the questioning by Rene' for information regarding the Park Ave Sewer. Michael Wilson provided table 1-2 of CH2MHILL's SWMM analysis of area CSOs that provided maximum peak flows of 71.5 and 147 cfs for regulators HO and H1 respectively, at low tide. It was indicated by Michael Bennett that the figures were base[d] model~~ing~~ and it assumed no impediments in the respective culverts from the regulators to Long Slip.
2. Michael Wilson provided a plan and profile of the Park Avenue sewer from regulator HO to Long Slip. This was a letter size sheet, # H-O-2 by Killam Associates and dated 01/10/96. The profile assumes a consistent gradient from the regulator to the outfall at Long Slip. Discussion took place regarding what the maximum pipe sizes could be for the cleaning and slip lining of the existing culvert, when assuming Killam's consistent sewer gradient, which need be compliant with NJT criteria for crossings under active rail lines.
3. Steve Jurow requested that Rene' assess several options for the Park Avenue sewer's rehabilitation, meet and discuss options with CH2MHILL. Rene' to meet with them within the next to weeks.
4. CH2MHILL to assess several additional SWMM models within the next 4 weeks to ascertain if a by pass from regulator HO to H1 would provide a more desirable solution than the slip lining and cleaning the Park Avenue sewer.
5. Steve indicated that the responsibility for assessing the condition of the twin 48-inch diameter culverts under the train shed and identifying the exact location and invert of their outfall at Long Slip would be the responsibility of North Hudson.. Steve further indicated that New Jersey Transit might be inclined to contribute a total of $700K to North Hudson to facilitate improvements to their system. ?

Post Script: ~~Editors Note~~ we [illegible] a great need to assess the location + condition of the twin 48" culverts. CH2MHILL should investigate the requirements to do the work + mobili[ze] the divers if the HO-H1 bypass model results are favorable.)

The aforementioned minutes are Dames & Moore's understanding of the meeting and we will proceed in reliance thereof unless notified within 7 days of issuance.

NJ TRANSIT
The Way To Go.

MEMORANDUM

TO: Steve Jurow

FROM: Albert R. Hasbrouck III *arh*

DATE: June 19, 2000

SUBJECT: **CLOSEOUT: NOTICE OF PUBLIC NOTICE OF AVAILABILITY OF THE DRAFT ENVIRNOMENTAL ASSESSMENT FOR THE PROPOSED LONG SLIP CANAL HABITAT CREATION PROJECT**

The following are for your files:

Public Notice:
See attachment

Newspapers:
Jersey Journal
Star Ledger
La Voz
The Record

Publishing Dates:
March 31, 2000
April 17, 2000

Public Comments:
See attached request

Service List:
See attached

NJ TRANSIT PUBLIC NOTICE

NJ TRANSIT PUBLIC NOTICE
OF AVAILABILITY OF THE DRAFT ENVIRONMENTAL ASSESSMENT
FOR
THE PROPOSED LONG SLIP CANAL HABITAT CREATION PROJECT

The Federal Transit Administration (FTA) and New Jersey Transit Corporation (NJ TRANSIT) hereby announce the availability of the Final Draft Environmental Assessment (EA) and Section 4(f) Statement for the **Long Slip Canal Habitat Creation Project** for public review and comment.

The Long Slip Canal Habitat Creation Project draft documents the social, economic, and environmental impacts of filling the Long Slip canal at NJ TRANSIT's Hoboken rail yard, which is located in the cities of Hoboken and Jersey City, both in Hudson County, New Jersey. The project involves:

1. Fill to existing grade 4.6 acres of open water contiguous with the Hudson River, known as the Long Slip (canal), measuring approximately 100 feet in width, oriented east-west, and projecting approximately 2,000 feet west from the bulkhead line into the rail yard;

2. Construct a waterfront pedestrian walkway which satisfies New Jersey Department of Environmental Protection guidelines and design requirements bridging the Slip at the limit of the filled portion;

3. Enhance solids floatable control and sediment capture capabilities of a Jersey City combined sanitary and storm sewer and extend it to a new outfall beyond the planned eastern limit of fill;

4. Enhance solids floatable control and relocate North Hudson Sewer Authority (Hoboken) combined sewer outfalls to a new outfall location north of Hoboken Terminal,

5. Create a fin-fish habitat area at the mouth of the Slip, east of the limit of fill, through improvements to water quality;

6. Contribute to the enhancement and/or creation of 9.6 acres of tidal wetlands at the Marsh Resources wetlands mitigation bank site on the Hackensack River.

