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New York District

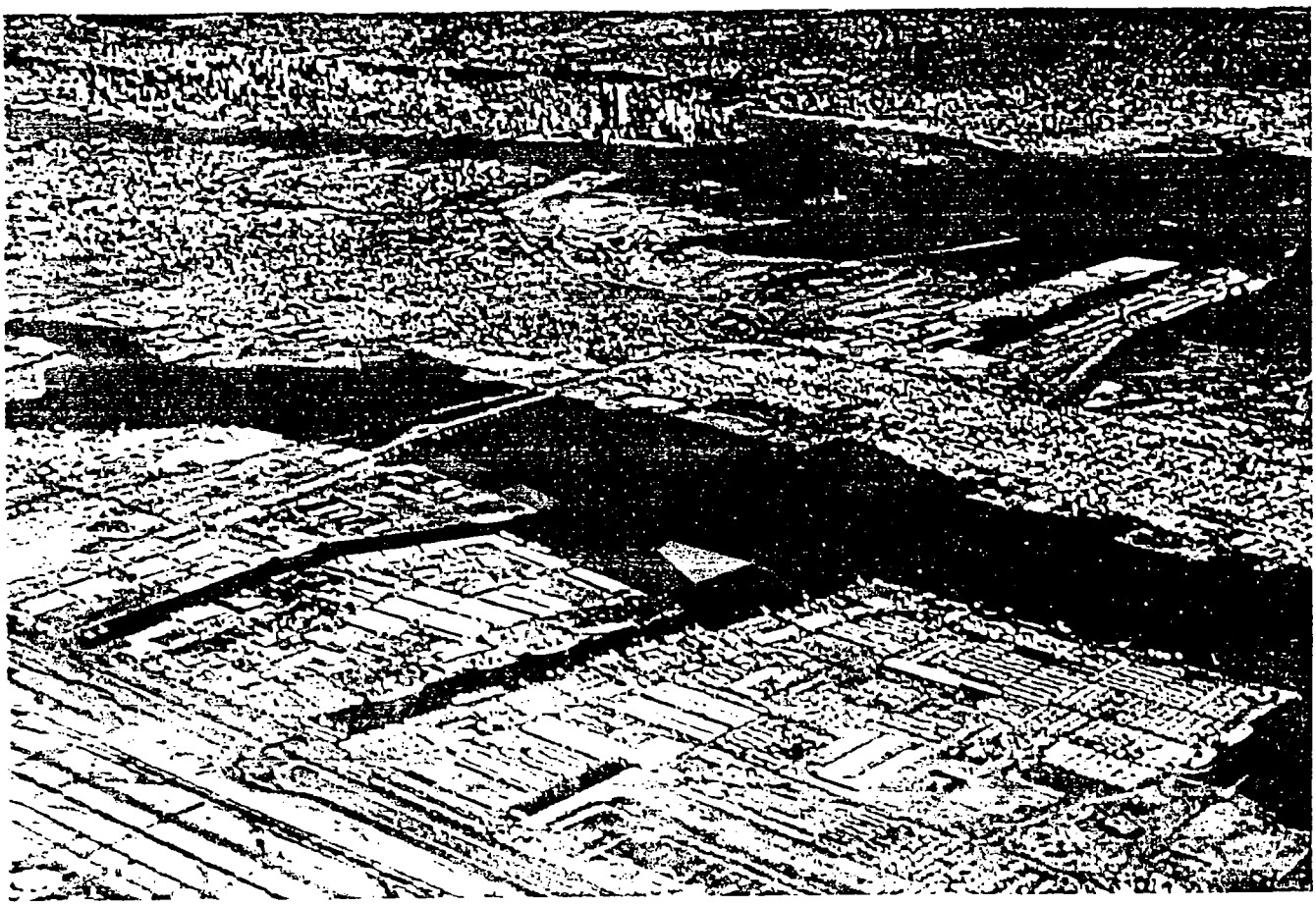


Final Environmental Impact Statement

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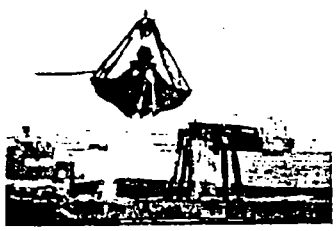
Newark Bay Confined Disposal Facility

April 1997



In Cooperation with

U.S. Environmental Protection Agency
U.S. Fish and Wildlife Service
National Marine Fisheries Service
N.J. Department of Environmental Protection
N.J. Department of Transportation





FINAL
ENVIRONMENTAL IMPACT STATEMENT
ON THE
NEWARK BAY CONFINED DISPOSAL FACILITY

April 1997

Responsible Lead Agency
U.S. Army Corps of Engineers
Regulatory Branch
Jacob K. Javits Federal Building
New York, New York 10278-0090

Cooperating Agencies
U.S. Environmental Protection Agency
U.S. Fish and Wildlife Service
National Marine Fisheries Service
New Jersey Department of Environmental Protection
New Jersey Department of Transportation

Abstract:

In accordance with the National Environmental Policy Act (NEPA), and the U.S. Army Corps of Engineers (USACE) regulations for implementing NEPA, a Final Environmental Impact Statement (FEIS) has been prepared as part of the permit application review process for the Newark Bay Confined Disposal Facility (NBCDF).

Dredging of shipping channels and berthing areas in the Port of New York and New Jersey is necessary to maintain sufficient water depths for safe navigation and maintenance of a viable shipping industry. In recent years this has been hampered by the lack of disposal sites for dredged material. The NBCDF is proposed as an environmentally acceptable short-term method of disposing of contaminated dredged material.

The concept for the NBCDF came from New Jersey Governor Christine Todd Whitman's Dredged Material Management Team (DMMT), which recommended the construction of sub-aqueous borrow pits in Newark Bay as a short-term alternative for the disposal of contaminated dredged material deemed unsuitable for ocean disposal. The team selected the Newark Bay sites because they are located in an area of maritime activity with a history of previous environmental impacts. At the Governor's request, the Port Authority of New York and New Jersey agreed to initiate action and serve as the project sponsor. The NBCDF, as described in this FEIS, is an outgrowth of the DMMT recommendation.

The current application proposes to construct three subaqueous pits with a combined capacity of approximately 3 million cubic yards (MCY) on the west side of Newark Bay near the Port Newark-Port Elizabeth terminals. The dredged material that would be disposed of in the NBCDF would come from waters in New York-New Jersey Harbor contiguous to the State of New Jersey, including Newark Bay, the Arthur Kill, and the Kill Van Kull. Alternatives to the proposed action, described and evaluated in Chapter 2, include construction of only one of the three proposed CDFs, construction of a CDF on the east side of Newark Bay, construction of CDFs on both sides of the Bay, and taking no action. Other alternative disposal options, including but not limited to upland disposal, aquatic peninsulas or containment islands, and

borrow pits in other areas (including other parts of Newark Bay) are described and evaluated in the same chapter.

The database for evaluation of the affected environment and potential impacts included all available literature on the environment and flora and fauna of Newark Bay, a field research program that focused on benthos and fish/shellfish, a hydrographic/sedimentation modeling program, and chemical and geotechnical laboratory analyses of Newark Bay sediments. The affected environment is described in Chapter 3 and the environmental impacts in Chapter 4.

Potential impacts, including indirect and cumulative impacts, were evaluated for the proposed action and the other action alternatives. The analysis indicates that short-term adverse environmental impacts, such as benthic habitat disruption, would be balanced by beneficial impacts, such as removal and isolation of contaminants from the biosphere and revitalization of the maritime industry. Long-term adverse impacts are not expected to occur if the NBCDF is built.

Construction practices, management plans, and postclosure monitoring plans and techniques are discussed in Chapter 5. The purposes of the monitoring are to ensure the integrity of the cap and to document the community successions in recolonization of the site(s).

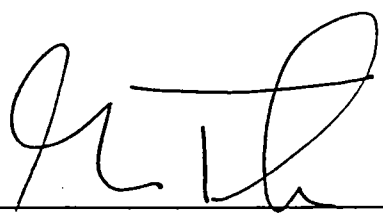
A 404(b)(1) evaluation has been prepared for the NBCDF and is included in the FEIS as Chapter 6. The preliminary determination is that the proposed action and alternatives do not represent a significant threat of degradation to the aquatic environment and are in compliance with the Section 404(b)(1) guidelines of the Clean Water Act.

A public notice announcing the availability of this document will be published concurrently with an announcement of its availability in the Federal Register.

Send written comments to:

U.S. Army Corps of Engineers, New York District
ATTN: Dr. Marc Helman
Regulatory Branch
Jacob K. Javits Federal Building
New York, New York 10278-0090

For further information, or additional copies of this document, write to Dr.Helman at the address above or call him at (212) 264-3912.

Approved by:  1 Apr 97

Gary Thomas
Colonel, U.S. Army Corps of Engineers
New York District Engineer

Date

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S.0 EXECUTIVE SUMMARY

The construction of subaqueous pits in Newark Bay was the primary alternative recommended by New Jersey Governor Christine Todd Whitman's Dredged Material Management Team (DMMT) as a ". . . short-term, environmentally sound, economically viable management option for the disposal of contaminated (Category II and Category III) dredged material . . ." (DMMT 1995). Governor Whitman adopted the report and requested that the Port Authority of New York and New Jersey (PA) take the lead in implementing the recommendation. The Newark Bay Confined Disposal Facility (NBCDF), described in this Final Environmental Impact Statement (FEIS), is the direct result of that original recommendation.

The NBCDF was originally proposed as a two-pit facility (Areas 1 and 2) that together could accommodate approximately 14 million cubic yards (MCY) (10.7 million cubic meters [MCM]) of dredged material deemed unsuitable for ocean disposal. The two sites are located on the west side of Newark Bay, near the Port Newark and Port Elizabeth facilities (DMMT 1995; this document - Section 1.02, Figure 1.02-1). The original two-pit recommendation was based on the assumption that sediment contamination in the project areas was not substantial and existed only to a depth of 3 ft (1.0 m) below the sediment-water interface (DMMT 1995). Subsequent feasibility investigations and historical research revealed substantial areas of disturbance and, locally, sediment contamination to depths greater than 3 ft (1.0 m). The extent of the areas' sediment contamination resulted in the project being redefined as three smaller pits (Areas 1S, 2S, 2N), located within the original areas, with a combined capacity of 3.0 MCY (2.3 MCM) (Section 1.02, Figures 1.02-1 and 1.02-2). During preparation of the Draft Environmental Impact Statement (DEIS), testing to determine the suitability of project area sediments for ocean disposal was conducted; resuits of the sediment evaluation are discussed in the text and in Appendix 1.02.

S.01 PROJECT NEED AND OBJECTIVES

The NBCDF was conceived as a regional facility for the disposal of dredged material deemed unsuitable for ocean disposal. The region (also referred to as the draw area) is defined as waters in New York/New Jersey (NY/NJ) Harbor contiguous to the State of New Jersey, including Newark Bay, the Arthur Kill, and the Kill Van Kull. Sediment buildup, a product of the natural shallowness of the port (average depth 19 ft [6 m]) and high sedimentation rates (6 in./year [15 cm/year]) (Section 4.04), clogs navigation channels and berthing areas. Harborwide, approximately 4 to 6 MCY (3.1 to 4.6 MCM) of sediment must be dredged annually to maintain mandated safe water depths and to deepen existing navigation channels to accommodate deeper-draft vessels that will call at the port in the near future (USACE 1996).

Maintaining navigation channels and berthing areas offers both economic and environmental benefits. The economic benefits related to waterborne commerce in the region

are well known: more than $20 billion in economic activity, up to 200,000 port-related jobs, approximately $47 billion in exports of New York and New Jersey products, and over 70% of arriving containers having the port as their final destination (DMMT 1995; USACE 1996; this document - Sections 3.17 and 4.18).

Retaining and increasing these economic benefits is dependent, in large measure, on providing sufficient water depths to safely accommodate modern container ships and tankers. The loss or reduction in Port of NY/NJ shipping operations would have far-reaching effects on the local and regional economy (USACE 1996).

Concomitant with maintaining economic competitiveness, environmental benefits can accrue from dredging projects. Sediment analyses from various parts of the Harbor reveal varying degrees of residual contamination from previous activities in the port area and related waterways. Contaminants of particular interest are heavy metals (e.g., cadmium, chromium, mercury, zinc), polycyclic aromatic hydrocarbons (PAHs), chlorinated pesticides (e.g., DDT, DDD, DDE), polychlorinated biphenyls (PCBs), and dioxins and furans (e.g., 2,3,7,8-TCDD). Dredging contaminated sediments and disposing of them in a subaqueous confined disposal facility (CDF) can be beneficial. The potential for bioaccumulation and biomagnification of contaminated sediments would be reduced in the short- to mid-term. Longer-term beneficial effects would require remediation/ removal of contaminant sources (Sections 4.17, 4.24).

S.02 ALTERNATIVES ANALYSIS

All reasonable alternatives to the NBCDF are evaluated in this document in accordance with the provisions of the National Environmental Policy Act (NEPA). In accordance with Title 40 of the Code of Federal Regulations, Part 1502.14(e), a preferred alternative is identified. The preferred alternative and the rationale for the selection are discussed below, in Section 2.03.4 and in the response to comment letter F2.

All potential alternatives were subjected to a three-phased screening process. The first phase eliminated alternatives that were not responsive to the purpose of the project as defined in Sections 1.03 and 1.04 and the criteria for alternative selection given in Section 2.01. The second and third screening phases considered alternative locations and construction methods, respectively.

Phase one screening eliminated the greatest percentage of alternate dredged material disposal options. Upland sites were scrutinized under the Phase I screening process as a disposal option, although permitting considerations would render most not feasible. The only currently permitted site, the Orion Site, is potentially infeasible due to operational constraints, timing, availability, and financial factors (Appendix 2.01).

Phase two screening was primarily limited to the evaluation of other CDF sites within Newark Bay - northwest of Shooters Island, north of the I-78 New Jersey Turnpike Bridge, and east of the Federal Navigation Channel opposite Port Newark. Potentially unacceptable adverse impacts related to the number of buried cables and pipelines at the Shooters Island and Turnpike Bridge sites eliminated them from consideration (Section 2.03.1). A site on the east side of Newark Bay (referred to as Area 3) was evaluated as an alternative, although additional data would be required should a CDF in this area become a proposed action. Comparison of potential impacts that would likely result from a project in this area vs a project in Areas 1 and 2 was made on the basis of scale and location (Section 2.03.2).

The results of testing to determine the suitability of material for ocean disposal strongly influenced the alternatives analysis. Sediments proposed for ocean disposal are categorized based upon testing (sediment chemistry, bioassay [toxicity], bioaccumulation) proscribed by the U.S. Army Corps of Engineers (USACE) and the U.S. Environmental Protection Agency (USEPA) (Section 1.01, Table 1.01-1).

The stratigraphy of Newark Bay consists of three distinct layers of unlithified Holocene and Pleistocene sediments overlying Mesozoic bedrock. The uppermost unit consists of black silts and clays related to postglacial sea level rise. The middle unit consists of glaciofluvial gray sand and the lower unit of glaciolacustrine red-brown clay. The two lower sediment packages were exempted from a requirement for ocean disposal bioassay and bioaccumulation testing because they met exclusionary criteria defined in 40 Code of Federal Regulations (CFR) Part 227.13(b)(3)ii.

The upper layers of all three proposed CDF areas were tested as composites. The upper unit of Area 1S has been determined to be Category II on the basis of bioaccumulation testing. The upper units of Areas 2S and 2N were determined to be Category III on the basis of bioassay (toxicity) testing and bioaccumulation testing, respectively. Test results and a more complete analysis are given in Section 3.04. and in Appendix 1.02.

Five alternatives, including the "no-action" alternative, are discussed in detail (Section 2.03.3). Each alternative offers the potential for a NBCDF with increasingly greater capacities, except for Alternative 5, the "no-action" alternative. The alternative choices are:

1) ***Construct CDF 1S Only.*** Material dredged for construction to the Mud Dump Site (MDS); Capacity = 1.5 MCY (1.2 MCM).

2) ***Construct CDF 1S (as Above), Then Construct CDFs 2S and 2N.*** If Category III from 2S and 2N were disposed of in CDF 1S; net capacity = 2.5 MCY (1.9 MCM). If Category III is placed at a state approved upland disposal site net capacity = 3.09 MCY (2.29 MCM).

3) ***Construct One or More CDFs in Area 3.*** Material dredged for construction presumably would be disposed of a the MDS; capacity (potential) > 10 MCY (> 7 MCM).

4) ***Construct CDF or CDFs in Area 3, Then construct CDFs 1S, 2S, and 2N.*** Category II and III dredged material from CDFs 1S, 2S, and 2N to Area 3; capacity (potential) > 14 MCY (>10 MCM).

5) ***Do not Construct CDFs.*** No construction material; no capacity.

The alternatives were evaluated by comparing them to each other and to the objectives of the project as defined in Sections 1.01, 1.03, and 1.04. Alternative construction methods, including dredging options, transport/placement options, and engineering, design, and construction issues, are discussed in Section 2.04.

In light of comments received in response to the NBCDF DEIS, and in accordance with Title 40 of the Code of Federal Regulation (CFR) Part 1502.14(e), Alternative 2 has been selected as the preferred alternative. This alternative was selected because it meets all the criteria developed in Section 2.01 and provides maximum capacity within the time frame set by the criteria. (NOTE: Also see reply comment F1-1.)

S.03 AFFECTED ENVIRONMENT AND ENVIRONMENTAL IMPACTS OF DREDGING/DISPOSAL OPERATIONS

Chapter 3 describes the affected environment and forms the basis for the evaluation of the environmental impacts associated with dredging/disposal operations (Chapter 4). The analysis of alternatives (Chapter 2) was, in large measure, dependent upon a knowledge of existing conditions.

A detailed search and analysis of all available literature, a field research program focused on fish/shellfish and benthos (Sections 3.06 and 3.08, respectively), a hydrographic/sedimentation modeling program (Section 3.02), and chemical and geotechnical laboratory analyses of Newark Bay sediments conducted to determine feasibility, suitability for ocean disposal, and engineering design parameters formed the basis for characterization of the affected environment. To the maximum extent possible, tables and figures were used to present data collected from the various sources. Written text was regarded as a vehicle to amplify and summarize the data.

Results of sediment testing to determine suitability for ocean disposal are briefly discussed above and in detail in Section 3.04 and Appendix 3.04.1. Levels of residual contamination vary both spatially and temporally throughout the Bay. This variation is documented and discussed in Section 3.04.

Newark Bay is a partially stratified estuary and, as such, its water quality is influenced strongly by conditions in the Hackensack and Passaic rivers (upstream) and in the Arthur Kill and Kill Van Kull (downstream). Indicators such as dissolved oxygen (DO) and coliform bacteria counts show a trend toward improving water quality (Section 3.05). Metal concentrations in Newark Bay waters vary with respect to criteria used by EPA to judge water quality in that area. Specific data are provided in Tables 3.05.3, 3.05.4, and 3.05.5.

Faunal surveys and a literature review show that fauna are moderately abundant in Newark Bay but generally limited with respect to species diversity. Surveys of finfish resulted in nearly 30 species being found in shoal areas and over 40 species in channel areas. However, the finfish community is dominated by only a few species (see Table 3.06.4). Seasonal variations in finfish abundance and diversity correspond to normal seasonal patterns for migratory and resident estuarine species.

Studies of benthic organisms (organisms that live within the sediment or at the sediment/water interface) show that a similar pattern, moderate abundance with limited diversity, exists with respect to this type of fauna (Tables 3.08.3 and 3.08.4). Newark Bay benthos is dominated by polychaete worms, with dominant species and population levels varying seasonally in relation to normal changes in environmental conditions. Of particular note is the observation that Newark Bay benthic organisms are least abundant and diverse in areas dominated by fine-grained sediments (silt and clay). Surveys in

other areas of the sand dominated Raritan Bay/New York Harbor system show that polychaete worms ranked fourth in overall abundance.

The impacts associated with the construction and operation of the NBCDF and reasonable alternatives are discussed in Chapter 4. The spatial boundaries for the analysis coincide with Newark Bay because, with the exception of taking no-action, all alternatives are within the Bay. The temporal boundaries for the analysis are two-fold: (1) short term - the time necessary to build, fill, and close the facility, and (2) Long term-the monitoring period after closure of the facility. The impacts to the various aspects of the affected environment described in Chapter 3 are dealt with in Sections 4.01-4.23. Indirect and cumulative impacts are discussed in Sections 4.24.1 and 4.24.2, respectively.

In general, the analysis suggests that direct impacts would be limited, both spatially and temporally. For example, approximately 2% of the Bay bottom shoal area would be disturbed if the proposed action were undertaken. The impact of dredging and disposal operations upon finfish would be temporary, given that they would be able to avoid the area and that they are found in lesser abundance and diversity in shoal areas of the Bay. Similarly, benthic fauna would incur limited, short-term impacts given their preference for coarser sediment than is typical of the proposed project areas.

The results of hydrodynamic and sedimentological modeling studies (Sections 4.02 and 4.04) indicate that the proposed action would have minimal impact upon the hydrodynamics of the Bay or upon the rate of sedimentation in proposed action areas. Current velocity would be expected to decrease in the project area during construction and prior to filling (Figure 4.02.4), but not in other areas of the Bay (Figure 4.02.5). The sedimentation model suggests that suspended sediment concentrations in the water column would not be altered by the proposed action (Figure 4.04.3).

Indirect impacts, those induced by a decision to implement a project, on natural resources would be related to effects due to the disruption of aquatic habitat and disturbance of contaminated sediments. The area of Bay bottom that would be disturbed by the proposed action is small compared to the size of the Bay. Although contaminated sediments will be disturbed, the areas of proposed construction were selected because they were less contaminated than other proposed areas.

Indirect impacts could potentially result from the no-action alternative. The curtailment of dredging activities in other areas, due to the lack of available disposal facilities, would not decrease the region's need for goods that currently arrive by sea. Each container ship that calls at the port carries the equivalent of 2000 tractor-trailer loads of goods (DMMT 1995). A potential adverse impact that could result from decreased shipping is an increase in air pollution. Direct impacts that could result from the no-action alternative include increased double handling of available cargo and increased lightering with a concomitant increase in risks and costs associated with each.

The major impact on human resources would be related to the maintenance of infrastructure related to existing commercial shipping operations in waters contiguous to New Jersey. Loss of shipping could have significant negative impacts on the economic vitality of the region, as well as a traffic burden that could result in further deterioration of the region's highway infrastructure.

Cumulative impacts, those resulting from combined effects of similar projects occurring in the same area or time frame, would involve dredging activities that would occur as a result of the availability of the NBCDF. These are not confined to the proposed project area(s) because the construction of the NBCDF should result in dredging operations throughout the draw area. Adverse impacts that might result from dredging and disposal activities would be of short duration, would be areally restricted, and would be offset by the beneficial effects of removing and isolating contaminated sediments from the biosphere.

S.04 IMPLEMENTATION STRATEGIES FOR THE USE OF THE NBCDF

Chapter 5.0 discusses implementation strategies for the NBCDF. Section 5.04 discusses the application of the hydrodynamic and sedimentation models to the design of the proposed cap for the facility. Section 5.07 discusses the monitoring and management plan for the NBCDF.

The modeling effort was combined with a "worst-case scenario" (i.e., a 100-year storm event) that was projected to occur immediately after cap emplacement. The results of this analysis indicated that a safety margin of 1 ft (0.3 m) could be built into the capping plan, resulting in a sand cap 4 ft (1.2 m) thick. However, given the requirement of a 3-ft (0.9-m) sand cap for Category II and III material at the MDS, NJDEP's suggestion that a 3-ft (0.9-m) cap for subaqueous disposal is sufficient for New Jersey's tidal waters (NJDEP 1996), and the Port Authority's commitment to long-term cap monitoring, planning for closure of the NBCDF focuses on a 3-ft sand cap.

The management plan for the NBCDF focuses on setting up an organizational structure to oversee the operation and monitoring of the facility. The goal of the monitoring plan is to ensure cap integrity, thus ensuring isolation of the contaminated sediments placed in NBCDF, and to determine the extent of benthic organism recolonization. The tasks relate to bathymetry, surficial sediment, cap integrity and function, and water quality. Tasks related to these aspects of the project would occur prior to dredging for construction, after construction but prior to disposal activities, during disposal activities, after disposal activities but prior to capping, and after capping.

S.05 SECTION 404(B)(1) GUIDELINES EVALUATION

Chapter 6 evaluates the proposed action with respect to regulations found in 40 CFR Part 230.2(b), which implements Section 404(b) of the Clean Water Act. The evaluation concludes that the proposed action is in compliance with the guidelines.

The evaluation is given in outline form, with all elements of the evaluation addressed directly or by reference to the appropriate section of the FEIS.

1.0 NEED AND OBJECTIVES

1.01 INTRODUCTION

The Port of New York and New Jersey (NY/NJ) is vitally important to the New York Metropolitan area and the Northeast. Except for the Port of New Orleans, the Port of NY/NJ handles more tonnage than any other port in the eastern United States. In 1995 imports and exports moving through the Port totaled 120 million tons (108.9 million metric tons) with a total monetary value of more than $20 billion, including support for approximately 200,000 jobs (USACE 1996).

The NY/NJ Harbor is naturally shallow and subject to heavy annual sediment deposition from a number of sources, including major rivers: the Hudson, Passaic, Hackensack, and Raritan (Figure 1.01-1). The Hudson River basin, for example, contributes almost 800,000 tons of sediment per year, accounting for some 67% of the total Hudson/Upper Bay/Newark Bay waterborne solids (Abood et al. 1992). The annual volume of sediments to be dredged in order to maintain the navigation channels in the Port region is approximately 4 to 6 million cubic yards (MCY) (3.1-4.6 million cubic meters [MCM]) (approximately 8 million tons at 100 pounds/cubic foot [7.3 metric tons]).

Until recently, maintenance dredging to maintain ship channels and Harbor berthing facilities was conducted on a routine basis, with the dredged material normally disposed of at the Mud Dump Site (MDS), an ocean disposal site in the New York Bight apex southeast of Sandy Hook (Figure 1.01-1). In 1977 the U.S. Environmental Protection Agency (USEPA) and the U.S. Army Corps of Engineers (USACE) developed a testing methodology for determining which sediments are suitable for ocean disposal and which require more contained disposal methods. The testing protocol, Ecological Evaluation of Proposed Discharge of Dredged Material Into Ocean Waters, also known as the Green Book (USACE/USEPA 1977), is national in scope; thus, implementation requirements considering local dredged material concerns are addressed through regional guidance manuals (USACE/USEPA 1984). Under the 1984 regional testing protocols (USACE/USEPA 1984) 90% of the sediments dredged from NY/NJ Harbor were found to be acceptable for ocean disposal and were transported to the MDS.

In 1991 a new guidance manual with modified testing protocols replaced the 1977 Green Book (USEPA/USACE 1991), and regional guidance for performing tests on dredged materials followed in 1992 (USACE/USEPA 1992). Under the new testing protocols the analytical sensitivity of detection limits was expanded, the number of chemicals of concern to be tested was increased, and additional biological assays were included. This 1991 revision significantly decreased the volume of dredged materials that qualified for ocean disposal. Preliminary testing information indicates that approximately 80% of the sediments to be dredged from the NY/NJ Harbor will require special management practices (capping with clean sediment) or will not be eligible for ocean disposal.

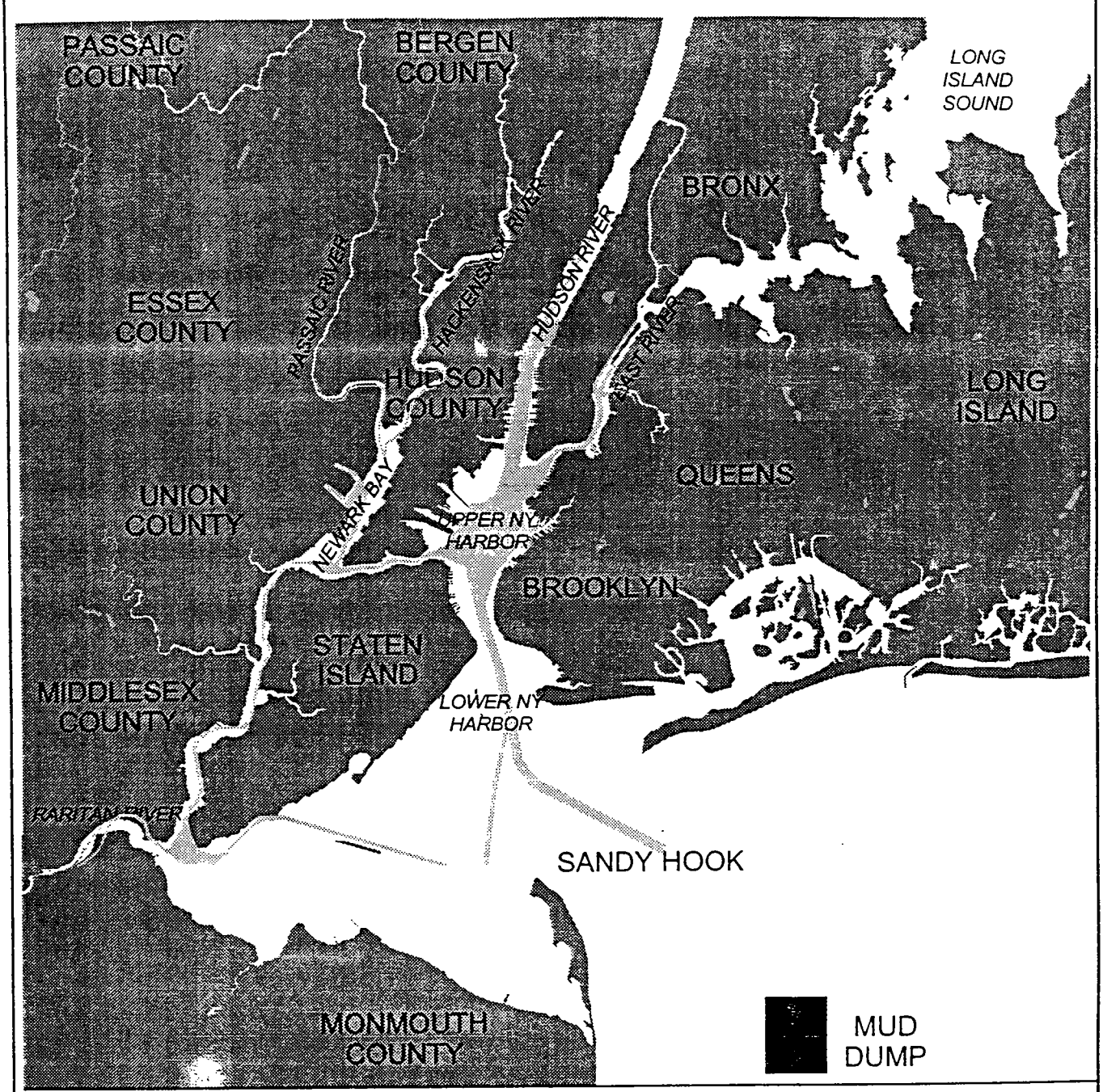


Figure 1.01-1

U.S. Army Corps of Engineers
Newark Bay Confined Disposal Facility

The New York and New Jersey Harbor

Within this region concerns over bioaccumulation and potential biomagnification of low concentrations of contaminants and potential human health risks led to the development of more stringent ocean disposal methodologies such as capping. To determine which dredged materials are acceptable for unrestricted ocean disposal and ocean disposal with capping, dredged material is tested and evaluated and then assigned to one of three categories. These sediment disposal categories (Table 1.01-1) are used to define the eligibility of different dredged materials for various disposal alternatives. Category I sediments pass toxicity and bioaccumulation testing and are eligible for unrestricted ocean disposal. Category III sediments fail to meet the testing requirements for ocean disposal. Category II sediments, although meeting the ocean disposal criteria defined by USEPA in that they do not pose a threat of mortality to aquatic organisms, contain some characteristics that require additional levels of confinement. Category II sediments do not meet criteria for unrestricted ocean disposal but may be suitable for ocean disposal with capping or used at landfills, borrow pits, and containment facilities.

On 24 July 1996 the Federal government announced a plan to close the MDS by 1 September 1997. After that time only Category I material can be deposited at the site. The volume of material that can be accommodated at the MDS in compliance with the required closure is the subject of a Supplemental EIS being prepared by USEPA and expected to be completed in June 1997.

USACE-NYD is responsible for maintaining the Federal navigation channels in the Port of NY/NJ (Figure 1.01-1). Ultimately, it is hoped that disposal of materials will be conducted under a Dredged Materials Management Plan (DMMP) developed specifically for the NY/NJ Harbor with alternatives selected by each of the states. A Plan of Study (POS) for implementation of the DMMP has been developed by the District (USACE-NYD 1995). The POS identifies short-, mid-, and long-term goals. The POS short-term goal is "to maintain the Port through its current crisis, in an environmentally safe manner." Short-term solutions must be ones that can be put into operation within three years (i.e., by 1998), in a manner that meets environmental standards acceptable to the regulatory agencies and the general public. The POS further states that short-term solutions should be capable of sufficient capacity to accommodate a meaningful proportion of dredged material deemed not acceptable for ocean disposal, either harborwide or from specific projects with urgent or special needs, and should be simple enough to be implemented without extensive study.

For the Port Authority of New York/New Jersey (Port Authority) to accomplish its mission to strengthen the Region's role as a center for trade and business, required water depths must be maintained at all Port facilities, including Port Elizabeth/Port Newark, New York berthing facilities, and adjacent navigational channels (Figure 1.01-2). The dredging conducted in Port Newark/Port Elizabeth during 1993 experienced greater permitting difficulties and incurred significantly higher costs for the disposal of sediments that were not suitable for unrestricted ocean disposal. This and other events described

Table 1.01-1

Dredged Material Disposal Categories

Category	Test Result Characteristics	Disposal Implications
I	Does not cause unacceptable toxicity or bioaccumulation in biological test systems.	Suitable for unrestricted ocean disposal or beneficial uses. Coarse-grain sand may be used for beach nourishment; coarse-grain and fine-grain material may be used as interim or final cap material; may be used for cover of historical disposal areas.
II	Does not meet criteria for unrestricted ocean disposal but does not pose a definite threat of mortality.	Suitable for ocean disposal with capping; suitable for disposal at landfills, borrow pits, and containment facilities or as daily or interim landfill cover.
III	Fails to meet ocean dumping criteria.	Not suitable for ocean disposal; suitable for disposal at containment facilities and borrow pits or as sanitary landfill cover.

Source: USACE (1995)

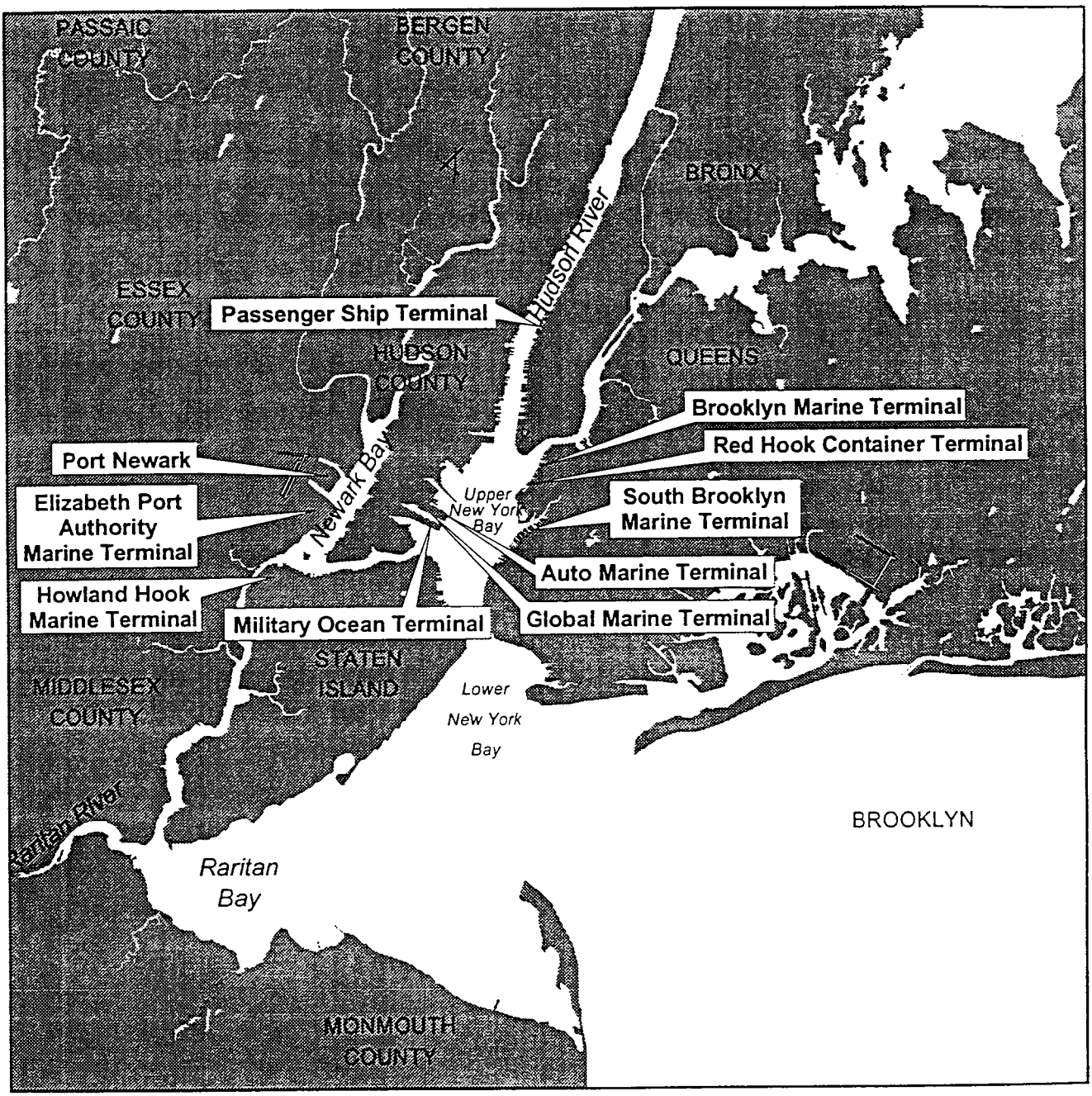


Figure 1.01-2

U.S. Army Corps of Engineers
Newark Bay Confined Disposal Facility

Map of Marine Facilities Within the Port Authority of NY/NJ Harbor Region

in Sections 1.02, 1.03, and 1.04 resulted in the determination that materials to be considered for disposal in the Newark Bay Confined Disposal Facility (NBCDF) would be drawn from waters in NY/NJ Harbor contiguous to the State of New Jersey, including Newark Bay, the Arthur Kill, and the Kill Van Kull. The Port Authority's permit application for the construction and operation of a new subaqueous CDF in Newark Bay, Essex County, New Jersey was submitted on 19 April 1995. The purpose of the CDF would be to provide a short-term solution in the form of a disposal site for contaminated dredged material not suitable for ocean disposal. The CDF will not provide sufficient capacity to accommodate all of the dredged materials requiring disposal even in the short-term but it does provide a reasonable first step.

This document (1) identifies the applicant's initial dredged material disposal alternative and (2) assesses the anticipated environmental impacts associated with this alternative, as well as impacts associated with the no action alternative and with other disposal alternatives that meet the goals and objectives of the project. The document identifies appropriate mitigation methods and suggested long-term monitoring plans. The preferred alternative is identified in Section 2.03.4.

At this time the Port Authority is planning to develop the NBCDF in a phased fashion, with the CDF identified as Area 1S (see Section 1.02, Project Description) proceeding first. To achieve this plan, the Port Authority is proceeding to prepare contract specifications for Area 1S, with the expectation of awarding a contract for construction as soon as all necessary permits are in hand. This expeditious approach is driven by the administration's decision to close the MDS in 1997. The Port Authority is positioning itself to use the remaining disposal capacity available at the MDS in order to develop the CDF in a timely, cost effective manner.

1.01.1 STATUTORY AND REGULATORY AUTHORITY

USACE manages the regulatory permitting process for dredging and dredged material disposal activities. In the NY/NJ Harbor region, this responsibility is undertaken by USACE-NYD. The following presents additional Federal, state, and local laws, and rules and regulations that are addressed in this NEPA document.

The Rivers and Harbors Act of 1899 was enacted to control discharges of refuse into navigable waters by requiring issuance of a permit for such actions. Section 10 of the Act delegates to USACE the authority to control and review any obstruction or alteration of any navigable waters of the United States. This Act is the historical basis by which USACE regulates dredging and the disposal of dredged material.

The Clean Water Act of 1972 (CWA), and its amendments of 1977, established a permit program and evaluation guidelines (Section 404(b)(1)) by which USACE regulates discharges of dredged material at disposal sites which are within the waters of the United States. The Act stipulates the criteria to be used in determining the degree of degradation

to waters of the United States that will result from a given action. Issuance of a permit depends upon a determination that the proposed action will not cause a significant degradation of the aquatic environment and is in compliance with the Section 404(b)(1) guidelines. Economic impacts to navigation (and anchorage) must also be considered (Section 404(b)(2)).

The Marine Protection, Research and Sanctuaries Act (MPRSA) of 1972 regulates the transport of materials for the purpose of disposal in ocean waters. Section 103 of the Act authorizes USACE to issue permits for ocean disposal of dredged material, using criteria developed by EPA (in consultation with the Secretary of the Army). The regulations under the Act establish application procedures for ocean disposal permits, environmental review parameters to evaluate applications, and designation and management procedures for ocean disposal sites. The MPRSA regulates and governs ocean disposal of any material that would adversely affect human health, welfare, or the amenities of the marine environment.

The Coastal Zone Management Act of 1972, as amended (16 U.S.C. 1456(c)), established guidelines, and a process, for states to manage the resources and development of coastal zones. An applicant for a Federal permit to do work in a state's coastal zone must certify that the proposed work would comply with the state's coastal zone management program. No permit is issued until the state has concurred.

The National Environmental Policy Act (NEPA) establishes processes designed to ensure that environmental information is available to public officials and citizens before decisions and actions are taken by Federal agencies. A Federal agency's decision to prepare an EIS under NEPA is based on the magnitude of the impacts associated with the project, the similarity of the project to others that normally require an EIS, or the unprecedented nature of the project (40 CFR 1501.4). For this project, USACE NYD is the lead agency. Federal, state, and local agencies and interested persons were invited to participate in public scoping sessions that were held in June 1995.

The Draft EIS was prepared following the outline of a scope of work derived from the scoping meetings, and meets the format requirements of 40 CFR Part 1502.10. The Final EIS includes responses to comments received on the Draft EIS. Comments received and replies to these comments are provided in Appendix 1.01. Transcripts of the public hearings held on February 19, 1997, are available for review by contacting Dr. Marc Helman at the U.S. Army Corps of Engineers at (212) 264-3912. As lead Federal agency USACE reviews all relevant information presented and considers all alternatives described in the EIS in order to render a decision on the proposed action. At the time of a permit decision, USACE will prepare a concise "Record of Decision," or ROD, identifying all alternatives considered by the agency in reaching the decision and specifying the alternative considered to be environmentally preferred. The ROD will state whether all practicable means to avoid or minimize environmental harm have been adopted, and if not, why they were not.

There are further opportunities for public review and comment on the selected alternative. Under NEPA, a notice of availability of the FEIS will be published in the Federal Register. This notice is followed by a comment period. Readers who wish to offer comment on this document are advised to contact Dr. Marc Helman at (212) 264-3912 for the date that comment period will close.

The proposed project requires Federal, state, and local permits and approvals. This NEPA document provides a substantial basis for decision making on permit applications. The administrative procedures for acquiring the various permits and approvals will provide opportunities for agency and public comment. Permits from State of New Jersey agencies and USACE cannot be issued until the NEPA process is completed for the project. The permits that will be required to undertake the proposed action are listed in Table 1.01-2.

In addition to the authorities listed, two other pieces of legislation may have an effect on this document and the proposed project: the National Historic Preservation Act of 1966 (NHPA) and the Endangered Species Act of 1973 (ESA).

Under Section 106 of the NHPA, Federal agencies must take into account the effects of activities that would require a Federal license or permit on properties listed in or eligible for listing in the National Register. This FEIS addresses this in Sections 3.14 and 4.14.

Under Section 7 of the ESA, Federal agencies are required to engage in biological assessments whenever their actions may affect endangered or threatened species and to consult with the U.S. Fish and Wildlife Service (USF&WS) and/or the National Marine Fisheries Service (NMFS) whenever such actions will likely affect listed species or their habitats. Those consultations have been conducted.

NJDEP will regulate the construction of any of the NBCDF alternatives pursuant to the Rules on Coastal Zone Management (N.J.A.C. 7:7E-1.1 et seq.). The Rules define Newark Bay as a semi-enclosed bay and generally prohibit the disposal of dredged material in such bays where the water depth is less than 6 ft (2 m) (N.J.A.C. 7:7E-d.2[h]). All of the Newark Bay locations identified in the FEIS have water depths less than 6 ft (2 m) at mean low water.

However, the Rules are intended to represent the consideration of various competing and conflicting interests in coastal zone management. Included in the Rules are eight basic coastal policies intended to guide administrative discretion in the application of the Rules to specific projects (N.J.A.C. 7:7E-1.5). Two of these eight basic policies apply to the proposed NBCDF: (1) to protect and enhance the coastal ecosystem, and (2) to maintain active port facilities, and to provide for necessary expansion in adjacent sites. In the case of the proposed NBCDF, a decision under the Rules cannot be focused upon the narrow language of N.J.A.C. 7:7E-4.2(h), but must necessarily balance the need to protect the estuarine ecosystem of Newark Bay with the need to maintain commerce and Port activities.

Table 1.01-2

Permits Required for the Construction and Operation of the NBCDF

Agency	Permit
State of New Jersey	1) Waterfront Development Permit
	2) Water Quality Certificate
	3) Coastal Zone Management Plan Consistency Concurrence
	4) Tidelands Instrument
USACE	1) Permit

1.02 PROJECT DESCRIPTION

1.02.1 HISTORY

A Dredged Material Management Team (DMMT), whose mission was to investigate and propose nonocean, short-term solutions for Port dredging, was appointed by the Governor of New Jersey, Christine Todd Whitman, in June 1994. Governor Whitman appointed Assemblyman Steven Corodemus to chair the DMMT. The DMMT was given six months to research the problem and to recommend solutions. Assemblyman Corodemus and the DMMT presented their final report to Governor Whitman on 1 February 1995. The Governor adopted the report, stated that she would work to implement its recommendations, and requested the Port Authority to act as lead agency to fulfill the plan's goals.

The principal recommendation, supported by all DMMT members, was a proposal to construct two subaqueous pits on the west side of Newark Bay for the containment of dredged material that was deemed to be unsuitable for ocean disposal. The pits would be dug to a depth of approximately -70 ft (-21.3 m) with a capacity to hold an estimated volume of 14 MCY (10.7 million cubic meter [MCM]). It was assumed that most of the material removed during excavation would be disposed of in the ocean or used beneficially. The proposed CDFs are shown on Figure 1.02-1 as Area 1 and Area 2.

The Dredged Material Management Forum's Containment Workgroup, within the framework of the Harbor Estuary Program (HEP), also considered the proposed Newark Bay CDFs as potential disposal locations. Some earlier investigations indicated that Newark Bay was underlain by fine-grained sediments that could be excavated to form the CDFs. Newark Bay was selected to demonstrate the advantage of a CDF in an already environmentally impacted area. Surficial sediments are contaminated and ultimately this condition could be improved with the construction and closure of the proposed NBCDF.

The Port Authority authorized a preliminary investigation in March 1995. This initial effort consisted of eight borings for environmental and geotechnical testing. A detailed search of historical records was also undertaken. The Port Authority submitted a permit application for the construction of the NBCDF to USACE on 19 April 1995.

USACE issued a public scoping notice on 31 May 1995. The estimated storage capacity stated in the notice was 14 MCY (10.7 MCM).

In June 1995, results of preliminary environmental testing and historical literature reviews indicated that portions of the proposed CDF areas were contaminated, probably as a result of dredging and deposition of contaminated sediments from historic activities. In July 1995 a second series of environmental and geotechnical borings was undertaken to better define the contaminated areas.