The Draft EA describes: (1) the purpose and need for the project; (2) alternatives to the proposed action; (3) design modifications incorporated into the project to minimize its impacts on the natural environment; and (4) additional project elements designed to mitigate those environmental impacts of the project which cannot be avoided.

Federal funds will be sought to implement this project. The non-federal share will be provided by the State of New Jersey. A copy of the ***Final Draft Environmental Assessment and Section 4(f) Statement for the Long Slip Canal Habitat Creation Project, Hoboken Yard, Hoboken, New Jersey*** is available for review and comment by any individual, citizen group or public agency during normal business hours at the following locations:

New Jersey Transit Corporation Headquarters
One Penn Plaza East
Newark, New Jersey 07105-2246
Contact: Albert Hasbrouck, III
Telephone: (973) 491-7022

U.S. Department of Transportation
Federal Transit Administration
One Bowling Green, Room 429
New York, New York 10004-1415
Contact: Anthony Carr
Telephone: (212) 668-2170

Hoboken Public Library
Reference Department
500 Park Avenue (Entrance on 5th Street)
Hoboken, New Jersey
Contact: Bruce Massis, Director
Telephone: 201-420-2280

Jersey City Main Library
472 Jersey Avenue
Jersey City, New Jersey 07302
Contact: Sonya Araujo, Asst. Dir.
Telephone: 201-547-4549

Jersey City Five Corners Library
678 Newark Avenue
Jersey City, New Jersey 07302
Contact: Ms. Susan Stewart
Telephone: 201-547-4543

All interested persons may express their views and concerns concerning the environmental effects of the project. Members of the public may submit written comments concerning the findings of the environmental assessment or any additional remarks relative to the project. All written comments received by mail will be given equal weight and will be made part of the record. Written comments may be sent to Albert R. Hasbrouck, III, Senior Director, Corporate Affairs, NJ TRANSIT, One Penn Plaza East, Newark, NJ 07105-2246 by **May 1, 2000**.

This notice is published in accordance with the public notice requirements of 23 CFR, Section 771.119(f) as published in the Federal Register Vo. 52, No. 167, Rules and Regulations.

Jeffrey A. Warsh
Executive Director
New Jersey Transit Corporation

4714

STATEof NEW JERSEY } **SS.**
HUDSON COUNTY

Akema Robertson of full age, being duly worn, according to law, on his oath deposes and says that he is the bookkeeper of

THE JERSEY JOURNAL

newspaper printed and published in Jersey City, County and State aforsaid, and that a notice, a true copy of which is annexed, was published in the said newspaper on the following dates: march 31, 2000

Akema Robertson

Akema Robertson

Sworn to and subscribe before me this

31st day of march A.D. ~~1999~~ 2000

Carole J Brady

Carole J. Brady

Notary Public New Jersey

NJ TRANSIT PUBLIC NOTICE
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New Jersey Transit Corporation Headquarters
One Penn Plaza East
Newark, New Jersey 07105-2246
Contact: Albert Hasbrouck, III
Telephone: (973)491-7022

Carole J. Brady
Notary Public of New Jersey
My Commission Expires June 24, 2002

NJ TRANSIT PUBLIC NOTICE
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New Jersey Transit Corporation Headquarters
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Newark, New Jersey 07105-2246
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Jersey City, New Jersey 07302
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This notice is published in accordance with the public notice requirements of 23 CFR, Section 771.119(f) as published in the Federal Register Vo. 52, No. 167, Rules and Regulations.

Jeffrey A. Warsh
Executive Director
New Jersey Transit Corporation
One Penn Plaza East, Newark, NJ 07105-2246
$381.00
(973)491-7000

STATE OF NEW JERSEY }
COUNTY OF ESSEX } SS

Being duly sworn, according to law on his oath sayeth that he is Clerk of the Star-Ledger, in said County of Essex, and that the notice, of which the attached is a copy, was published in said paper on the 17 day of April 2000 and continued therein for ________ successively, at least once in each ________ for [illegible]

Sworn to and subscribed before me this 18 day of April 2000

Donna M. Clement
NOTARY PUBLIC of NEW JERSEY

DONNA M. CLEMENT
NOTARY PUBLIC OF NEW JERSEY
My Commission Expires Mar. 5, 2003

Encuentro de Candidatos a la Jta. de Educación, Eliz.