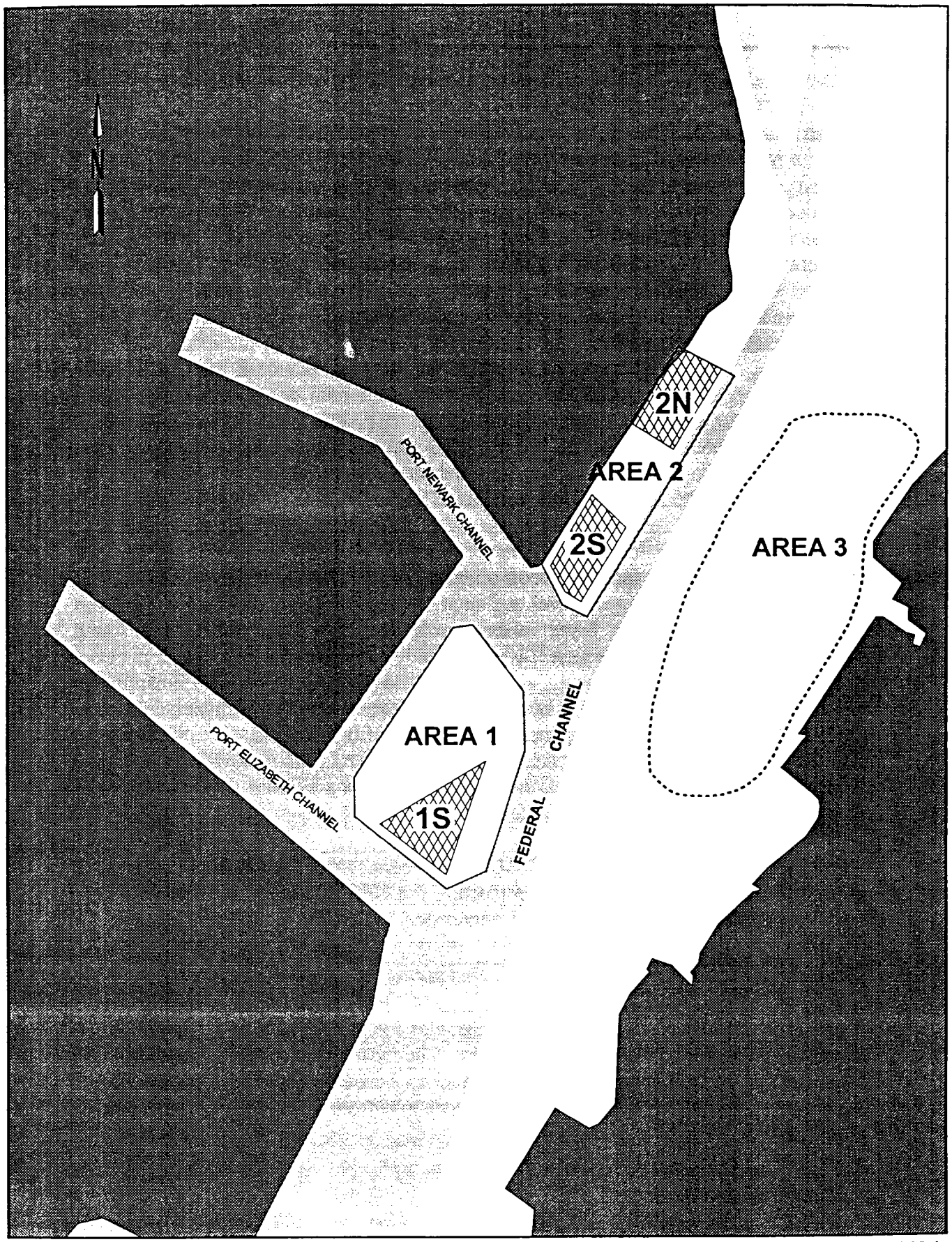


Figure 1.02-1

U.S. Army Corps of Engineers
Newark Bay Confined Disposal Facility

Proposed Newark Bay CDF Locations

The feasibility investigations, environmental testing, and engineering analyses conducted during 1995 led the applicant to believe that continuation of the project as originally proposed was not possible due to large volumes of contaminated sediments that would need to be disposed of to construct the CDF. The data from the various investigations and testing were used to define subareas within the original boundaries of Areas 1 and 2 in which there appeared to be little significant contamination. These subareas are shown as Areas 1S, 2S, and 2N on Figure 1.02-1. The capacity of the three subareas is approximately 3 MCY (2.3 MCM) of in-situ dredged material.

On 6 November 1995, the Port Authority amended its application to USACE-NYD and requested that a permit be issued to construct and operate CDFs in the areas shown on Figure 1.02-1. The amended application stated that the areal extent of the CDFs would be approximately 60 acres (0.25 km^2) and the capacity would be up to 5 MCY (3.823 MCM), depending upon the depth of construction. USACE-NYD, by letter dated 22 November 1995, notified those who had provided oral and written comments during the scoping process of the amended application, and provided an opportunity for additional public comment on the scope of work for this EIS.

Additional environmental testing was conducted during May 1996 to determine the feasibility of ocean disposal for the unconsolidated upper layer sediments in the three subareas. The results of upper level sediment testing are given in Section 3.04 and Appendix 1.02. The lower layer material was excluded from testing and found acceptable for ocean disposal because it is geologically older than the upper layer material and in a hydrostatic environment, which precludes the migration of contaminants downward. These conditions are in accordance with the criteria for exclusion defined at Title 40 of the Code of Federal Regulations, Part 227.13(b)(3)(iii), as, ". . . the site from which the material is proposed for dumping is to be taken is far removed from known existing and historical sources of pollution so as to provide assurance that such material has not been contaminated by such pollution . . ."

Construction of the NBCDF using the MDS could be a substantial economic advantage to the Port compared to the cost of constructing the NBCDF using an upland disposal site, if used before the MDS closes on 1 September 1997.

1.02.2 GEOTECHNICAL INFORMATION

Borings were conducted to obtain sediment samples for geotechnical and environmental analyses in the course of the feasibility studies. The locations of borings made in Areas 1 and 2 are shown in Figure 1.02-2. A third area, Area 3, located east of the Federal Channel, was also investigated and the boring locations from this area are also shown on Figure 1.02-2.

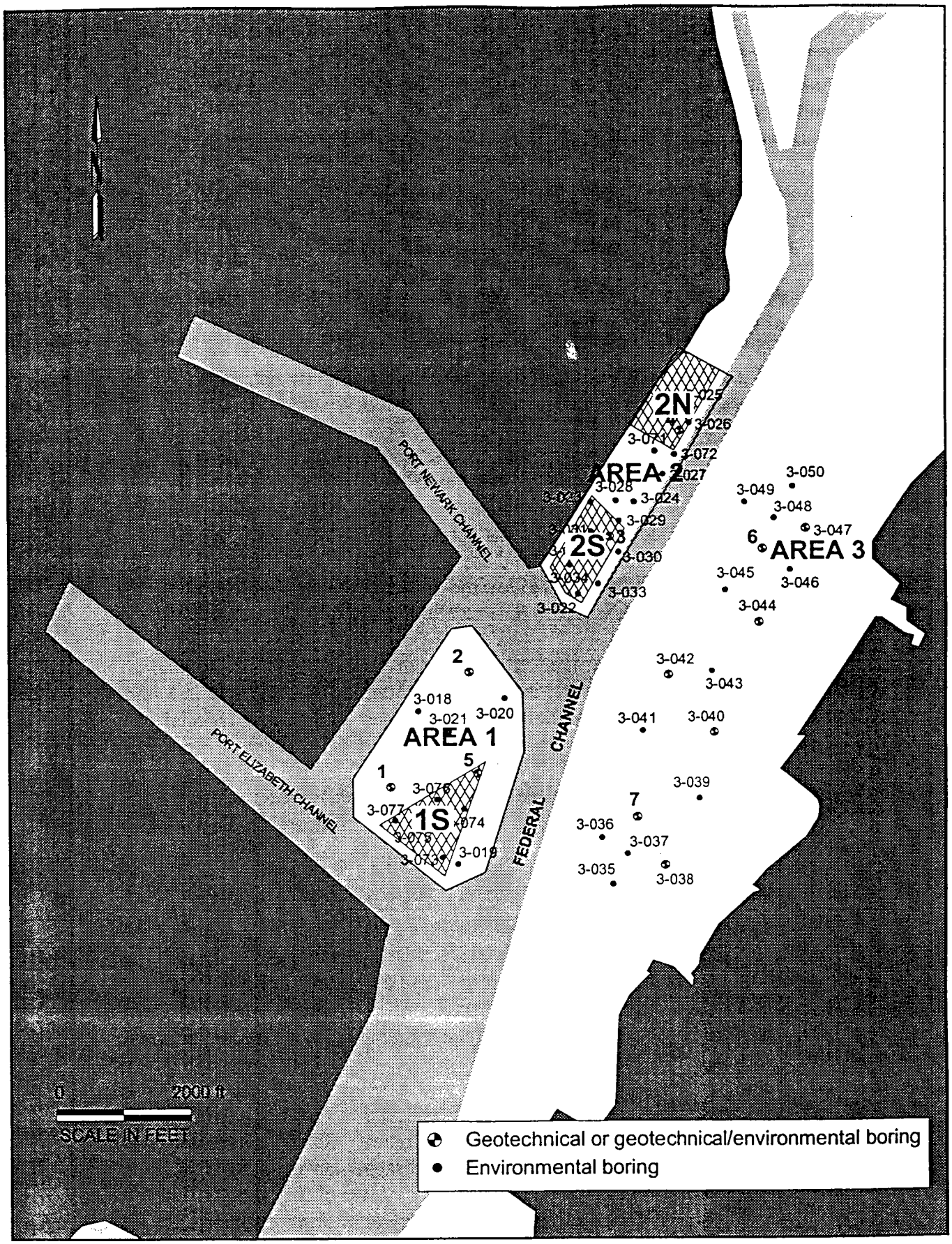


Figure 1.02-2
Location of Existing Stations

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Environmental borings were made to an approximate depth of 20 ft (6.1 m) below the sediment-water interface using a piston coring device. Geotechnical borings were made using an auger drill and were made from the sediment-water interface to bedrock.

Data acquired from the deep borings allowed the construction of a generalized geologic section for the proposed NBCDF areas. The general geologic section, starting from the surface and moving down, consists of about 15 to 20 ft (4.6-6.1 m) of soft black silty clay, 4 to 9 ft (1.2-2.7 m) of gray silty sands, 50 to 65 ft (15.2-19.8 m) of stiff red-brown silty clay, 6 to 15 ft (1.8-4.6 m) of very stiff gravelly silty clay, and bedrock consisting of red shale and sandstone.

Figure 1.02-3 presents detailed information concerning possible contamination in Area 1 and indicates that there is potential contamination to a depth of -25 ft (-7.6 m) or more, roughly down the center of Area 1 and toward the Port Newark Pierhead Channel and Federal Channel. CDF Area 1S would be located between these two areas to minimize the potential of excavating contaminated sediments.

The extent of potential contamination was inferred from historical data published on navigation charts, aerial photographs, and chemical and amphipod toxicity testing. The historical record was reviewed from 1812 to the present. The first indication of dredging in Area 1 was found on a U.S. Coast & Geodetic Survey (C&GS) chart dated 1937.

The depth and shape of the excavation area shown on the 1937 C&GS map are not consistent with a navigation project. An individual familiar with the area is reported to have stated that the excavation was performed to recover clay for commercial purposes (i.e., brick making). This seems consistent with information shown in Figure 1.02-3. The excavation is irregular, making it difficult to define its areal limits from the navigation chart. It is also not possible to define the depth limit on the basis of visual differences because both the potentially contaminated and clean soils are black silty clays and visually indistinguishable.

Figure 1.02-4 shows a similar plot for Area 2. The subarea CDFs, Area 2S and Area 2N, have been located to minimize the potential for excavating contaminated materials. The potentially contaminated portions of Area 2 were determined in the same manner used for Area 1. A C&GS chart from January 1944 shows a channel dredged to -11 ft (-3.4 m) traversing the central portion of Area 2. It is believed that this channel may have been excavated for access to shipways that are visible on an aerial photograph dating from 1952.

A C&GS chart from 1978 shows both of these excavation features. However, a subsequent National Oceanic and Atmospheric Administration (NOAA) chart from 1983 does not show either of these excavated areas. The disappearance of these features was originally thought to be the result of filling; however, it is probably the result of revising charts to reflect the latest data received by the agency publishing the charts. The 1937 and 1944 data were new and therefore recorded on the charts. If no new data were

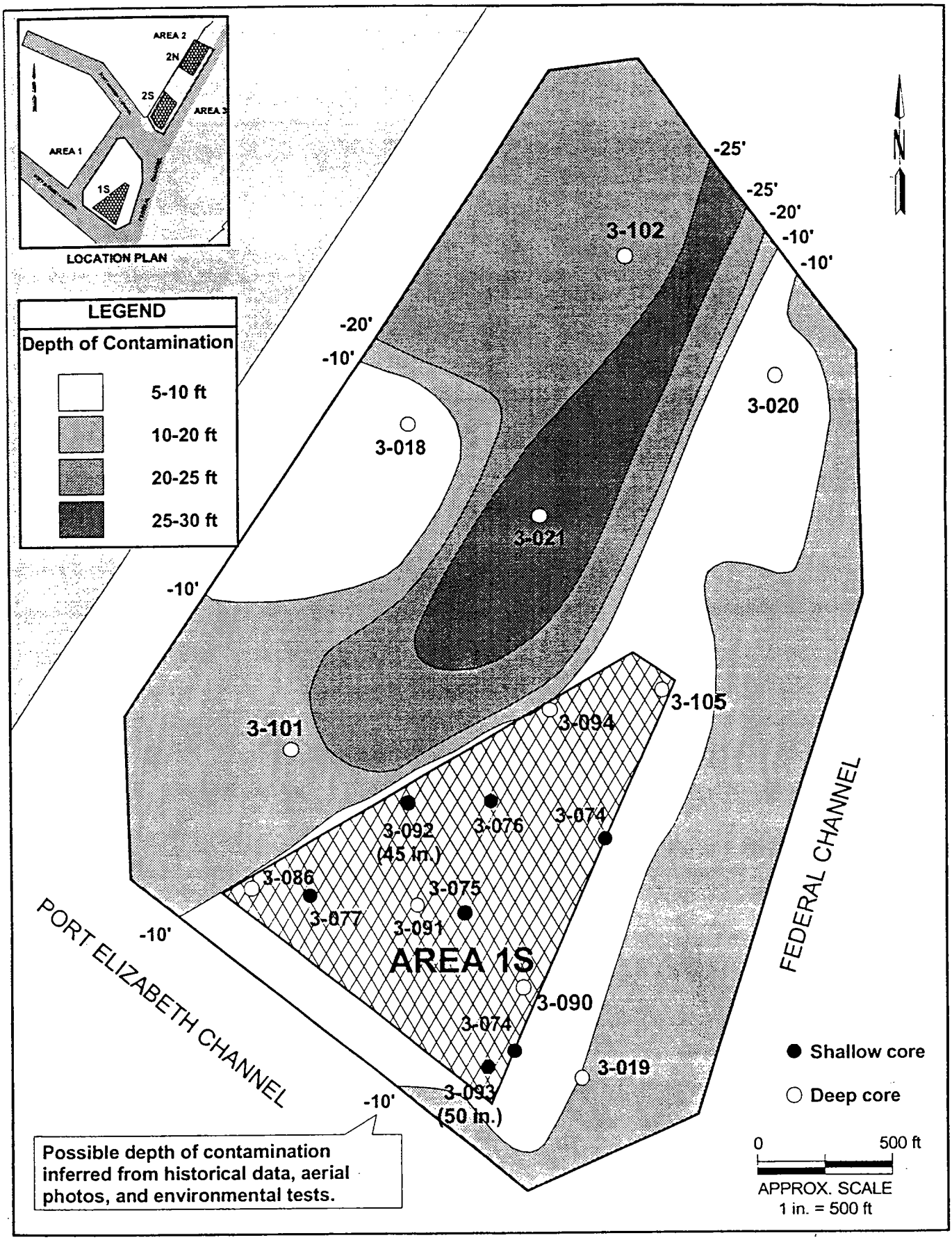


Figure 1.02-3

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Possible Depth of Contamination in CDF Area 1

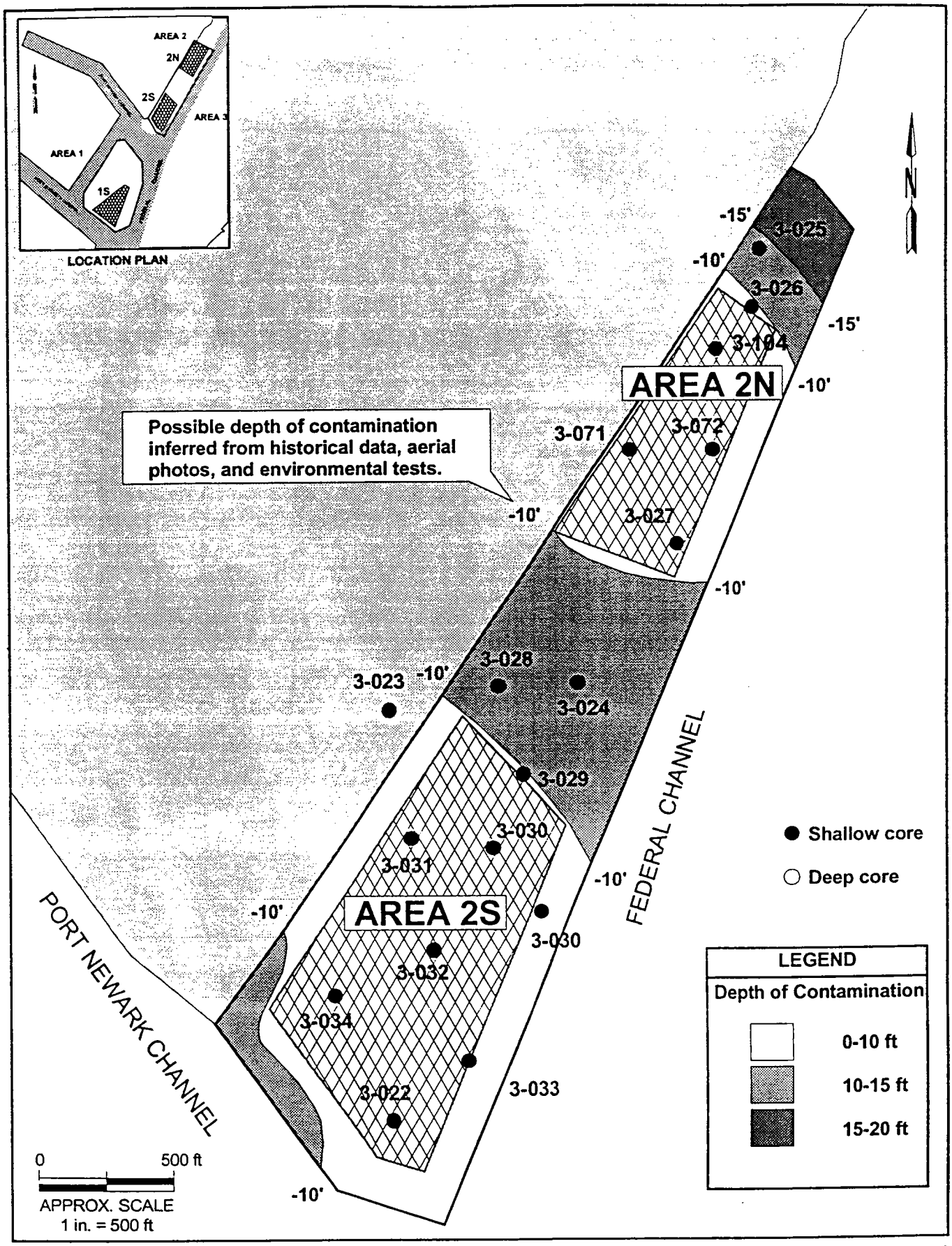


Figure 1.02-4

U.S. Army Corps of Engineers
Newark Bay Confined Disposal Facility

Possible Depth of Contamination in CDF Area 2

received, the original data would be shown until revised. Therefore, the excavation was shown until 1983 when, presumably, NOAA was notified of the shallow water depths in the proposed NBCDF areas. Thus, it is inferred that the original excavations probably filled with sediments during the time from initial excavation. until 1983. Any contaminants in these areas probably reflect contaminated sediments originating or carried into the Bay during that time period.

There is an area of deep contamination evident to the north of Area 2 in Figure 1.02-4. This may have been the result of contaminated sediments collecting in areas where dredging occurred to accommodate large waterborne equipment used for the construction of the New Jersey Turnpike Extension Bridge located immediately north of Area 2.

In addition to providing information on zones of possible contamination, soil borings conducted as part of the feasibility studies provided geotechnical data such as shear strength and water content. These data were used to develop proposed preliminary CDF design slopes and storage capacity calculations.

The storage capacity of the CDFs has been estimated on the basis of a series of conditions including, no interim caps, a final surficial cap thickness of 3 ft (1 m), and no consolidation prior to cap emplacement because of the anticipated short life span of the proposed CDFs. A bulking factor of 1.2, considered representative of maintenance-dredged material in the Port of NY/NJ area, was employed in estimating the amount of dredged material that could be placed in the CDFs.

1.02.3 SEDIMENT CHEMISTRY AND TOXICITY

A number of environmental tests were performed on the sediment samples recovered from within the CDF areas to support a feasibility evaluation of the project. These are described in detail in Chapter 3.0, Affected Environment, Section 3.04. Figure 1.02-3 shows a plan of Area 1S. The potential depths of contamination are shown graphically. Figure 1.02-4 shows similar data for areas 2S and 2N.

The test data were used along with other data (Section 1.02.2) to identify possible subareas for the proposed CDFs to minimize the potential for excavating contaminated materials. The dredging or excavation perimeter would be within the outer testing perimeter so that potential sloughing of the surficial sediments would not extend beyond the area tested. Based on geotechnical information on Newark Bay CDF (NBCDF) sediment samples collected during 1995 and 1996, the proposed CDFs will be set back a minimum of 175 ft (53.3 m) from the Federal Navigation Channels to allow for a -50-ft (-15.2-m) deep channel at some future date. Initial amphipod bioassay test data and chemical analyses indicated that the soils to be excavated in the selected subareas might pass ocean disposal criteria; however, the results of chemical and biological analyses conducted on composited surficial sediment samples collected from the NBCDF subareas during 1996, indicates that surface sediments from Area 1S meet the criteria for ocean

disposal with capping (Category II), but surface sediments from Areas 2S and 2N do not. Results of upper level sediment testing are given in Section 3.04 and Appendix 1.02. Based on the data available through October 1996 the total storage capacity of the three subareas is about 3 MCY (2.3 MCM) (Table 1.02-1).

1.02.4 CONSTRUCTION CONCEPT

The potential areas identified for the construction of the CDFs were selected on the basis of geotechnical and environmental investigations performed during 1995 and 1996. The construction concepts discussed herein, apply equally to any or all of the potential CDFs that might be developed within Newark Bay. Evaluation of site geotechnical information results in side slope designs of 3 horizontal to 1 vertical (3.0:1.0) in the surficial unconsolidated clayey silts, and 1.5 horizontal to 1 vertical (1.5:1.0) in the underlying consolidated soils. The side slope would have a 15-ft (4.6-m) offset (bench) at the interface between the unconsolidated surface sediments and the underlying consolidated sediments. Based on the use of currently available construction equipment, the proposed depth of the CDFs -70 ft (-21.3 m) below mean low water (MLW).

The Newark Bay CDF would be constructed by excavating in situ soils using standard dredge and disposal procedures. Using ocean disposal for all material deemed acceptable for ocean disposal removed during construction of the NBCDF will provide a cost effective, short-term, environmentally sound disposal option in keeping with the recommendations of the DMMT.

Proposed NBCDF Area 1S, shown in Figure 1.02-5 with section line A-A drawn through the proposed CDF disposal area and the entrance channel (Site Plan), will be used to describe typical construction techniques. NBCDF construction would begin with a clamshell dredge excavating an entrance channel from the Port Elizabeth Channel (channel entrances to Areas 2S and 2N would be from the Federal Channel). The location of the entrance channels would be selected to provide the shortest access to the CDF. The CDF entrance channels would be approximately 300 ft (90 m) wide at the top, 200 ft (60 m) wide at the bottom, and 20 ft (6.1 m) deep. Existing water depths at the three proposed NBCDF entrance channels referenced to MLLW are Areas 1S, 2.2-2.6 ft (0.6-0.8 m); Areas 2S, 6.9-8.0 ft (2.1-2.4 m); and Area 2N, 4.6-5.3 ft (1.4-1.6 m). The proposed dimensions of the CDF entrance channel would provide adequate width and depth to maneuver loaded scows.