Por: Edwin Ocasio

A sólo varios días para la celebración de los comicios donde se elegirán los nuevos delegados a la Junta de Educación, los dos equipos en contienda realizaron un debate público convocado por la Asociación de Padres y Profesores (P.T.A.) del sistema educativo de la ciudad de Elizabeth. Durante el foro, realizado en el Auditorio Dwyer en la Elizabeth High School recientemente, los seis candidatos que componen los dos equipos que irán a las urnas el próximo día 18 del mes en curso, contestaron preguntas del público y plantearon lo que, según ellos, serían las soluciones a los problemas que en la actualidad confronta el sistema de educación de la ciudad.

Eduardo Dias, Carole Casio y David Lewis.

El grupo #3, #4 y #6 integrado por el Dr. Peter Lenahan, Jessica García y Andrea Martínez enfrentarán el próximo martes 18 de abril al equipo 1, 2 y 6 integrado por el incumbente Eduardo Dias, Carole Casio y David Lewis.

El grupo #3, #4 y #6 integrado por el Dr. Peter Lenahan, Jessica García y Andrea Martínez.

Hace apenas dos semanas, el equipo #3,#4,#6 de Lenahan, García y Martínez pidierón al Departamento de Educación realizar una investigación por alegado despilfarro de fondos y favoritismos políticos practicados por la actual Junta de Educación de Elizabeth y su presidente Rafael Fajardo.

Entre los problemas que merecen atención inmediata dentro del sistema educativo, el Dr. Peter Lenahan mencionó la falta de maestros y la necesidad de más salones de clases ya que según explicó, en la actualidad hay de 41 a 43 estudiantes por salón.

La Navidad Llega Tarde a Eliz. Ave.

ELIZABETH- El sábado 8 de abril la Elizabeth Avenue Parnership estará organizando una fiesta en la pizzería situada en el 871 Elizabeth Avenue para algunos niños especiales de la ciudad de Elizabeth.

Esta fiesta se realiza para responder a todas esas cartas escritas a Papa Noel la Navidad pasada.

El Buzón de Papá Noel es un programa de Navidad de 1999, el cual también incluía el primer árbol alumbrado de la avenida y 143 alumbrados a lo largo de la misma, un concurso de la mejor vidriera decorada y dos visitas de Papá Noel al Banco Popular donde niños de todas las edades se tomaron fotos gratis junto a él.

Ralph Salerno, Presidente de Elizabeth Avenue Parnership y propietario de Tri-State Furniture dijo, "Después de revisar las cartas, nuestro comité sabía que Papá Noel nos respondería ·nos conmovió la sinceridad de los niños. La fiesta empezará a la 1:30 pm y los niños que asistan recibirán regalos y certificados".

El comité está poniendo los toques finales en mercadeo y horarios de promoción que incluirán, promociones dentro de la tienda y regalos para atraer más clientes a Elizabeth Ave.

GALLEY 021, E-S A1,
]ATE 04-17-00

NJ TRANSIT PUBLIC NOTICE OF AVAILABILITY OF THE DRAFT ENVIRONMENTAL ASSESSMENT FOR THE ?ROPOSAL LONG SLIP CANAL HABITAT CREATION PROJECT

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w Jersey Transit Corporation adquarters
e Penn Plaza East
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Jeffrey A. Warsh
Executive Director
New Jersey Transit Corporation
March 31, April 17-fee:$238.32 (138)

State of New Jersey, ss.,
County of Bergen.

Peggy L. Neill
....

of the said County, being duly sworn, say that she is Accounting Clerk for The Record, a newspaper published and printed in Hackensack, in the County of Bergen aforesaid, and that the notice of which the annexed is a printed copy, was published in the said newspaper on

3-31-00
4-7-00
....

Sworn and subscribed to before
me on Apr 17 2000 Marie Kasetta
....
Notary Public of N. J.

MARIE KASETTA
NOTARY PUBLIC OF NEW JERSEY
My Commission Expires Feb. 23, 2005