Once within the area of the CDF, the clamshell dredge would widen the excavation but would maintain a minimum setback of 40 ft (12.2 m) from the edge of the CDF footprint. This would ensure that any local sloughing of material would not cause material from outside the identified CDF footprint to enter the CDF area. The slope behavior would be monitored to verify side slope stability and determine what final side slope may be achieved. This would allow for the maximum storage capacity to be developed later in the excavation process, without concern that material that had not been environmentally

Table 1.02-1

Capacity of Newark Bay Subaqueous Confined Disposal Facility (NBCDF)

Physical Parameter		CDF Area 1S	CDF Area 2S	CDF Area 2N	CDF Area 3
CDF Surface Area	ft^2	1,133,400	910,000	427,500	9,000,000
	m^2	105,293	84,539	39,715	836,100
	Acres	26.0	20.9	9.8	206.6
	km^2	0.11	0.08	0.04	0.84
Volume of unconsolidated surface sediments	CY	579,000	485,000	200,000	2,274,987
	CM	442,700	370,830	152,920	1,739,455
Depth of unconsolidated surface sediments	ft	16	16	14	7
	m	4.9	4.9	4.3	2.1
Total CDF volume to sediment surface	CY	1,984,000	1,360,000	645,000	17,838,900
	CM	1,516,965	1,039,855	493,165	13,639,620
Cap volume[a]	CY	125,000	97,000	50,000	1,000,000
	CM	95,575	74,165	38,230	764,600
Net storage capacity[b]	CY	1,549,000	1,050,000	495,000	16,100,000
	CM	1,184,365	802,830	378,475	12,310,060

[a]Assumes 3 ft (0.9 m) cap depth.
[b]Based on bulking factor of 1.20.

m = meter
ft = foot
CY = cubic yard
CM = cubic meter
km^2 = square kilometer

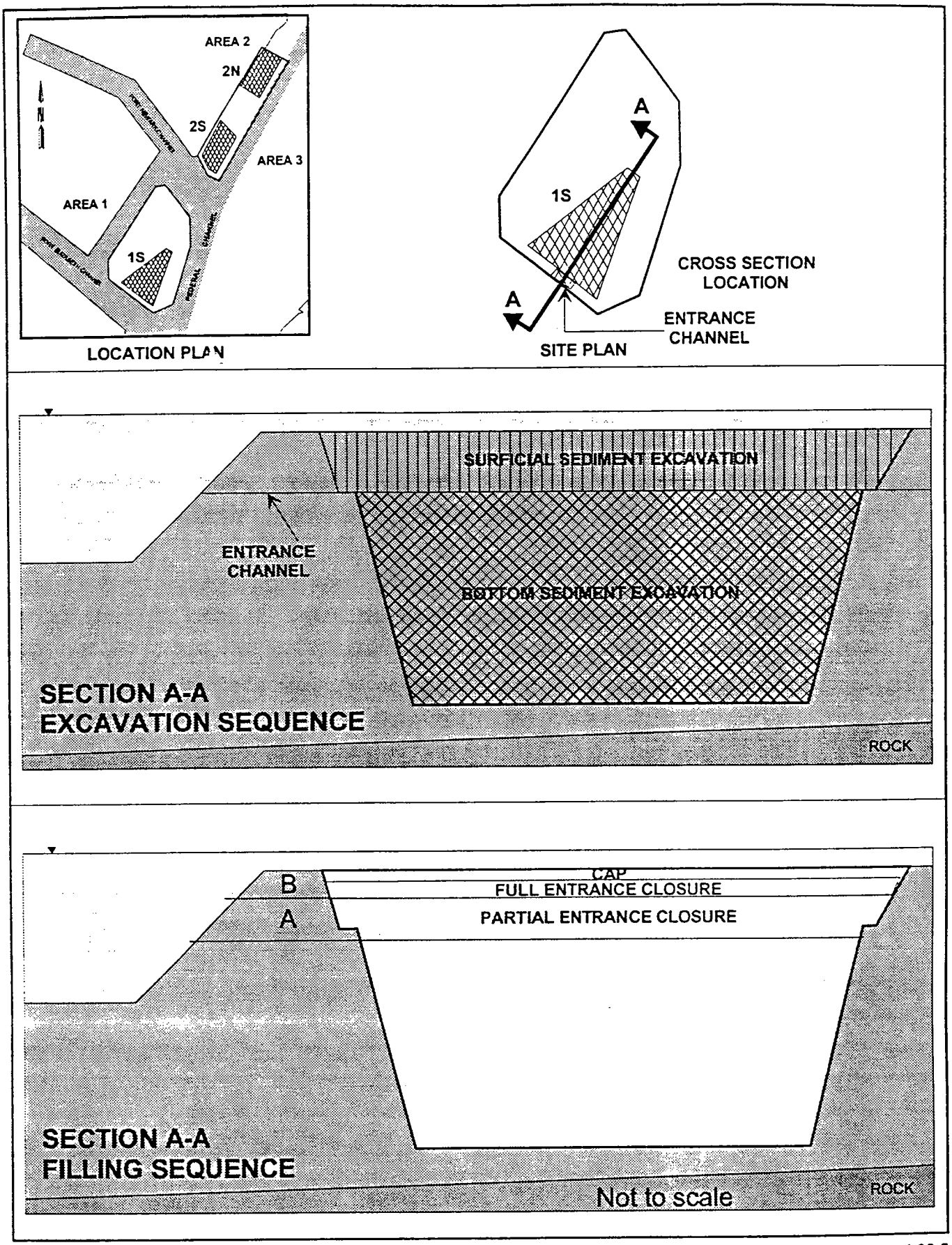


Figure 1.02-5

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Newark Bay Confined Disposal Facility

Excavation and Filling Sequence

characterized would have an impact on the construction of the CDF. The surficial, Category II material (black clayey silt/clay) (Area 1S approximately 579,000 CY [442,700 CM] including access channel material) will be removed using a clamshell dredge equipped with a large environmental bucket. The surficial sediment excavation is shown by the vertical lines on Figure 1.02-5.

When the mud bucket is no longer effective in removing deeper or stiffer material, a smaller more aggressive bucket will be used or a different dredge type (such as a dipper dredge or hydraulic marine excavator dredge [backhoe]) will be brought to the site to complete the excavation. Existing dipper dredges and hydraulic marine excavation dredges are capable of dredging to depths of -70 ft (21 m). The consolidated bottom sediment excavation that would remove approximately 1.4 MCY (1.1 MCM) from proposed CDF Area 1S is shown by the cross hatching on Figure 1.02-5.

At this stage the CDF excavation would be complete and disposal of dredged material from facilities in the draw area as defined in Section 1.01 deemed not suitable for ocean disposal can commence. The perimeter of the CDF will be marked by buoys which will eliminate any potential for disposal of dredged material outside the CDF area. Dredged material can be deposited into the CDF by bottom dumping from split-hull scows until the material reaches the base of the entrance channel. The entrance channel would then be partially filled (A on Figure 1.02-5) to result in a bottom depth of approximately -10 ft (3.1 m) MLW, and bottom dumping continued using smaller scows, more lightly loaded scows, or high water transit. When bottom dumping is no longer feasible due to water depth, the entrance channel will be filled to about three ft below the original surface elevation.

Final filling of the CDF storage capacity will be by removing dredged material from scows using a barge-mounted clamshell bucket. Scows will be positioned inside the CDF at high tide by shallow draft tugs. Dredged material will then be moved with clamshells, lowered through the shallow water to the depth of the previously placed dredged material and opened to release the dredged material. This process will allow a high degree of accuracy in placement location, minimize water quality impacts, prevent the surge due to bottom impact, and obviate the need for hydraulic pumping of dredged material.

The filling of the CDF will proceed from the area farthest away from the entrance channel and proceed in the direction of the entrance channel for all methods of filling in order to maintain the maximum clearance at the entrance channel and to measure the natural slope for the placed dredged material.

When the fill reaches the base of the planned cap, placement of dredged material will cease and the cap will be placed on the CDF to isolate the contaminated sediments from the overlying water column. The sand cap will be placed by sprinkling sand from the end of a hydraulic pipeline. Sprinkling the cap material minimizes displacement of dredged material and the potential for resuspension of contaminated sediment. At this stage the CDF is complete and the long-term integrity monitoring will begin.

1.03 NEED FOR THE PROJECT

The proposed project is a short-term solution designed to address the immediate disposal needs of the Port with a facility that can be constructed by October 1997. The proposed project, if fully developed, will serve the immediate need for a disposal site for dredged material deemed unsuitable for ocean disposal. This project is meant to help keep the Port viable, especially taking into consideration the introduction of larger ships with deeper drafts, while more efficient mid- and long-term disposal alternatives are being developed (USACE-NYD 1995; NJ/NY 1996).

1.03.1 NEED TO DREDGE

Use of the Port facilities requires maintaining adequate water depths in the shipping channels and berthing areas. As the average natural channel depth is approximately 19 ft (5.8 m) and the equilibrium depth of nearshore zones, where berthing facilities are located is approximately 3 ft (1 m), dredging is necessary to maintain authorized depths. If authorized depths are not maintained in the Harbor, water-related industry and commerce are likely to relocate outside the region in order to avoid closing or changing their operations by developing less economic procedures (USACE-NYD 1995; NJ/NY 1996). Examples of changes in operations would include (1) light-loading large vessels or using a larger number of small vessels; (2) additional lightering of petroleum products from large deep-draft ocean-going vessels to smaller shallower-draft vessels; and (3) moving through the Harbor only at high tide.

At present, lightering is necessary in order to use bulk facilities throughout the Harbor (USACE-NYD 1995). Lightering is estimated to involve approximately 913,920,000 gal (3.5 MCM) of fuel per year and increases the amount of vessel traffic between eight and 36 barges per facility per year (N.J. Petroleum Council). Lightering results in an increased risk for serious environmental consequences attributable to spills and safety hazards to vessels due to increased traffic. Risks associated with the additional handling of flammable material are similarly increased.

If the short-term dredging requirements for the Port are not met, commercial users are likely to invest in facilities located in another harbor. Once these investments are made it is unlikely that commercial users will return to the Port of NY/NJ.

In the interests of maintaining short-term viability while working toward a longer-term stability, the following, ongoing efforts have been undertaken:

1. USACE has published the Interim Report on its DMMP and made it available for public review and comment. This document presents a menu of 53 options for the disposal of contaminated dredged material. An Environmental Impact Statement associated with the Final DMMP Report is in preparation with issuance anticipated in September 1998.

2. Regulatory actions related to new opportunities for the disposal of contaminated dredged material are being reviewed by Federal and/or state agencies. The scope of these actions ranges from a few hundred thousand cubic yards to ten million cubic yards. The smaller proposals may serve to meet some very short-term needs for individual facilities whose need to dredge is urgent. The time frame for larger-scale proposals is much more problematic.

3. Six pilot-scale demonstrations of decontamination technologies are ongoing at this time. Pending completion of these demonstrations and evaluation of their results, the most successful of the technologies may be included in a Water Resource Development Act of 1996 authorized 500,000 CY/year/ facility production-scale demonstration and/or move on to full-scale operation. Decontamination may offer a mid- to long-term solution to the dredged material disposal issue.

4. Proposals for "predredging" parts of Newark Bay after the next round of maintenance dredging have been suggested. This would involve deepening channel and/or berthing areas beyond authorized depths and allowing them to become more active depositional areas for the accumulation of sediment.

5. A very short-term technique that has been successful is reprofiling of berthing areas to maintain water depths. Limited amounts of sediment are moved from areas of greatest accumulation to areas of lesser accumulation.

The aforementioned efforts do not provide a panacea. Rather, they indicate the extraordinary lengths to which effort is being made to preserve the viability of the Port.

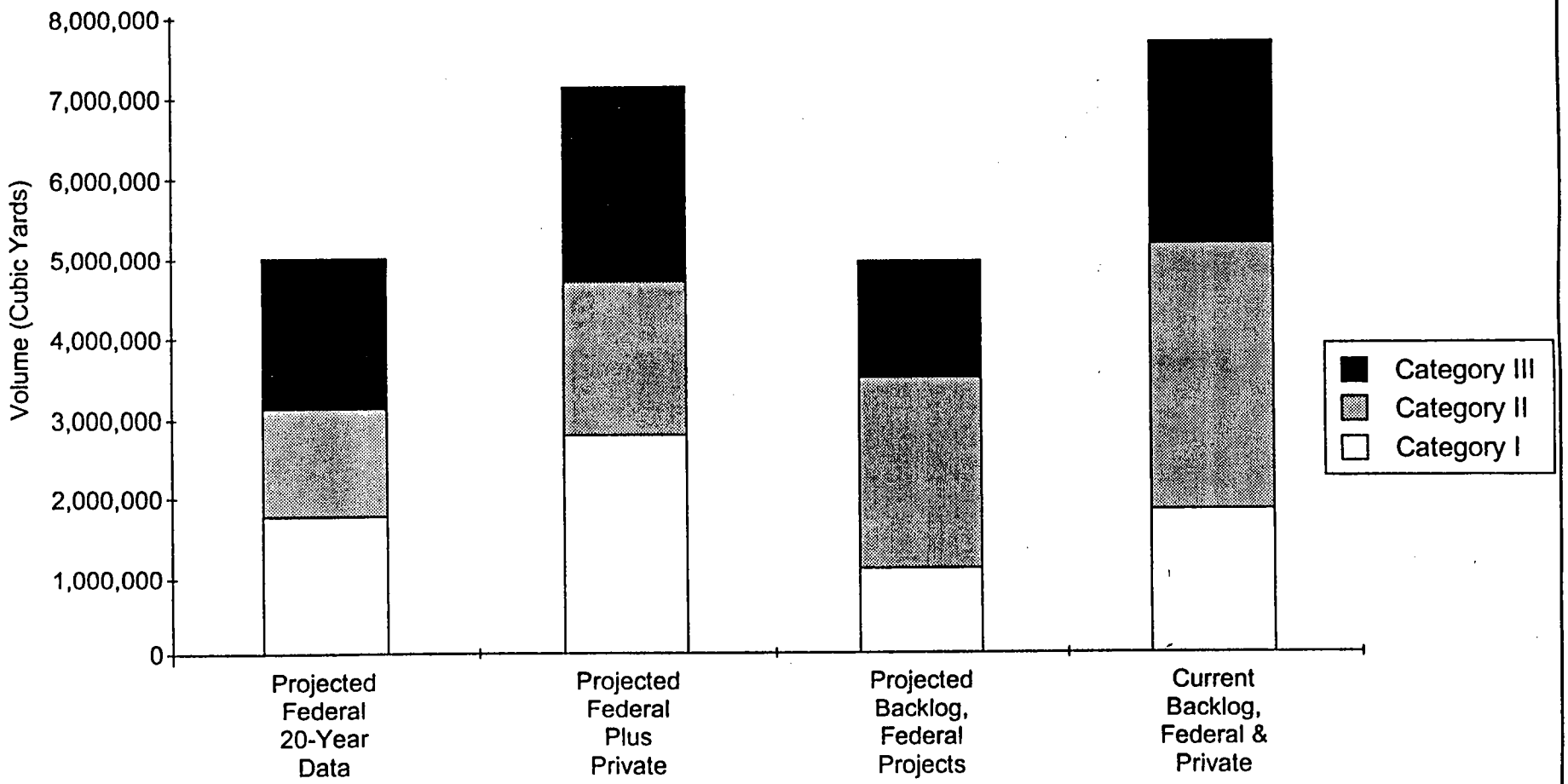
1.03.2 AMOUNTS OF MATERIALS TO BE DREDGED

The POS for the DMMP evaluated 20 years of dredging in NY Harbor and developed preliminary order of magnitude estimates of future dredging needs. Federal navigation projects and private projects together result in an estimated 4 to 6 MCY (3.1 to 4.6 MCM) of dredged materials each year (Figure 1.03-1).

The New Jersey and New York Joint Dredging Plan for the Port of New York and New Jersey (NJ/NY 1996) presents the following dredged material estimates:

- Short-term (September 1997 through 2000) maintenance dredging totals approximately 21 MCY.

- Long-term (2001 through 2025) maintenance dredging totals approximately 115 MCY (4-5 MCY per annum).



Source: USACE (1995).

Figure 1.03-1

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Newark Confined Disposal Facility

Comparison of Dredging Volumes per Year Using Projected Federal and Private Project Volumes and Current Backlog of Federal Projects

- Long-term (2001 through 2025) capital dredging projects could approach 40 to 60 MCY, with higher estimates likely if currently authorized or anticipated channel deepening projects are conducted.

Nearshore areas typical of berthing facilities often have a higher percentage of Category II and III sediments than do the Federal Channel areas. These nearshore areas are more directly influenced by point and nonpoint sources of pollution, and sedimentation may occur at a faster rate due to the lower water velocities within the berthing areas. The POS estimated that between 1.8 and 2.8 MCY (1.4 and 2.1 MCM) of Category III material per year needed to be dredged and disposed of from the Harbor. Between 10 and 15 private projects and 13 Federal projects totaling between 4 and 6 MCY (3.1 and 4.6 MCM) have been delayed due to insufficient disposal capacity.

The dredging database of the Port Authority, MudOne, provides a summary of the total maintenance dredged material volume throughout the Port region (Table 1.03-1). This database comprises information provided by past permit holders and USACE. The database indicates that approximately 1,129,000 CY (863,230 CM) throughout the region are the responsibility of the Port Authority and 17,313,000 CY (13,237,520 CM) the responsibility of USACE, out of a total of 25,719,550 CY (19,665,170 CM) to be generated between 1997 and 2000.

In 1995 USACE and the Port Authority conducted an informal survey on future Port dredging needs. Based on responses to USACE's questionnaire, an estimated total volume of 24,847,600 CY (18,998,475 CM) will require dredging and disposal between 1996 and 2012 (Figure 1.03-2).

Table 1.03-1

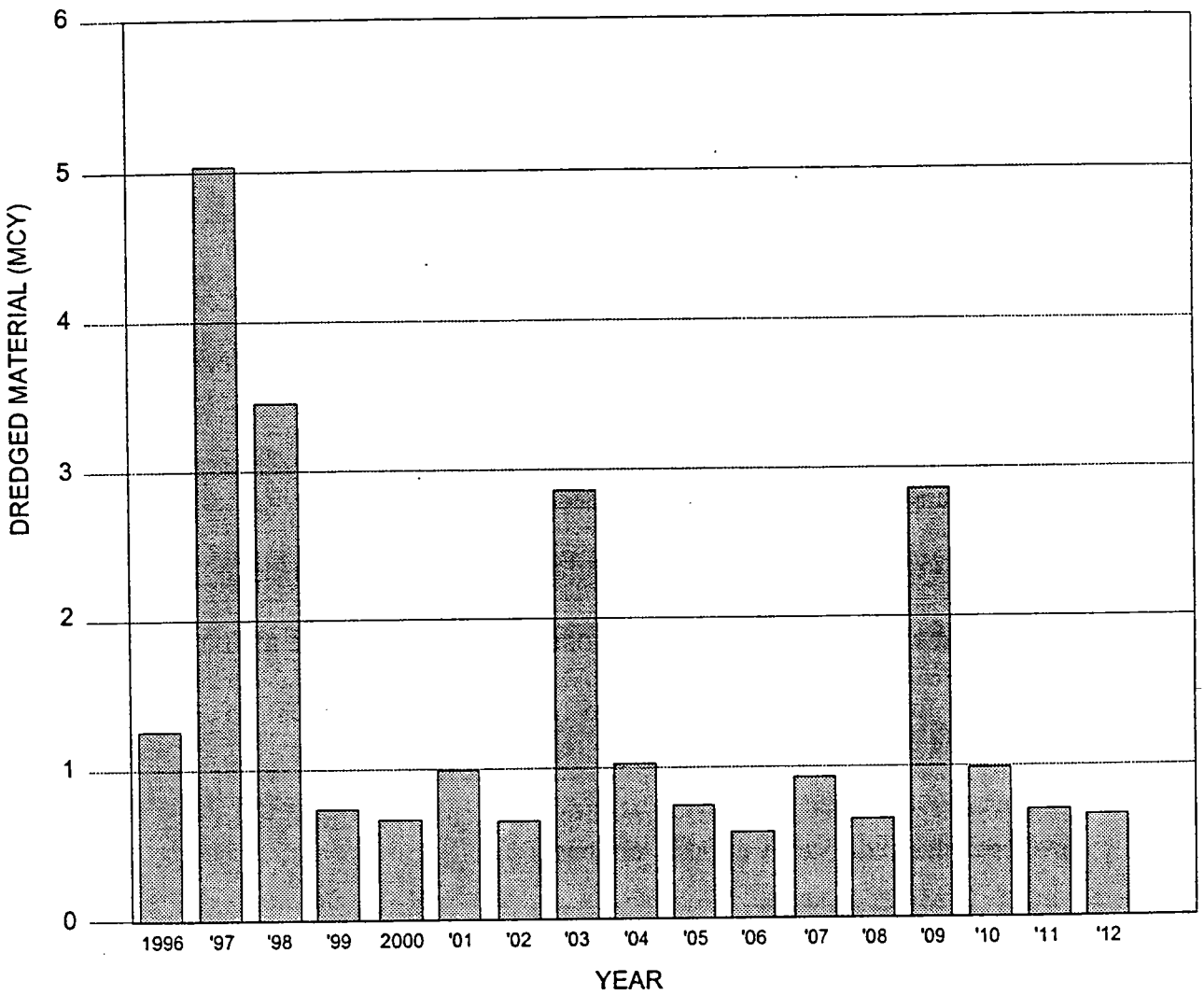
Projected Total Maintenance and Channel Deepening Dredging Volumes
(cubic yards) For 1997 to 2000 in the NY/NJ Harbor Region

Organization	1997	1998	1999	2000
Port Authority				
New Jersey	195,000	0	0	300,000
New York	209,000	145,000	175,000	105,000
Private and Local Government Agencies				
New Jersey	1,129,450	1,135,200	108,800	128,000
New York	2,603,000	690,000	757,000	726,100
USACE[a]				
New Jersey	1,491,000	2,350,000	345,000	0
New York	2,841,000	2,463,000	819,000	731,000
NY/NJ (Federal Navigation Channels)	586,000	5,170,000	0	517,000
Total				
New Jersey	2,815,450	3,485,200	453,800	428,000
New York	5,653,000	3,298,000	1,751,000	1,562,100
NY/NJ	586,000	5,170,000	0	517,000
Total	9,054,450	11,953,200	2,204,800	2,507,100

Source: MudOne, December 1996.

[a]Includes U.S. Navy Facilities.

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Total = 24,847,600 CY

Based on an informal U.S. Army Corps of Engineers Survey
(Some respondents indicated a need and desire to dredge but not amounts)

Figure 1.03-2
Anticipated Dredging Needs in New York-New Jersey Harbor Region

1.04 OBJECTIVES OF THE PROJECT

As stated in the preamble to the bistate plan titled "Joint Dredging Plan for the Port of New York and New Jersey" (NJ/NY 1996), "The continued operation and economic development of the Port facilities and private terminals located in New York Harbor is vital to the regional economy of New York State, New York City, and New Jersey. Additionally, and as importantly, the preservation, conservation, and restoration of the harbor's natural resources are critical to the quality of life in the metropolitan region." The preamble further states that recognizing these overall concerns, and in compliance with parameters developed by environmental groups and Federal agencies, the States of New Jersey and New York developed a plan to accomplish two major objectives vital to the maintenance of the region's navigational assets. The two components of the plan are to:

- Promote greater certainty and predictability in the dredging project review process and dredged material management.

- Facilitate effective long-term environmentally sound management strategies for addressing dredging and disposal needs for the region.

Specific objectives of the bistate dredged material management plan include:

- Maintaining and strengthening the economic vitality of the Port region

- Providing for a comprehensive and coordinated approach to the management of dredged material in the region

- Identifying immediate and short-term disposal requirements and initiating development of long-term disposal options

- Eliminating contaminants at their source

- Supporting continued research into feasibility of decontaminating sediments

The stated goal of the New York Harbor Dredged Material Management Plan: Phase I Report-Plan of Study (USACE-NYD 1995) "is to maintain the viability of the Port while protecting and improving the quality of the environment of the Harbor and adjacent waters."

Dredged material management studies evaluating NY/NJ Harbor disposal options recognize that no single solution will solve the complex problem facing the Port. Potential solutions to the existing dredging and material disposal problem have been broken down into two groups: short-term solutions covering the period September 1997

through the year 2000, and long-term solutions covering the period 2001 through 2025. The criteria for screening and selecting short-term sites include (USACE-NYD 1996):

- Capable of implementation in three years (end 1999)
- Little or no additional data needed
- Expeditious regulatory review is likely
- Environmentally acceptable
- Acceptable cost
- Minimal disposal capacity of one year (for Category II and III material)

One of the short-term options listed in both dredged material management plans for the disposal of dredged material deemed not suitable for ocean disposal is the development of a subaqueous CDF in Newark Bay (NBCDF). Previous studies conducted on aquatic CDFs indicate that the subaqueous CDF option, and the proposed NBCDF in particular, meet the following short-term disposal criteria: (1) A substantial Newark Bay environmental database exists, (2) the proposed project has minimal and short-duration environmental impacts, (3) permitting for the proposed project will require regulatory review, but can be completed within the project's proposed time frames, and (4) the CDFs can be constructed and be operational in a relatively short period of time. The projected capacity of the NBCDF can meet part of the short-term disposal requirements from the draw area for dredged material deemed not suitable for ocean disposal. The proportion of material that might be accommodated in the NBCDF would vary strongly depending upon the alternative selected (see Sections 2.03.3 and 2.03.4). The currently proposed action (Alternative 2) would provide space for approximately 65% of New Jersey's projected needs based on the above table. If Alternative 1 were undertaken only 40% of New Jersey's need would be met. The NBCDF must be viewed as one of several complementary solutions being investigated at this time.

The objective of the proposed project and alternatives evaluated is to provide a repository for dredged material deemed unsuitable for ocean disposal from a draw area defined as waters of the NY/NJ Harbor, contiguous to the State of New Jersey, including Newark Bay, the Arthur Kill, and the Kill Van Kull (Figure 1.04-1). The draw area was defined pursuant to discussions with representatives of New York and New Jersey to optimize the objectives of the Joint Dredging Plan.

The overall objective of the NBCDF EIS is to assess the potential impact of the construction, operation, and closure of the proposed NBCDF and its alternatives on Newark Bay and the New York/New Jersey Harbor. The evaluation of potential environmental impacts and a determination that any adverse environmental impact could be mitigated are required to obtain the necessary Federal and state approvals for the project.

1.05 CONNECTED, CUMULATIVE, AND SIMILAR ACTIONS

Dredging has been a necessary part of shipping in New York Harbor; thus, parts of the bottom habitat in the Harbor are disturbed by or recovering from dredging on an almost continuous basis. Some areas of the Harbor have been dredged numerous times in order to maintain adequate depths for ships. Dredging causes temporary disruptions of bottom habitat, a temporary increase in turbidity, and exposure of aquatic life to contaminants released during the dredging. Similar effects will occur at disposal sites for the dredged material, except that the exposed bottom habitat is covered rather than exposed.

Studies in New York Harbor and other coastal environments have shown that open-water estuarine habitats recover from dredging at a relatively rapid rate (USACE/Massport 1995). The rate of recovery will vary from site to site, but generally aquatic life returns to a dredged area in less than a year. Some aquatic life forms will recolonize dredged areas in a matter of weeks. The rate of recovery of dredged areas is an important factor in the assessment of cumulative effects of similar types of actions that cause habitat disruption. The timing of similar actions in relation to the dredging and filling activities of the proposed NBCDF must be related to the expected rate of recovery at each site in order to assess the cumulative effects of all actions. NBCDF utilization will cause habitat disruption for a period of time as dredged material is added to each disposal pit.

NY/NJ Harbor projects that are likely to occur during the construction, operation, and closure and that may directly and indirectly affect the proposed NBCDF include:

- Dredging and reprofiling of berthing facilities and shipping channels at various locations in the New Jersey portion of the Harbor.

- Remediation of hazardous waste sites in the Hackensack Meadowlands and other Newark Bay watershed areas, which may contribute contaminants to the waters of the Bay.

1.06 REFERENCES

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2.0 ALTERNATIVES ANALYSIS

Since 1977 dredged material disposal alternatives evaluated for the Port of New York and New Jersey have focused on the containment of large volumes of dredged material unsuitable for ocean disposal. More recently, in 1993, the Port Authority of New York and New Jersey experienced difficulties in obtaining permits associated with disposal of sediments for Port Newark/Elizabeth dredging projects. Additionally, the costs for disposal of dredged material for recent Port Authority projects have been high. In response to these difficulties and concerns over the environmental impact of these activities, a task force for dredged material management was established by New Jersey Governor Christine Todd Whitman. The Governor's DMMT, chaired by Assemblyman Steven Corodemus, issued its final report in early 1995. The first recommendation of the DMMT was ". . . construction and utilization of subaqueous pits in Newark Bay for the disposal of contaminated sediments taken from the Port of New York and New Jersey" (DMMT 1995). Preliminary site recommendations, that have changed the estimated volumes, and estimated costs were given in the report. The project proposed by the Port Authority and described in Chapter 1 was developed from the DMMT's recommendations. Events that have occurred since the DMMT's recommendation that have changed the configuration and capacity of the Newark Bay CDF are described in Section 2.03-3.

2.01 CRITERIA FOR ALTERNATIVE SELECTION

As this project was deemed a major Federal action, an environmental impact statement (EIS) to evaluate the impacts of the proposed project and its feasible alternatives is required by the National Environmental Policy Act (NEPA). The proposed alternative for the disposal of sediments deemed unsuitable for ocean disposal must be evaluated in the context of other alternatives that may have different and/or lesser environmental impacts. The phrase "sediments deemed unsuitable for ocean disposal" most commonly refers to Category III sediments (see Chapter 1). However, changing circumstances result in sediments currently classified as Category II becoming eligible for disposal in the proposed facility.

Potential alternatives to the Port Authority's proposed project were evaluated in a three-phased screening process. The first phase considered potential alternative dredged material disposal strategies (Section 2.02). The second phase considered alternative locations for the proposed facility (Section 2.03). The third phase considered alternative construction methods (Section 2.04). The screening process considered the objectives identified in the Dredged Material Management Plan (USACE-NYD 1991) and used these objectives to develop the specifics required of feasible alternatives for the NBCDF. These criteria included:

Table 2.02-1

Summary of Alternatives Screening Criteria

Alternative	Screening Criteria						Acceptable for Further Consideration?
	Permitability	Capacity	Timing	Constructibility	Unsuitable Ocean Disposal*	Environmental Acceptability	
Ocean Disposal at Shallow Ocean Sites (Mud Dump Site)	o	+	o	o	•	•	No
Deep Ocean Disposal	o	+	•	o	•	o	No
Ocean Spreading	•	+	o	o	•	o	No
Containerized Ocean Disposal	•	+	•	•	o	o	No
Disposal in Abandoned Interpier Basins	•	•	o	o	+	•	No
Incineration	o	o	•	o	o	•	No
Aquatic Containment Islands or Peninsulas	o	+	•	o	o	o	No
Subaqueous Borrow Pits in the Lower Harbor and the Bight Apex	•	+	•	+	+	•	No
Subaqueous Confined Disposal Facilities	+	+	+	+	+	+	Yes
Upland Disposal	•	+	•	o	o	o	No

* Must not involve disposal of unsuitable sediments in the ocean.
o Indicates not evaluated or not applicable.
+ Indicates alternative is viable in this selection criteria.
• Indicates primary elimination factor.

Deep Ocean Disposal. Deep ocean disposal would involve the creation of an ocean disposal site beyond the continental shelf. Major problems are associated with thisalternative, including the economics of transporting dredged material long distances, potential environmental impacts to an undisturbed ocean site, and disposal dispersion considerations associated with a deepwater ocean site. Additionally, at least two years are necessary to identify a site, prepare an EIS, and permit the site, and this time frame does not meet the requirements of the short-term project. As a result, this alternative does not meet the objective of short-term availability and was dismissed from further consideration. Current regulations prohibit deep ocean disposal.

Ocean Spreading. The ocean spreading alternative was given initial consideration due to its potential to prolong the useful life of the MDS. The process of ocean spreading involves dispersive and nondispersive techniques for placing uncontaminated dredged material on already disturbed ocean bottom areas. This alternative was eliminated from further consideration because it cannot accommodate dredged material that is unsuitable for ocean disposal. Ocean spreading is currently prohibited.

Containerized Ocean Disposal. Containerized ocean disposal assumes that dredged material would be placed in sealed containers and disposed of in the ocean. To date, no sites have been identified for this method of disposal. Additionally, this method may be inconsistent with the London Dumping Convention, which eliminates it from further consideration. Current regulations do not permit containerized ocean disposal.

Disposal in Abandoned Interpier Basins. Disposal in abandoned interpier basins involves the placement of dredged material behind barriers, e.g., sheet piles, erected around and between abandoned piers. Because there are few interpier areas presently available for filling (River Terminal and Long Ship Canal), this alternative provides limited capacity, does not satisfy the volume criterion for the project, and may involve permanent loss of aquatic habitat although it may be viable for disposal of small volumes of dredged material. USACE has identified a number of environmental issues associated with disposal of dredged material at abandoned interpier sites. Most significantly, interpier basins provide valuable habitat for overwintering striped bass. Certain piers are listed on New Jersey's State Historic Preservation List. If fish habitat and/or cultural resources are to be maintained while still using an abandoned pier for dredged material disposal, capacities are reduced to the point that disposal in abandoned interpier sites is no longer feasible. Therefore this alternative was eliminated from further consideration because it does not provide much capacity and may involve permanent loss of aquatic habitat.

Incineration. Incineration is most effective when applied to fine-grained material with a high organic carbon and organic contaminant content. Incineration does not destroy metallic contaminants, and in some cases it produces dioxins. Ash, a byproduct of incineration, requires disposal.

There is limited access to incineration facilities, and properly equipped incinerators are not presently available in the NY/NJ area. The engineering, permits, and approvals needed to site a new incinerator could not be achieved in the short-term time frame. This alternative is eliminated from further consideration because incineration does not meet the short-term objective, is limited to small volumes of material, and involves significant environmental issues.

Aquatic Containment Islands or Peninsulas. Aquatic containment facilities involves a breakwater or diked area in open water into which dredged material is placed, ultimately creating a peninsula attached to land or a containment island separated from land (USACE-NYD 1995). Containment islands, have the potential to accommodate long-term dredging requirements. For instance, a 500-acre containment island could provide a capacity of approximately 28 to 150 MCY (21-115 MCM) of dredged material, depending on water depth and the type of dikes used. In addition, a containment island is engineered to isolate dredged material unsuitable for ocean disposal from the biosphere.

The current status of implementing an island involves siting efforts by USACE New York District (NYD) and the Waterways Experimental Station (WES), cost estimating by USACE-NYD, and cooperative planning efforts between the Port Authority, USACE-NYD, and state and local governments. An absolute minimum of three to four years would be required to site, permit, and construct an island. This lengthy time requirement eliminates a containment island from consideration as a short-term alternative.

Subaqueous Borrow Pits in the Lower Harbor and the Bight Apex. Subaqueous borrow pits or CDFs are depressions in the harbor or ocean floor, either preexisting or newly excavated, where disposal of dredged material unsuitable for unrestricted ocean disposal may be an option. Subaqueous pits may be capable of accepting large volumes of dredged material, depending on the size of the depression. Clean sediment could be used to cap and isolate the underlying contaminated dredged material. Existing excavated depressions located in the Lower New York Bay are the result of past sand and gravel mining operations. According to the "Final Supplemental Environmental Impact Statement: Use of Subaqueous Borrow Pits for the Disposal of Dredged Material From the Port of New York-New Jersey," prepared by USACE in January 1991, the Large East Bank Pit, located in the Lower Bay east of the Ambrose Channel off of Coney Island, was the most economically and environmentally suitable for disposal of dredged material. This site could provide disposal capacity for up to 6 MCY (4.6 MCM) of dredged material deemed unsuitable for ocean disposal. This and other sites were identified by the 1991 FEIS. The New York State Department of Environmental Conservation (NYSDEC) is currently evaluating potential impacts associated with the use of the existing pits, particularly the East Bank Pit. USACE currently has an application pending for the use of the Lower Bay pits before NYSDEC.

The Port Authority attempted to use the CAC pit (located west of the Chapel Hill Channel) in 1995 for disposal of contaminated dredged material that would have been

dredged from the Howland Hook Marine Terminal. Approximately half the material would have been enclosed in geotextile containers for disposal. The original proposal was to use the bagged material to cap unbagged sediments. This plan was later modified in favor of a plan to use the bagged material to create a berm adjacent to the eastern wall of the CAC Pit, behind which the unbagged material would be placed. The berm and material disposed behind it would then be capped by 3 ft (1 m) of sand.

The Port Authority later modified its application to use the CAC Pit in favor of an upland disposal option. The Port Authority's decision was made with the concurrence of the City of New York, the owner of the Howland Hook facility. The decision recognized the difficulties attendant in the permitting process and the desire of the Port Authority and the City of New York to dredge and reopen the facility at the earliest possible opportunity. At the time of the amended application, the Port Authority had not yet received a notice of complete application from NYSDEC, with one or more years anticipated as the time needed to complete the application.

Construction of new pits was also discussed in the 1991 Borrow Pit FSEIS. However, because of the added expense to create a pit, the use of existing pits was the preferred alternative. Accordingly, new pits were not pursued by USACE after the 1991 FSEIS. As part of a report on dredged material management alternatives, USACE-NYD is conducting a siting study in cooperation with WES to identify potential sites in the New York Harbor and Bight for new pits. The additional cost of new pits can be justified by a number of factors, such as siting to minimize adverse environmental impacts, special design to maximize containment efficiency, and proper planning for mitigation measures. Construction design and cost estimates will be part of this report. The use of existing borrow pits for the disposal of contaminated dredged material is considered an implementable alternative; however, siting and permitting for this alternative will take more than two years, which does not meet the time criterion for this project. Therefore, this alternative is eliminated from further consideration.

Subaqueous Confined Disposal Facilities in Newark Bay

As described previously, the New Jersey Governor's DMMT recommended construction of subaqueous CDFs in Newark Bay for the disposal of contaminated sediments. As described in Section 1.0, the Port Authority studied Newark Bay to determine the engineering and environmental feasibility of creating new pits for subaqueous disposal of dredged material. Studies included bathymetric measurements, geotechnical borings, chemical analysis of sediments at multiple locations and depths, biological sampling, and engineering analyses. Numerous public interest groups have reviewed the information, and the New Jersey DMMT and the Dredged Material Management Forum Containment Workgroup have reviewed the scientific findings.

Three areas west of the Federal Navigation Channel with a combined volume of over 3 MCY have been studied. A CDF in Newark Bay meets the objectives and is feasible

with respect to timing, constructability, capacity, permitability, and environmental acceptance. This alternative is further discussed in Section 2.02.

Upland Disposal

During the permit and approval process for each dredging project, upland disposal options are evaluated as the primary alternative to any "in-water disposal" option. The capacity available at permitted upland sites is insufficient to accommodate the existing need for dredged material disposal. Additional, new sites are required for this alternative to be viable. A number of sites for upland disposal facilities have been identified for dredged material deemed unsuitable for ocean disposal (see Appendix 2.02). However, all proposed projects are evaluated on a case-by-case basis and the length of time required to secure a suitable site, select a design engineer, perform wetlands delineations, conduct surface and groundwater studies and modeling, prepare the engineering design, and obtain the requisite permits for an upland disposal site is estimated to be approximately two years. This does not meet the required schedule, eliminating upland disposal as a viable alternative. The Orion site (discussed in greater detail in Appendix 2.01) is not considered a feasible alternative because the dredged material processing rate will not allow for disposal of sufficient contaminated sediment before its scheduled closure in October 1997. It is also noted that the expected processing rates for materials going to Orion have not been achieved.

In order for an upland New Jersey site to be considered as a viable disposal option for dredged material, the site must comply with permitting regulations regarding construction, operation and closure of upland CDFs, described in "Management and Regulation of Dredging Activities and Dredged Material in New Jersey's Tidal Waters" (NJDEP 1996). The estimated time required to complete the permitting process for the New Jersey Pollutant Discharge Elimination System (NJPDES) regulations (N.J.A.C. 7:14A), Ground Water Quality Standards (GWQS; N.J.A.C. 7:9-6.), and the wetlands permitting process is one year (NJDEP, pers. commun., J. Peccholi, 31 July 1996). Contracting engineering studies, conducting the studies, and preparing the required documentation could take an additional year. Current New York State regulations exempt dredged material from solid wastes regulations under 6 NYCRR Part 360 when both excavation and disposal are permitted under the Federal WPCA and companion state statutes and regulations.

2.02.2 SCREENING OF ALTERNATIVES

The selection of feasible alternatives from among the alternatives evaluated in the Phase 1 literature search was based primarily on meeting the project objectives of capacity, permittability, timing, environmental acceptability, constructability, and the capability of sites to accommodate dredged material deemed unsuitable for ocean disposal. Table 2.02-1 summarizes the alternatives and their ratings with respect to each factor.

The alternative that best meets the project objectives is construction of a CDF such as that recommended by the DMMT. CDFs are suitable for dredged material deemed unsuitable for ocean disposal and provide a short-term solution for dredging requirements. The CDF alternative requires excavation of one or more pits, mechanical deposition of dredged sediment unsuitable for ocean disposal, and a cap to contain dredged material. The primary advantages associated with CDFs are:

- They have a long-term ability to isolate sediments from the water column, thereby limiting contaminant bioavailability and potential for bioaccumulation.
- They have minimal adverse impacts to aquatic resources and human health.
- They can be readily constructed or, as in the case of preexisting pits, are immediately available.
- They are a proven technology that has been used successfully in other areas of the United States and around the world.
- They are permittable under existing regulation and authority.
- They minimize waterborne and landside transportation.

Following the screening of disposal alternatives, the subaqueous CDF was selected as the most appropriate alternative dredged material disposal opportunity. Next, several alternative locations for a CDF within Newark Bay were evaluated.

2.03 ALTERNATIVE LOCATIONS WITHIN NEWARK BAY

Newark Bay has several characteristics conducive to the development of a CDF and this was recognized by the DMMT (DMMT 1995), which limited the search for a subaqueous CDF to the immediate Newark Bay Complex. The Bay has large shallow areas with depths and sediments that are appropriate for the construction of CDFs. These areas are close to existing channels thus avoiding the construction of lengthy access routes for construction and disposal barges. The Bay and adjacent waterways contain sediments that are unsuitable for ocean disposal, providing an abundant source of potential disposal material. The use of Newark Bay isolates contaminated sediments in an area already contaminated rather than transporting this material to an uncontaminated environment. Both the DMMT and the Port Authority support a Newark Bay location.

In addition, the New York-New Jersey Harbor Estuary Program's (HEP) Comprehensive Conservation and Management Plan (CCMP) which defines specific actions to cleanup, protect, restore, and enhance the Harbor/Bight ecosystem, calls for the practical integration of contaminant reduction (or isolation of bioavailable toxics) with dredging projects. A Newark Bay location contributes to the goal of contaminant reduction by removing contaminants known to be present in surficial sediments and replacing them with a clean cap. The sources of these contaminants are described in Chapter 3.

2.03.1 DESCRIPTION OF ALTERNATIVE LOCATIONS

Locations for subaqueous pits in Newark Bay were determined from data collected by the Port Authority and USACE. The evaluation of suitable locations included sites east and west of the Federal Navigation Channel in the vicinity of Port Newark, southwest Newark Bay north of Shooters Island, and north of the I-78 New Jersey Turnpike Bridge. These areas are shown in Figure 2.03-1 and are discussed below:

- ***Northwest of Shooters Island.*** Historically, this area had water depths in excess of 10 ft, although the present depths are generally less than 5 ft. The accumulation of sediment in this area is believed to be influenced by construction of a submerged dike (the U.S. Dike) along the northern limit of the North of Shooters Island Reach. The U.S. Dike was constructed to reduce sediment accumulations within the North of Shooters Island Reach. Construction of the U.S. Dike caused accelerated rates of deposition from the 1970s through present time (Moffat and Nichol 1996).

  Construction and operation of a CDF in this location would not be possible due to the extensive number of buried cables and pipelines.

- ***Newark Bay North of the I-78 New Jersey Turnpike Bridge.*** This area was eliminated for the following reasons: (1) a number of underground utilities cross Newark Bay north of the I-78 Bridge; (2) this area was selected as the discharge point for the Passaic River Flood Protection

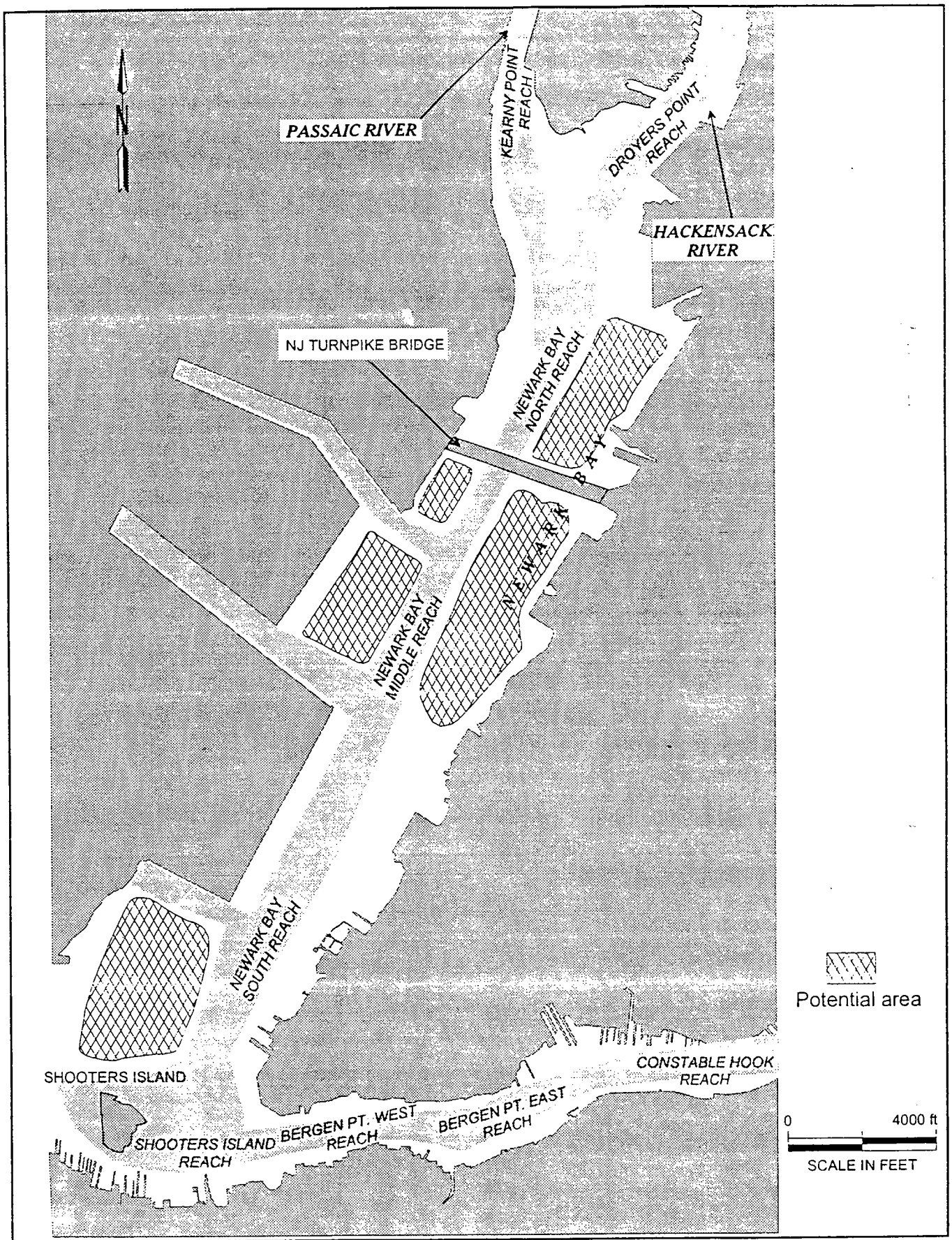


Figure 2.03-1

U.S. Army Corps of Engineers
Newark Bay Confined Disposal Facility

Potential NBCDF Locations

Project's Tunnel Outfall, and while the Flood Control Tunnel Project was recently put on hold by the sponsoring agency (USACE), this project could be reactivated; (3) the area available north of the I-78 bridge for a pit does not provide sufficient storage capacity; and (4) no subbottom sediment chemistry data are available for this area. This data gap would require additional field work that would delay progress on implementation of this critically needed project. For these reasons, this area was eliminated from additional evaluation.

- ***Newark Bay West of the Federal Navigation Channel Adjacent to Port Newark.*** This area is the location proposed by the Port Authority and evaluated by the DMMT. Originally, it was estimated to provide a capacity of 14 MCY. To confirm the site as a viable location, the Port Authority undertook an extensive sampling effort that included geotechnical and chemical analysis of sediments. The results of tests conducted to determine the acceptability of in situ surficial sediments for ocean disposal indicated the presence of contaminants that rendered large portions of the location unsuitable for ocean disposal. These data are presented in Section 3.04, Sediments. From the larger west side areas originally evaluated, three smaller areas with different toxicological characteristics have been identified as potentially feasible for construction of pits (Figure 2.03-2). These Areas 1S, 2S, and 2N are discussed in Section 2.03.3.

- ***Newark Bay East of the Federal Navigation Channel Opposite Port Newark.*** This alternative locates a CDF in Newark Bay east of the main Federal Navigation Channel in the vicinity of the City of Bayonne, New Jersey (Figure 2.03-2). This site, Area 3, could potentially create a 12.7-MCY capacity CDF, assuming that dredged sediments placed in the pit will bulk (i.e., increase in volume) by 20% Unlike the west-side location, detailed feasibility studies have not been conducted for this area, although some sampling of sediment chemistry was conducted in 1995. There are few site-specific geotechnical data, and sediments from Area 3 have not been tested for bioaccumulation potential in marine organisms to determine their suitability for ocean disposal. The time to complete the geotechnical and ocean disposal testing necessary to develop a construction design for an east-side CDF will require a six-month delay from the date specified for receiving dredged material in the CDF. Thus, this alternative does not meet the schedule required for the project.

2.03.2 ENVIRONMENTAL EFFECTS OF ALTERNATIVE LOCATIONS

A larger CDF could be constructed on the east side than on the west side because the depth of the contaminated surficial layer appears to be thinner on the east than on the west. The construction cost per cubic yard of dredged material disposal would be less

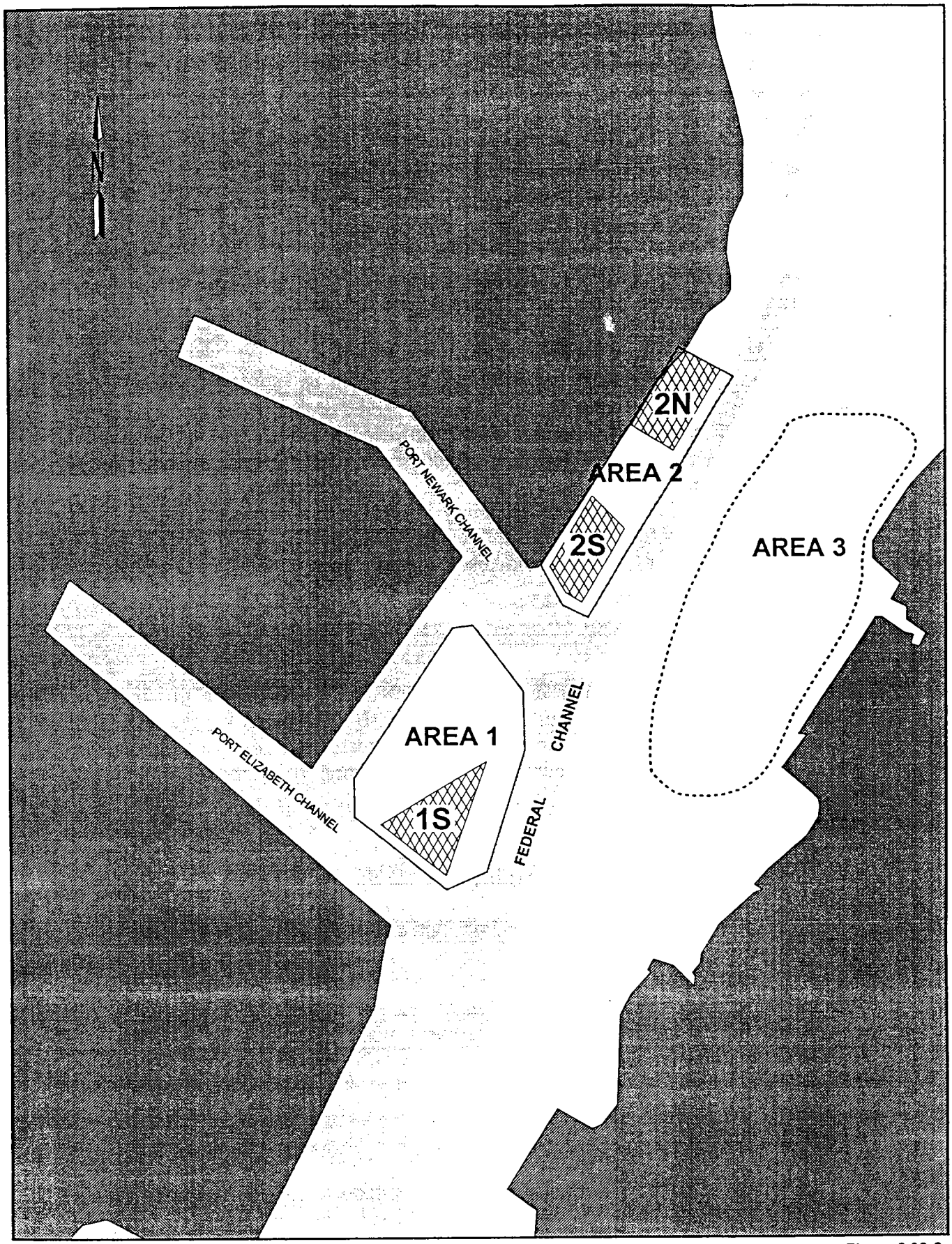


Figure 2.03-2
East and West Side Locations

and larger volumes of contaminated sediments could be sequestered in the CDF. The benefit of sequestering large volumes of contaminants makes the Area 3 locationattractive from the perspective of long-term and cumulative impacts to the general environment.

In view of the potential value of the east-side location, the short-term impacts associated with construction and operation of an east-side location are compared to those of west-side alternatives. The screening-level assessment presented here compares effects that might be expected. Detailed impact assessment of a CDF located on the west side of Newark Bay is given in Chapter 4. Environmental effects that would differ because of differences in the **location** of the facilities are described below.

Among the CDF alternatives on the east or west side of the Federal Channel, no site-specific differences are likely to be associated with effect on physical oceanography, meteorology, fish, wildlife, benthos, wetlands, endangered or threatened species, critical habitats, flooding, hydrology or human health. However the differences in the potential size of projects in the different locations would result in differences in the **scale** of temporary impacts to fish, benthos, wildlife, water quality, and socioeconomics. For example, a larger CDF would cause temporary disruption to a larger area of the Bay's bottom habitat dislocating more fish and benthic organisms. With respect to the socioeconomics, a larger project would result in more jobs in the Newark Bay area during construction and operation.

Air Quality

Impacts on air quality are similar in nature at each site; however, the proximity of residential communities would result in more sensitive receptors on the east side compared to the west side. The east side would be greater in scale due to the longer construction schedule and greater number of barges entering the larger site.

Aesthetics

An east-side location, temporarily detracting from the Bay, would place the CDF closer to residences and parks, thus temporarily detracting from the visual quality of the Bay more than a facility located more distant from potential view sites. The pleasant visual quality of the east side as viewed from the New Jersey Turnpike Bridge would be temporarily disturbed by the presence of construction equipment. An east-side location would also have more significant visual impacts because of the longer time required to excavate and fill the larger pit. Bayonne residents would be subject to dredging and excavation operations for three to four years, compared to one to two years for smaller alternatives.

Cultural Resources

There are known shipwrecks in the east-side area. Impacts to cultural resources cannot be determined without additional studies of these wrecks and any others that may be

present. However, the presence of wrecks suggest that additional analyses of impacts to cultural resources would be required to assess the size and feasibility of the east side location.

Navigation

The east side is more removed from the Port Elizabeth/Port Newark berthing areas, resulting in less potential for traffic congestion in the channels near the ports. However, more vessels would be required to construct and deliver dredged materials to the larger site. Consultation with the Coast Guard and Harbor Pilots Association would be needed. Overall projected effects to navigation would be small.

Land Use

A west-side location is more consistent with the existing land use characteristics than an east-side location. The east side is dominated by residential areas and recreational facilities. The west side is dominated by shipping and transportation facilities.

Noise

Noise associated with construction and operation would have a greater potential impact on the residential community on the east shore and would not be noticeably different from the existing uses on the west-side. The City of Bayonne has noise level restrictions that would limit the hours of construction and operation of an east-side CDF, potentially extending the construction schedule.

In summary, with the exceptions of effects associated with the proximity of an east-side location to residential areas and effects related to differences in the scale of the alternatives, potential environmental impacts associated with east and west locations are similar. The east side alternative may not meet the project criteria of availability by October 1997.

2.03.3 ALTERNATIVE CDFs

The CDF project initially recommended by the New Jersey Governor's task force and described in a public notice on 31 May 1995 was located on the west side of the Federal Navigation Channel. The project included two pits covering 160 acres (0.65 km^2) and had a capacity of approximately 14 MCY (10.7 MCM). As originally conceived, the project called for disposal of surficial contaminated sediments in a CDF, with the balance of the dredged material being disposed of at the MDS, or to be used for beneficial purposes. The Port Authority initiated a feasibility evaluation that included analyses of sediment chemistry. The resulting data suggested that large portions of the areas proposed for the pits were contaminated and would not qualify for ocean disposal. The size of the project was reduced to three smaller pits with an estimated capacity of 3 MCY (2.3 MCM).

An addendum to the public notice was issued and additional geotechnical and environmental sampling was conducted in the smaller areas. Results of the toxicity and bioaccumulation testing to evaluate suitability for ocean disposal showed that surface sediments from two of the three smaller areas are not acceptable for ocean disposal. Because sediments from sites 2S and 2N failed ocean disposal criteria, only Area 1S can be developed in accordance with the original plan. As described in Chapter 1, a CDF in Area 1S would have a capacity of about 1.55 MCY (1.1 MCM). Approximately 579,000 CY (442,703 CM) of Category II material on the surface of Area 1S would be transported to the MDS. The balance could be used as capping material at the MDS or for other beneficial purposes.

As described in Section 2.02.1, the Federal Government announced the closure of the MDS to Category II material by September 1997. After that time only Category I material needed for specific remediation purposes can be deposited at the MDS. At this time the volume of material that can be accommodated at the MDS and the specifications for material that can be used for capping are under review by USEPA. The final design of the CDF cannot be completed until the feasibility of using the MDS for disposal of in situ sediments is known.

Given the presence of sediments that are unsuitable for ocean disposal in Area 2S and 2N, the imminent closure of the MDS, and uncertainties associated with the suitability of all Category I-type materials for remediation at the MDS, the configuration of alternatives discussed in this FEIS has included several alternatives that do not meet the original project objectives. These alternatives (Table 2.03-1) have been included to allow for flexibility in modifying or expanding the project in the event that circumstances change (as is the case for Area 3).

Table 2.03-1

Summary of Newark Bay CDF Alternatives

Alternative	Description	Capacity
(1) Area 1S only	Category I & II to MDS	1.55 MCY
(2) Area 1S, then open 2S & 2N	Category III to 1S	2.41 MCY
(3) Area 3*	Category I and II to MDS	≈16.10 MCY
(4) Area 3, then 1S, 2S & 2N open	Category II & III to Pit 3	19.19 MCY
(5) No CDF	No Action	0 MCY

*Area 3 sediments, have not been tested for ocean disposal. It is assumed that surface sediments would be acceptable for ocean disposal.

Alternative 1, Area 1S

This alternative proposes to create one CDF in Area 1S on the west side of Newark Bay. Area 1S has a surface area of 25 acres (0.10 km^2) and is located west of Newark Bay

Middle Reach Channel, north of the mouth of Port Elizabeth Channel, south of the mouth of Port Newark Channel, and east of the Pier-Head Channel (Figure 2.03-2). The surficial sediments of Area 1S are estimated at 579,000 CY (442,700 CM) (Table 1.02-1). This Category II material would be transported to the MDS and would be capped. The remainder of the material dredged from Area 1S (1.41 MCY [1.07 MCM]) is suitable for unrestricted ocean disposal and may also be suitable as capping material. The storage capacity of Area 1S is 1.55 MCY (1.1 MCM).

Alternative 2, Areas 1S, 2S, and 2N

This alternative is also on the west side of Newark Bay and is composed of Areas 1S, 2S, and 2N. Area 2N with a surface area of 9.8 acres (0.04 km^2) is located north of Area 2S. Area 2S has a surface area or 20.9 acres (0.08 km^2) located between Areas 1S and 2N. Area 2S and Areas 2N are both west of Newark Bay North Reach Channel and north of Port Newark Channel.

The surficial materials from Area 1S would be transported to the MDS and capped. The remainder of dredged materials from Area 1S is suitable for ocean disposal and may also be suitable as capping material. The upper layer from both Areas 2S and 2N has not passed ocean disposal testing criteria and could be deposited in Area 1S or disposed of at a state approved upland disposal site. Surficial material from Area 2S are estimated to be 485,000 CY (370,830 CM). Surficial materials from Area 2N are estimated to be 200,000 CY (152,920 CM). Combined, the excavation of the three locations (Areas 1S, 2N and 2S) creates an estimated capacity of 2.41 MCY (1.84 MCM) if surficial sediments from Areas 2S and 2N are deposited in Area 1S and 3.09 MCY (2.29 MCM) if surficial sediments are disposed of at a state approved upland disposal site.

Alternative 3, Area 3

This alternative was described in Section 2.03.1. It would place a large-volume (16 MCY) capacity CDF on the east side of the Navigation Channel. Sediments in this area have not been tested for ocean disposal but the available data indicate that sediments in this area may be Category I or II.

If additional subaqueous CDFs are needed, the east side location (Area 3) warrants further consideration. Existing, although limited, data suggest that the east side has less contaminated materials and it may be feasible to build a larger-volume CDF than can be accommodated on the west side. There are two layers of sediments in Newark Bay: a deep layer of preindustrial, undisturbed, consolidated materials and a surficial layer of disturbed or recently deposited material. Typically contaminants are found in the surficial layer. Data collected by the Port Authority in 1995 indicate that the surficial layer of sediments is thinner on the east side than on the west side. The surficial layer on the east side is between 2 and 8 ft (0.6 and 2.4 m) thick. The west shore has unconsolidated sediments and contaminants as deep as 25 ft (7.6 m) (see Figures 1.02-3 and 1.02-4).

Data collected in 1995 and 1996 by the Port Authority indicate that the near surface layers in Area 3 have lower concentrations of metals and dioxin (2,3,7,8-TCDD) than samples collected from the near surface layer of Areas 1 and 2 (Table 2.03-2). These data also show that there are differences in the concentrations of metals in the top 2 ft (0.6 m) compared to sediments lower than 2 ft (0.06 m) deep in Area 3. Deeper sediment have the lowest concentrations of chemicals. In 1995 amphipods were exposed to sediments from the east side of Newark Bay in controlled toxicity tests (Table 2.03-3). Sediments from the southern portion of Area 3 were found to have significant amphipod mortality; however, sediments tested from the northern portion did not cause significant mortality.

The 1995 and 1996 Port Authority data suggest that Area 3 may have a thinner layer of less contaminated sediments than the areas on the west side. Additional sampling is needed to confirm this preliminary finding and to delineate the actual size of the relatively uncontaminated area. Data collected by NOAA show significant toxicity and high concentrations of dioxin in surface grab samples collected from sites in deeper water adjacent to Area 3 (Long et al. 1993).

Assuming a small volume of contaminated sediments, a large CDF in Area 3 could be constructed by disposing of contaminated sediments in the new facility itself. This could be accomplished by excavating a portion of the pit along the northern edge, presumed to contain the cleanest sediments, to create a cell. If the surface sediments from this cell were clean they could be disposed of in the ocean or used beneficially. Contaminated surface sediments from southern cells of Area 3 could be placed in this northern cell. The excavated material below 2 ft (0.6 m) could be transported offshore to the MDS to be used as a cap or for some similar beneficial purpose. If constructed in this manner a CDF with a volume of as much as 12 MCY (9 MCM) could be constructed in Area 3.

A large-capacity, Area 3 CDF provides the opportunity for dredged material management practices that are not readily available from other alternative CDF locations in Newark Bay. These practices include advance maintenance dredging and contaminant reduction. Advance maintenance is the practice of channel overdredging or constructing sediment traps that collect material before it settles in channels or berths. Contaminant reduction refers to improvement of water quality and sediment conditions so that future dredge projects involve "clean material." As described in Chapter 3, surficial sediments are contaminated throughout large portions of Newark Bay and adjacent water bodies. A large-volume CDF would allow disposal of more of the contaminated sediments from channels and berthing areas, sequestering contaminants away from biota.

Alternative 4, Areas 1, 2, And 3

This alternative is a combination of Alternatives 2 and 3. In this alternative, all surficial volumes from Areas 1S, 2S, and 2N will be placed in Area 3 (east side of channel site), and only Category I material excavated from Areas 1S, 2S, 2N and east side or Areas

Table 2.03-2

Sediment Chemistry Data for Newark Bay

CDF Area	Sample Date	Layer Thickness	Average Concentrations									
			As mg/kg	Cd mg/kg	Cr mg/kg	Cu mg/kg	Pb mg/kg	Hg mg/kg	Ni mg/kg	Ag mg/kg	Zn mg/kg	2,3,7,8- TCDD pg/kg
1S	1995	16 ft	20.9	0.05	49.1	64.5	94.8	1.75	15.81	0.00	116	
1S	1996	16 ft	8.6	0.54	80.3	49.3	115.0	0.90	15.70	0.41	252	8.6
2S	1995	19 ft	33.9	0.00	87.7	121.6	127.6	1.65	25.22	0.32	194	
2S	1996	16 ft	10.4	0.09	43.4	50.8	58.8	1.30	16.70	0.34	107	11.4
2N	1995	12 ft	15.6	2.03	175.4	112.8	171.6	2.27	24.77	0.80	220	
2N	1996	14 ft	17.4	0.43	117.0	96.6	112.0	2.80	21.90	1.00	192	99.6
3	1995	2 ft	11.1	0.18	60.0	37.9	36.2	0.63	14.69	0.00	86	2.3
3	1995	>2 ft	6.9	0.00	15.2	7.8	0.0	0.03	10.55	0.00	41	

Source: Port Authority.

2.04 ALTERNATIVE METHODS OF CONSTRUCTION

The conceptual construction sequence presented in Section 1.02 identified applicable methods of construction. Section 5.05 identifies proposed equipment and techniques. This section contains discussions of alternative dredge methods, transport and placement as well as other issues.

2.04.1 ALTERNATIVE DREDGING METHODS

Dredging is accomplished using either hydraulic or mechanical means, or a combination of the two methods. The following sections provide descriptions of these dredging methods, and their advantages and disadvantages.

2.04.1.1 Hydraulic Dredging. Hydraulic dredging involves removing sediment from the bottom and transporting it to the water surface as a water-sediment mixture. A suction hydraulic dredge is analogous to a vacuum cleaner, except that water rather than air is the fluid medium. A dredge pump can be located on the dredge at the water line or submerged on the dredge ladder. In cases where bottom sediment does not "flow to the suction pipe" and cannot be picked up by the suction process alone, a cutterhead hydraulic dredge is used. The cutterhead is typically a bowl shaped series of blades, which rotate in front of the suction pipe. The cutterhead mechanically cuts the sediment so that it can be picked up by the suction pipe. Cutterhead suction hydraulic dredges can work in hard soils and even weathered rock, but with significantly reduced production rates. In weathered rock or sand sediment with blow counts greater than 50 or stiff clay with blow counts in the vicinity of 30, an hydraulic bucket wheel dredge may be a preferred option.

Once the material has been excavated and transported to the surface, it can be transported to the disposal site either through a pipeline or by hopper barge. The hydraulic dredging process adds water to the in-situ sediment at an approximate ratio of 9-10 parts water to 1 part in-situ sediment volume. Thus when a hopper barge is used to transport the sediment mixture to the disposal site, a large percentage of the hopper capacity is taken up by water rather than sediment. The preferred method of slurry transport from the dredge to the disposal site is through a pipeline. The dredged material-water mixture is pumped, in a continuous process, from the bottom directly to the disposal site. Depending upon the size and power of the dredge, the sediment characteristics, and the distance from the dredge to the disposal site, booster pumps may be required in the discharge line.

A hopper dredge is a self propelled hydraulic dredge that holds the dredged material mixture in its hold (hopper) and physically transports the material to the disposal area. At the disposal site, the dredged material is dropped through the bottom of the vessel through hinged doors, through a split hull, or pumped out of the hopper through a pipeline. As all production ceases while the dredge moves to the disposal site, discharges its load, and travels back to the dredging location; and as the dredge is required to turn

at the end of each dredge cut, it is not efficient on projects with short dredging cuts and long distances to the disposal areas. In addition, a hopper dredge is less efficient in consolidated materials or fine grained unconsolidated materials.

2.04.1.2 Mechanical Dredging. Mechanical dredging involves removing sediment from the bottom using equipment that is similar to machinery used on land, particularly for mining operations. Mechanical dredges use some form of bucket to remove material from the bottom and lift it to the surface. The bucket used to remove the sediment is connected to the dredge by one of several methods; clamshell grabber dredge buckets are connected by a wire rope, dipper or marine excavator dredge buckets are connected structurally, and ladder dredges employ a combination of chain and structural connections to attach their buckets.

For small jobs located in shallow water, hydraulically operated shovels and backhoes mounted on a barge, or a clamshell bucket dredge, are capable of performing the work. For larger jobs in unconsolidated sediment, particularly in deeper water, higher-capacity, cable operated buckets are used. In consolidated sediment, structurally connected mechanical dredges, such as dipper dredges or hydraulic marine excavator dredges, are used. These structurally connected dredges are capable of developing the cutting force required to remove consolidated sediment.

A drawback to using a traditional clamshell bucket is that some portion of the original load may be washed away before the bucket finally breaks the water surface. If the bucket is not properly closed, the dredge material is very fine and unconsolidated, and the dredging depth is great, it is possible that part of the load may be washed from the bucket prior to breaking the surface. For that reason, specialized buckets have been developed in recent years to minimize spills and losses during lifting. Such equipment, when properly fabricated and maintained, reduces but does not entirely eliminate, material losses and the accompanying dispersion of sediments. The sealed clamshell bucket or environmental bucket is proposed for use in the construction of the NBCDF. As with any mechanical dredge, closed bucket dredges are subject to loss of material if debris blocks the bucket from closing.

2.04.2 DREDGED MATERIAL TRANSPORT/PLACEMENT OPTIONS

2.04.2.1 Dredged Material Transport to the Disposal Site. The dredged material would be excavated using hydraulic or mechanical equipment, or a combination of the two types of equipment. The sediment would be placed in a barge and then transported to the disposal site by a tug. The most common type of barge used in the New York/New Jersey Harbor is a split-hull scow. The split-hull scow barge is an efficient delivery method, as when the scow opens, the dredged material drops quickly into the disposal site as a fairly cohesive mass.

2.04.2.2 Dredged Material Placement at the CDF. Split-hull scows would be used for disposal/placement of dredged materials. Barges with fixed bottoms are used also by the

dredging industry, particularly when the dredged material is off-loaded at a dock for transport to upland locations. If this type of barge were used for placement of dredged material, barge-mounted mechanical dredges would be required to transfer the dredged material from the barge to the CDF. Double handling of dredged material results in an increase in disposal costs. However, either type of barge could be used for placement of dredged material into the CDF.

If disposed sediment accumulations prevent scow access to the disposal site, alternate methods, such as hydraulic pumpout, can be used to transfer dredged material from scows to the CDF, as discussed in Section 5.05.

There is a potential for debris, including rebar, concrete rubble, and logs, to be found in material dredged from the NY/NJ Harbor. Debris would be a particular problem for disposal operations that require hydraulic pumping into the facility, such as when closure is imminent. Various methods may be employed to deal with this possibility. One option is for the disposal site owner/operator to require users to screen material prior to transport to the disposal site. Alternatively, the owner/operator may elect to have a screening operation as part of the disposal process. This would require a clamshell dredge to remove the dredged material from the barge and drop it over a screening device mounted on another barge prior to pumping. In either case, the cost of disposal would increase.

For disposal sites requiring caps (i.e., subaqueous CDF), the capping material could be placed using barge pumpout equipment similar to that used to place upper layers of dredged material. Hydraulic dredges could also be used to spread the layer if a suitable borrow site(s) is available within economical pumping distance from the CDF.

2.05 CRITERIA FOR USE OF NBCDF

The owner/operator of the NBCDF will be required to identify a program that selects from among potential dredging projects, those that are acceptable for placement in the NBCDF. The Applicant's selection criteria may include the following:

- The dredging project has demonstrated that it will meet the requirements for all state, Federal, and local permits.
- Upland disposal is not an economically viable option.
- The dredged material is not suitable for ocean disposal.
- The dredged materials meet the operator's best management plan.
- The dredging site is within the draw area for the NBCDF.
- The dredging project provides regional economic and/or ecological benefit.
- A market-driven price can be reasonably negotiated for the owner/operator to recover at a minimum development and operation costs.

2.06 NO ACTION

Under the No Action alternative CDFs would not be constructed. The port would not have enough capacity in the short-term for disposal of contaminated dredged materials and would not be able to maintain sufficient channel depths for commercial ship traffic. Siltation in berths and channels will continue. If the harbor cannot be dredged, the economy and environment of the metropolitan region will be negatively impacted.

At present, depths in channels and berthing areas are not sufficient to allow the safe and efficient passage of fully loaded container and liquid bulk vessels calling on the Port. Tankers must lighter in anchorages and/or enter channels only during high tides. Anchorages become congested with queues of vessels (USACE 1994). Container ships calling on some marine terminals must be loaded to less than design capacity and new, deep draft vessels cannot be accommodated (USACE-NYD 1986 and 1996). These practices are inefficient, costly, and present unnecessary environmental risks.

The Port of NY/NJ is a vital element in the economy of the region. If a dredged materials disposal facility is not available within the year, commerce will continue to leave the area for ports capable of providing better service. If sedimentation reduces the channels to 30 ft (9 m), 90% of the containerized cargo volume would be diverted (Port Authority 1996). The economic consequences of preventing maritime operators from maintaining their berths at authorized depths include decreases in total sales, wages, and employment. The Port Authority (1996) estimates that the region would lose about $5 billion in total sales if the Harbor silts up to 35 ft (10.7 m) in the year 2000. Regional consumers would face higher prices and many firms would experience increased costs of doing business. Transportation costs will increase as goods are moved into and through the region.

The need to transport diverted marine cargo into the region will be met by increased use of roadway vehicles and vehicle miles of travel (VMT) (Port Authority 1996). As traffic increases, congestion will increase, travel times for individuals commuting to their job sites will increase, and roadway maintenance costs for state and local governments will increase. As VMT increases, emissions will increase and pollution from mobile sources will increase. The metropolitan region is currently classified as a nonattainment area. Increased emissions will not allow the states to achieve the goals required by their Implementation Plans to attain the National Ambient Air Quality Standards (NAAQs).

2.07 MITIGATION

Mitigation is an action that is performed to offset adverse impacts associated with performing a particular activity. Detailed descriptions of potential impacts and mitigation measures are provided in Chapter 4. This section discusses the differences in mitigation measures that are attributed to differences in the alternatives.

As described in Chapter 4, most potential long term impacts would be avoided through careful engineering design. All of the alternative CDFs would sequester contaminants safely and will restore the aquatic habitat to its existing condition with the exception that clean sediments will be used in place of the of the existing contaminated surface layer. The design elements of all of the alternative CDFs are also the same. For example, to protect groundwater from contamination, the proposed design includes a 10-ft (3.0 m) layer of clay along the bottom. This layer will prevent contaminants and solids from entering ground water aquifers.

The effects of CDFs on navigation are small and different depending upon the location of the facility. Alternatives involving the west shore may temporarily affect navigation in and out of the Port Newark and Elizabeth channels, which in turn will impact either the efficiency of commercial navigation or dredging operations. This impact can be minimized by careful scheduling of the traffic into and out of the CDF areas during construction and operation. Scheduling can mitigate against the impacts from the obstructions. Navigation is discussed in greater detail in Section 3.18.

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3.0. AFFECTED ENVIRONMENT

A substantial literature base is available describing the physical, chemical, and biological components of Newark Bay. The information, summarized in the following sections.

3.01 GENERAL ENVIRONMENT

Newark Bay is part of the NY/NJ Harbor Estuary, or alternatively the Hudson-Raritan Estuary. The Bay is on the western side of the Harbor complex and is connected to Upper New York Bay by the Kill Van Kull and to Raritan Bay by the Arthur Kill. The Kill Van Kull is located along the north side of Staten Island and the Arthur Kill extends along the western side of Staten Island, with both waterways forming the boundary between the States of New York and New Jersey (Figure 3.01-1). Newark Bay, located completely within the State of New Jersey, has a northeast-southwest orientation, and is formed by the Kill Van Kull to the south, the confluence of the Passaic and Hackensack rivers to the north, the City of Bayonne to the east, and the cities of Elizabeth and Newark on the west. The Union-Essex Counties and Hudson County line extends down the middle of the Bay; the Union County and Essex County line roughly corresponds to the Elizabeth Channel, which separates Port Elizabeth from Port Newark.

Newark Bay and its shoreline have been modified extensively by dredging, filling, and commercial operations since the mid-1800s (Crawford et al. 1994). The Bayonne, or eastern side of Newark Bay is characterized by varied industrial complexes near the Hackensack River and the Kill Van Kull. Residential areas, school campus, parks, and light industry are present over most of the remainder of the shoreline. The Bay's western shore is dominated by the extensive containership facilities of the Elizabeth Marine Terminal and Port Newark. Two Federal navigation channels - Port Newark Channel and Elizabeth Channel - permit ship access to the inner facilities of Ports Elizabeth and Newark. Small isolated wetland areas are present on the western shore of the Bay north and south of Ports Newark and Elizabeth.

Newark Bay is rectangular, approximately 5.5 miles (8.9 km) long and varying in width from 0.6 to 1.2 miles (1.0 to 2.0 km), with the widest section of the Bay opposite Port Newark, and the narrowest section opposite Port Elizabeth. Two bridges span Newark Bay: the New Jersey Turnpike-Newark Bay Bridge, and a Conrail railroad bridge cross the Bay on the northern side of Port Newark.

The surface area of Newark Bay is approximately 5.5 square miles (14.2 km^2). With the exception of the maintained shipping channels, turning basins, and docking facilities, Newark Bay is very shallow, with extensive shallow areas throughout the eastern half. Newark Bay is divided longitudinally into four reaches (NOAA 1983): (1) South Reach, the southern section of the Bay corresponding to the area between the Arthur Kill/Kill Van Kull to the south to South Elizabeth Channel to the north (South Elizabeth Channel

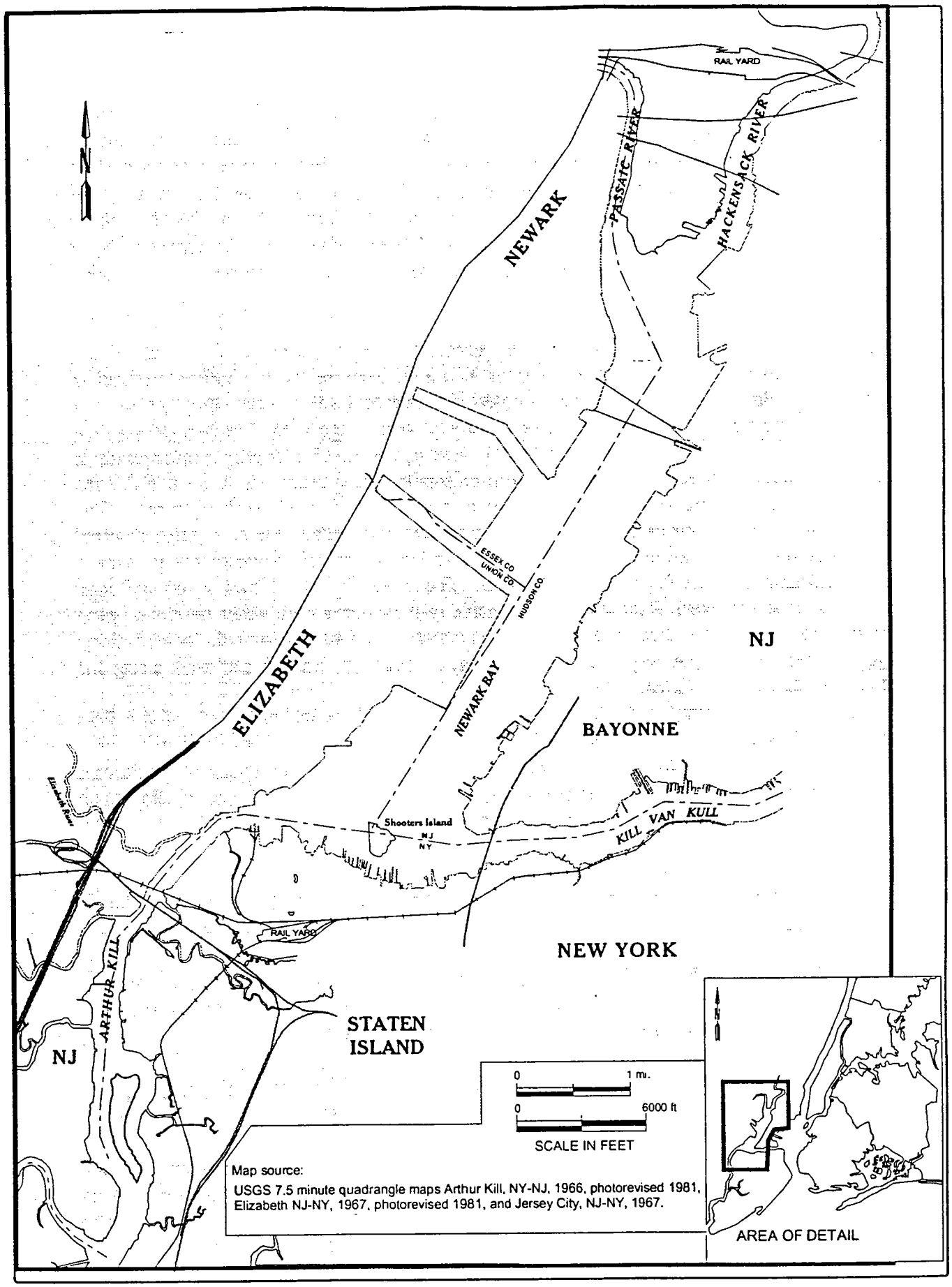


Figure 3.01-1

U.S. Army Corps of Engineers
Newark Bay Confined Disposal Facility

Newark Bay Area Project Location

is the south access channel to Port Elizabeth); (2) Middle Reach, the Bay area in front of Ports Elizabeth and Newark (location of the proposed NBCDF) extending from South Elizabeth Channel north to Port Newark Channel; (3) North Reach, extending from Port Newark Channel to a point approximately 3000 ft (915 m) north of the Conrail railroad bridge; and (4) the northern area, consisting of the Kearny Point Reach, which corresponds to the area around the mouth of the Passaic River, and the Droyers Point Reach, which corresponds to the area around the mouth of the Hackensack River (Figure 3.01-2).

The South Reach is characterized by an extensive shallow area to the west of the navigation channel and north of the Arthur Kill and, because the navigation channel is close to the Bayonne shore, relatively limited shallows and a few piers along the eastern shore. Water depth in the east and west shallows areas range from 1 to 8 ft (0.3 to 2.4 m) at mean low water (MLW). In the Middle Reach, the Port Elizabeth pierhead extends to the navigation channel, with water depth maintained at approximately 35 ft (10.7 m) by dredging. A narrow ship channel is maintained at the Port Newark pierhead. The large shallow area between the Port Newark pierhead channel and the navigation channel (where water depth ranges from 1 to 5 ft [0.3 to 1.5 m] MLW) corresponds to Area 1 for consideration in developing CDF site 1S. The eastern side of Newark Bay included in the Middle and North Reaches is an extensive shallows area with water depths ranging from 1 to 11 ft (0.3 to 3.4 m) MLW. The Federal Navigation Channel, located along the western side of the Bay in the North Reach, results in limited shallows along the Newark shore in this area. Area 2, the second area under consideration for NBCDF development, is located due east of Port Newark, which is located north of the Port Newark Channel. In the extreme northern end of Newark Bay, the navigation channel is approximately 300 ft (91 m) wide, with depths of 6.5 ft (2.0 m) recorded in the Passaic River and 18 ft (5.5 m) in the Hackensack River. The area around the Kearny Point and Droyers Point Channels is very shallow, ranging in depth from 1 to 4 ft (0.3 to 1.3 m) MLW.

The total bottom area of Newark Bay is approximately 4082.5 acres (16.5 km^2), calculated from National Oceanic Atmospheric Administration (NOAA) navigation charts 12333 and 12337 using surface planimetry techniques. Bottom area estimates obtained using planimetry techniques, a two-dimensional method, does not take into account bottom area associated with steep slopes, which would result in an underestimation of actual exposed bottom area, especially for the channel area.

The mean tidal range in the Bay is 2.8 ft (0.9 m), with the mean tidal range at the northern end of the Bay (Kearny Point) 2.85 ft (0.87 m), and 2.77 ft (0.84 m) at the southern end of the Bay off Port Elizabeth. Maximum flood and ebb tidal currents are 1.2 ft/sec (0.4 m/sec). The Hackensack River, which enters Newark Bay at its northeast corner, has a drainage basin area of approximately 113 square miles (293 km^2) and an annual mean discharge of 95.8 cfs (2.7 m^3/sec) (Bauersfeld et al. 1994). The range in annual mean discharge is from 0.4 cfs (0.01 m^3/sec) recorded in 1981 to 263 cfs (7.5 m^3/sec) recorded in 1928. The Passaic River, which enters Newark Bay directly to the

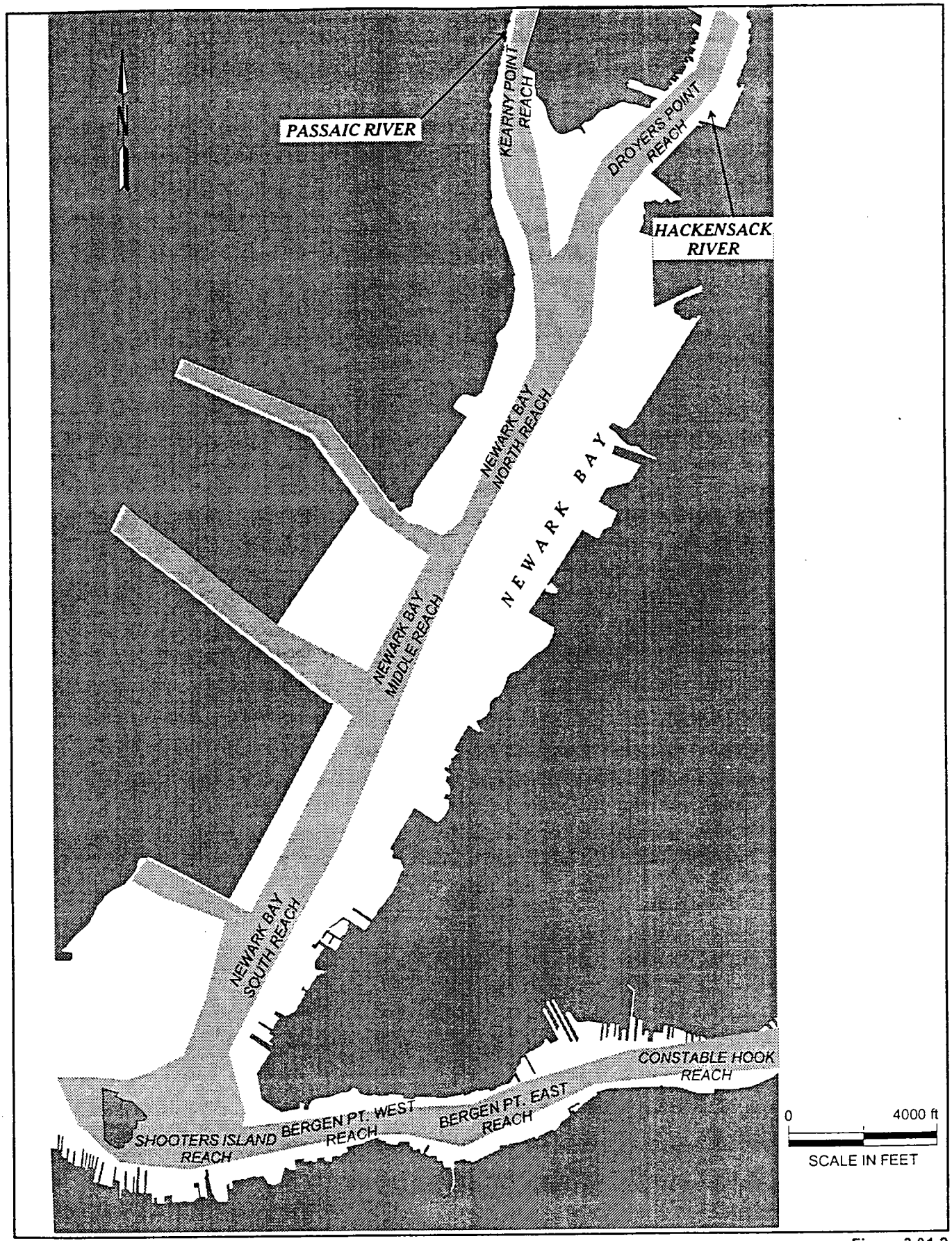


Figure 3.01-2

U.S. Army Corps of Engineers

Reaches in Newark Bay

Newark Bay Confined Disposal Facility

west of the Hackensack River on the northwest corner, has a drainage basin area of approximately 100 square miles (260 km^2) and an annual mean discharge of 173 cfs (4.9 m^3/sec) (USGS 1994). The highest recorded Passaic River annual mean flow was 305 cfs (8.6 m^3/sec) recorded in 1984, and the lowest recorded annual mean flow was 68 cfs (1.9 m^3/sec) recorded in 1965.

Geologically, the Newark Bay Drainage Basin is contiguous with the Atlantic Coastal Plain, with three general underlying stratigraphic units (USACE 1987a,b; NOAA 1994):

- ***Recent estuarine sediments***: Recent sediments are typically black organic muds, black sandy muds, or black muddy sands representing geologically recent estuarine sedimentation.

- ***Pleistocene glacial sediments or Cretaceous nearshore sediments***: Pleistocene (ice age) sediments are typically gray sands, gray gravelly sands, or gray sandy gravels that represent glacio-fluvial conditions. Pleistocene lacustrine sediments are typically red or red-brown clays. The underlying Cretaceous sediments, if present, are typically gray or green marine sands, red clays, gray clays, red gravelly sands, or brown muddy sands that represent nearshore marine sedimentation of several million years ago.

- ***Bedrock***: These are red shales, red sandstones, and diabase of Triassic-Jurassic age and serpentine of Pre-Cambrian age.

The present Bay sediments are predominantly fine grained. The sediment facies patterns reflect river input of sediment at the north end and exchange with the Upper Bay of New York Harbor and the Lower Bay at its southern end. Sand is the dominant sediment component at the northern end of the Bay in the vicinity of the Passaic and Hackensack rivers, and the central part of the bay is underlain with sandy-clayey-silts that grade southward to clayey-silty-sand and sandy-clayey-silts at the junction of the Arthur Kill to the south and the Kill Van Kull to the east. The coarser sediments found at the southern end of Newark Bay reflect scouring due to tidal currents at the junction of the three water bodies.

3.02 PHYSICAL OCEANOGRAPHY

The project site is located within Newark Bay at latitude 40°41'N, and longitude 74°8' W, as shown in Figure 3.02-1. The site is adjacent to the Port Newark and Port Elizabeth Marine Terminals and is approximately 3 miles (4.8 km) south of Newark, New Jersey, and 6 miles (9.7 km) west of Manhattan. Site conditions pertinent to project design include bathymetry and topography, wind conditions, water levels, wave conditions, and currents. A discussion of each of these factors is presented in the following paragraphs.

3.02.1 BATHYMETRY AND TOPOGRAPHY

Newark Bay is relatively wide compared to the Arthur Kill, the Kill Van Kull, the Passaic River, and the Hackensack River. Several Federally maintained channels exist within Newark Bay: (1) Newark Bay South Reach, (2) South Elizabeth Channel, (3) Newark Bay Middle Reach, (4) Newark Bay North Reach, (5) Port Elizabeth Channel, (6) Port Elizabeth Pierhead Reach, (7) Port Elizabeth Inshore Reach, (8) Port Elizabeth Branch Reach, (9) Port Newark Pierhead Reach, (10) Port Newark Inshore Reach, and (11) Port Newark Branch Reach. The Federal channels within Newark Bay provide access to very active port facilities at the Port Newark and Port Elizabeth Marine Terminals. The marine terminals at Port Newark and Port Elizabeth are located on the western side of the waterway, where the channels and Harbor basins are relatively deep. The channels and berthing areas are maintained at designated depths by dredging. The eastern side of the Bay consists of shallow areas with water depths ranging from 0.5 to 10 ft (0.2-3.0 m). The Federally maintained channels have authorized widths ranging from 400 to 600 ft (122 to 183 m) and water depths ranging from -35 to -40 ft (-10.7 to -12.2 m) MLW.

The shallow area where NBCDF Area 1S is proposed to be constructed lies north of the Port Elizabeth Channel, south of the Port Newark Channel, east of the Port Newark Pierhead channel,and west of the Newark Bay Middle Reach and Newark Bay North Reach; it is characterized by low water depths, ranging from 0.5 to 5 ft (0.2 to 1.5 m). The shallow area where NBCDF Areas 2S and 2N are proposed to be constructed is north of the Port Newark Channel and west of the Newark Bay North Reach. Low water depths range from 1 to 5 ft (0.3 to 1.5 m) MLW.

3.02.2 WATER LEVELS

3.02.2.1 Astronomical Tides. Normal water level variations in Newark Bay are generally dominated by astronomical tides, although wind effects can be influential. Astronomical tides in the vicinity of Newark Bay are semidiurnal, with a mean tide range of 5.1 ft (1.6 m) and a spring tide range of 6.1 ft (NOAA 1996). The mean tide level is 2.5 ft (0.8 m) water MLW. Tidal datum characteristics are presented in Table 3.02-1.

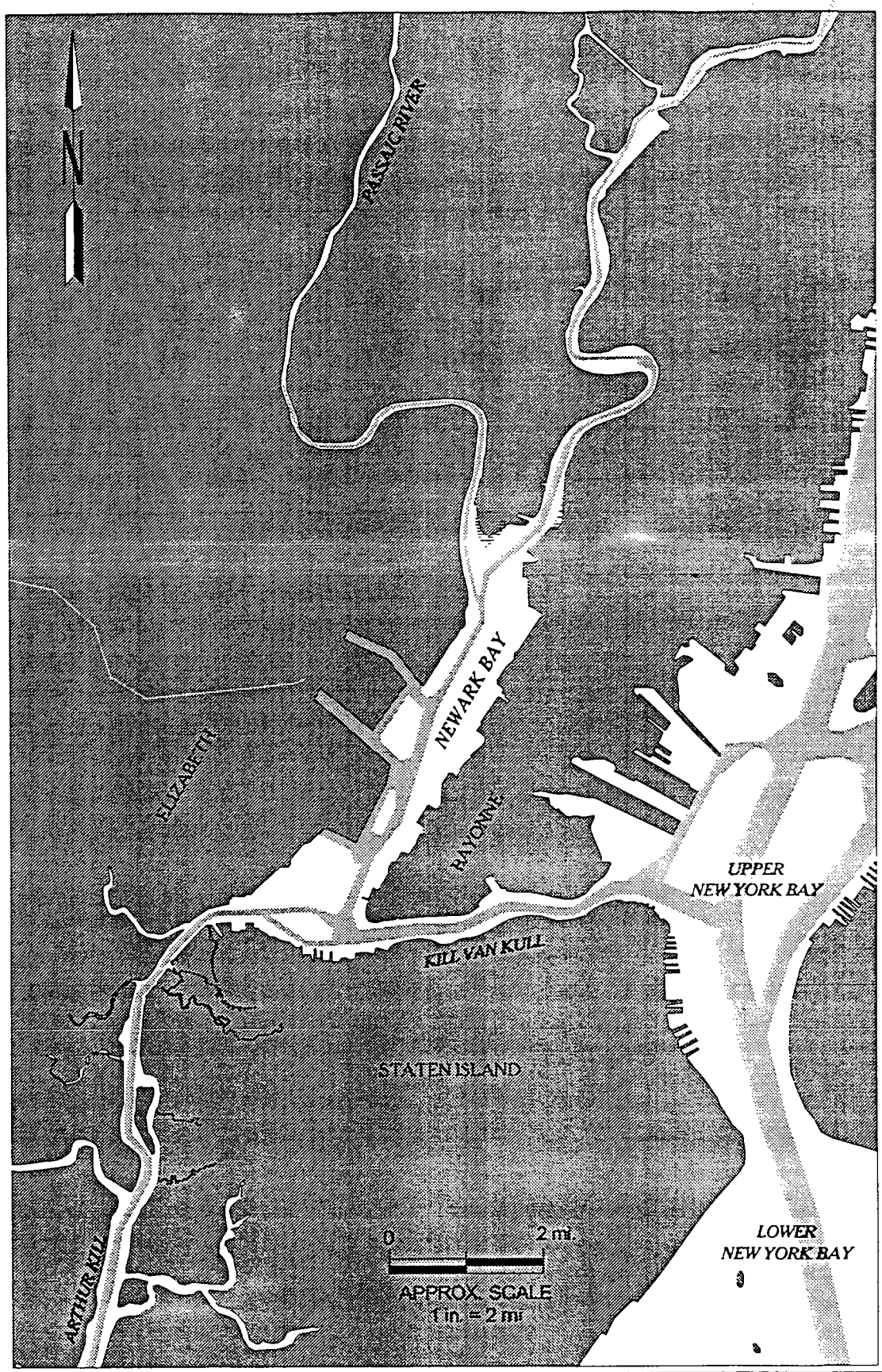


Figure 3.02-1
Newark Bay Area

TABLE 3.02-1

Astronomical Tidal Datum Characteristics of Newark Bay

Tidal Datum	Feet	Meters
Mean Spring High Water (MSHW)	5.9	1.80
Mean Higher High Water (MHHW)	5.5	1.68
Mean High Water (MHW)	4.9	1.49
Mean Tide Level (MTL)	2.5	0.76
Mean Low Water (MLW)	0.0	0.00
Mean Lower Low Water (MLLW)	-0.2	-0.06

3.02.2.2 Storm Surge. Extremes in project site water levels that influence CDF design are dominated by storm effects (i.e., storm surge and wave setup) in combination with astronomical tide. Storm surge is a temporary rise in water level generated either by large-scale extratropical storms, known as northeasters, or by hurricanes. The rise in water level results from wind shear forces, the low pressure of the storm disturbance which allows sea level to increase locally, and the Coriolis force. Wave setup describes the rise in water level due to wave breaking. Specifically, a change in momentum that attends the breaking of waves propagating toward shore results in a surf zone force that raises water levels at the shoreline. The maximum total water level (maximum stage) is typically used to define the return period of an extreme storm event. Storm tides for Newark Bay were taken from The New York City Flood Insurance Study (1981). Storm tide elevations range from 5.9 ft (1.8 m) National Geodetic Vertical Datum (NGVD) for a two-year storm to 8.7 ft (2.7 m) NGVD for a 100-year storm. Water level elevations vs frequency of occurrence are shown in Figure 3.02-2.

3.02.3 WIND CONDITIONS

Wind data were obtained for La Guardia International Airport, approximately 15 miles (24 km) from the project site, for the period 1947 through 1979 (Table 3.02-2). Wind data are fastest mile values that correspond to the highest recorded wind speed with a duration sufficient to travel 1 mile (1.6 km) during a 24-hr recording period. Yearly extremes, obtained from NOAA (1982) (Table 3.02-2a), show that the maximum wind speed recorded at LaGuardia was 73 miles per hour (mph) (117.5 km/hr) and had a northeast direction. Design wind speed per return period for the project site, based on the LaGuardia data, are shown in Table 3.02-2b. The 25-year return wind speed for the "All Directions" was 73 mph (117.5 km/hr) (Table 3.02-2b).

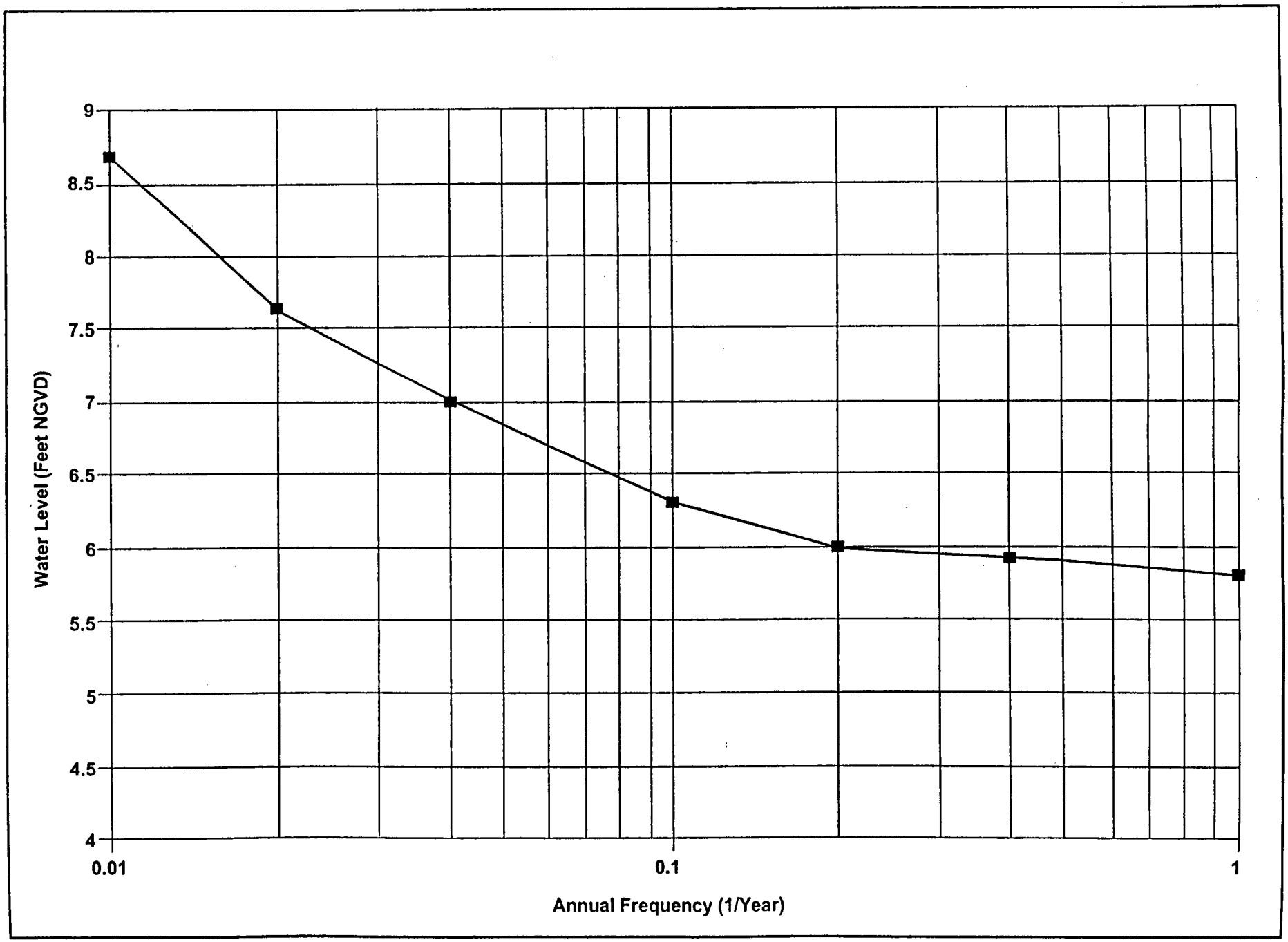


Figure 3.02-2

U.S. Army Corps of Engineers
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Water Level Elevation vs Frequency
in Newark Bay

Table 3.02-2

Wind Conditions: New York-New Jersey Harbor Area

a. Yearly Extreme Wind Speed Recorded at La Guardia Airport

Year	All Directions		North	Northeast	East	Maximum from NE quadrant
	Speed (mph)	Direction				
1947	55	SW	41	49	46	49
1948	58	NE	33	58	30	58
1949	49	NW	43	41	23	43
1950	60	SE	39	33	35	39
1951	52	NW	43	38	38	43
1952	52	E	37	37	52	52
1953	60	N	60	33	46	60
1954	58	SE	44	44	23	44
1955	49	W	49	37	49	49
1956	56	N	56	47	47	56
1957	49	NW	39	37	22	39
1958	60	NE	38	60	32	60
1959	55	NW	38	42	24	42
1960	61	NE	33	61	29	61
1961	52	NE	44	52	27	52
1962	59	NW	33	61	38	61
1963	65	W	37	52	33	52
1964	65	NW	31	63	20	63
1965	40	S	37	34	18	37
1966	56	W	26	43	26	43
1967	53	NW	40	44	31	44
1968	73	NE	40	73	37	73
1969	57	N	57	48	25	57
1970	51	E	31	39	51	51
1971	61	NE	32	61	40	61
1972	62	NE	37	62	24	62
1973	44	NE	32	44	26	44
1974	60	NE	30	60	25	60
1975	49	W	37	34	36	37
1976	57	NE	19	57	23	57
1977	59	NE	27	59	31	56
1978	47	W	28	42	29	42
1979	57	S	34	37	46	46

b. Wind Speed Return Periods

Return Period (Year)	Wind Speed (mph)			
	All Directions	North	Northeast	East
2	55	42	51	36
5	62	45	55	40
10	67	50	61	46
25	73	56	68	53
50	78	60	74	59
100	82	64	80	64

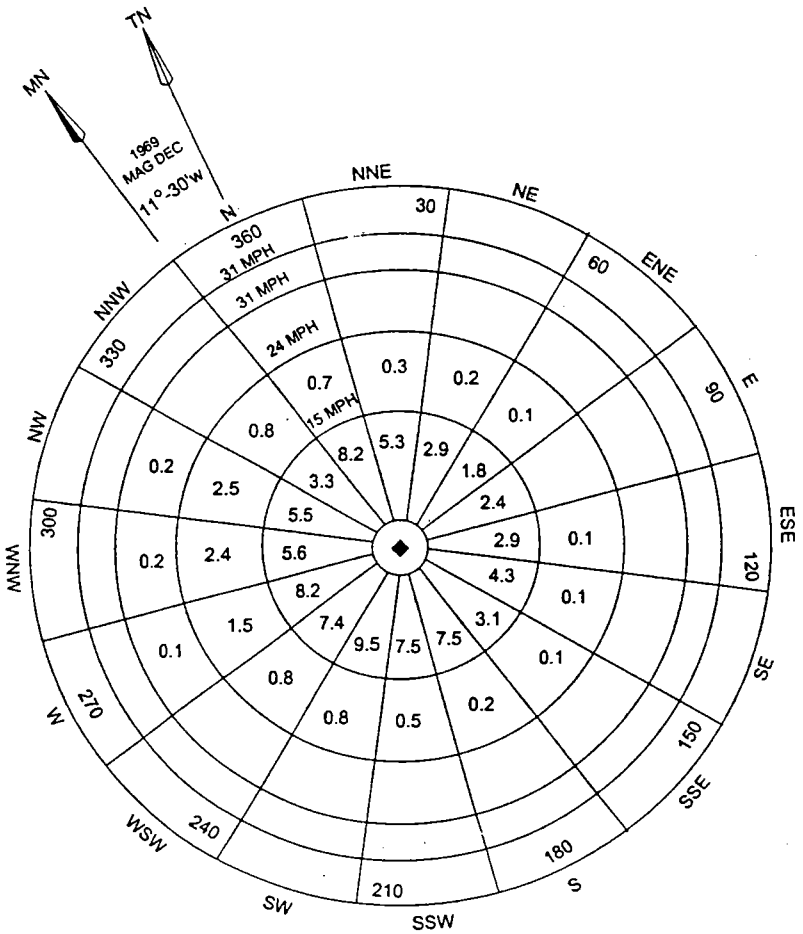
Wind speed and direction data for Newark Airport, adjacent to the Port Newark and Port Elizabeth terminals and less than 2 miles (3.2 km) from the project site, were obtained from NOAA and are presented in Figure 3.02-3. For the project site, predominating winds are from the southwest. These southerwesterly winds are prevalent during the summer and fall and occur about 11.8% of the time. Northwesterly winds are prevalent during the winter and spring and occur about 10.9% of the time. Annual average wind speed is 10.2 mph (16.4 km/hr); calm winds occur about 2.9% of the time.

3.02.4 WAVE CONDITIONS

The NBCDF site is exposed to wind-generated waves from the northeast and southeast quadrants. The longest fetch to which the site is exposed is to the northeast and the largest waves approach from that direction. In accordance with procedures recommended by the USACE (USACE 1984), a radially averaged fetch distance of 2.5 miles (4.0 km) was computed for the northeast direction. Wave conditions were hindcast along this fetch direction for the design winds presented in Table 3.02-2a,b (adjusted appropriately for duration) and the water levels presented in Figure 3.02-2. Wave hindcast results are presented in Figure 3.02-4a for offshore significant wave height (H_s) and Figure 3.02-4b for peak wave period (T_p).

A sea state is normally composed of a spectrum of waves with varying heights and periods that may range from relatively long waves to short ripples. In order to summarize the spectral characteristics of a sea state it is customary to represent that wave spectrum in terms of a distribution of wave energy over a range of wave periods. Having made this distribution, known as a wave spectrum, it is convenient to represent that wave spectrum by a single representative wave height and period. The wave conditions reported in Figures 3.02-4a and 3.02-4b are H_s and T_p, respectively. H_s is defined as the average of the highest one-third of the waves in the spectrum. Depending on the duration of the storm condition represented by the wave spectrum, maximum wave heights may be as high as 1.8 to 2 times the significant wave height. T_p, is the wave period that corresponds to the maximum wave energy level in the wave spectrum. The highest waves are estimated for the northeast fetch direction. The 25-year return period waves for this direction have an H_s value of 4.0 ft (11.2 m) and a T_p value of 3.2 sec.

The wave heights described above represent deepwater conditions some distance offshore of the proposed NBCDF, which is, however, located in relatively shallow water. The specific water depths at the project are located in MLW water depths of about 1 to 5 ft (0.3 to 1.5 m). Figure 3.02-4c shows plots for nearshore significant and maximum wave heights. Figure 3.02-4c indicates that nearshore significant wave heights from the northeast range from about 3.4 ft (1.0 m) for a two-year storm to about 4.5 ft for a 100-year storm. Figure 3.02-4c also indicates that maximum depth limited or breaking waves from the northeast range from 4.9 ft (1.5 m) for a two-year storm to 6.6 ft (2.0 m) for a 100-year storm.



◆ = Calms 0-1 MPH 2.9%

Period: 1972-1976, All Weather
15 MPH (13 Knots) Crosswind Coverage All R/W's 98.8%
% of VFR Weather 90.0
% of IFR Weather 10.0

Source: U.S. Department of Commerce, National Oceanic and Atmospheric Administration

Figure 3.02-3

U.S. Army Corps of Engineers
Newark Bay Confined Disposal Facility

Wind Rose Diagram for Newark Airport

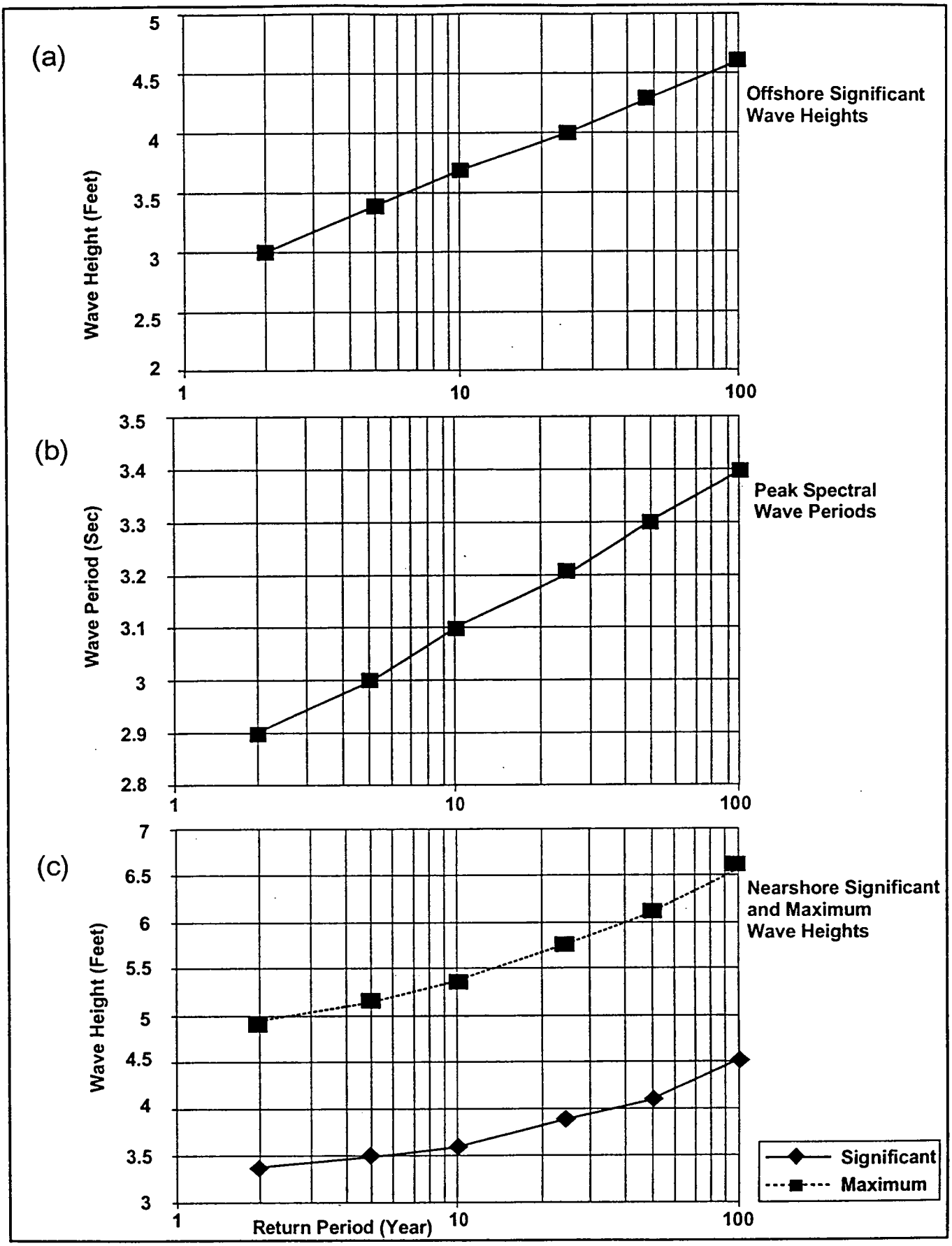


Figure 3.02-4

U.S. Army Corps of Engineers
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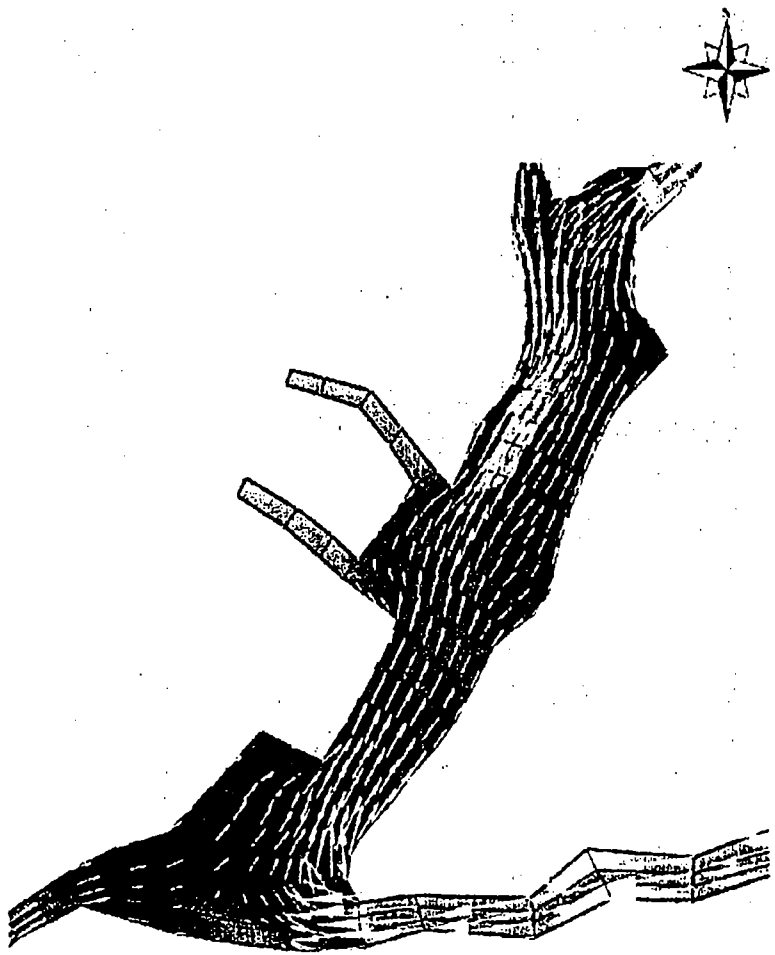
Newark Bay Wave Data Hindcast From Northeasterly Winds

The site is also exposed to vessel-generated waves associated with tug, barge, and deep-draft traffic. Computations prepared for a range of vessel sizes, speeds, and distances to sailing line indicate that the site may be exposed to waves having heights on the order of 3 to 4 ft (0.9 to 1.2 m).

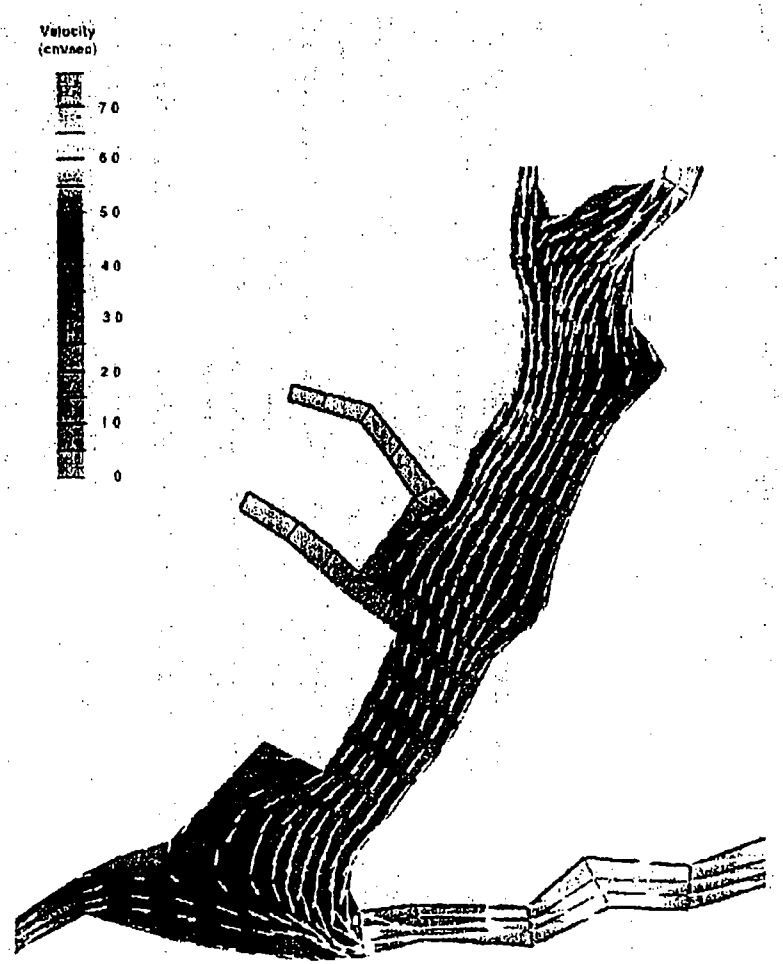
3.02.5 CURRENTS

3.02.5.1 Tidal Currents. Tidal current charts for New York Harbor are published by the U.S. Department of Commerce Coast and Geodetic Survey. According to these charts, maximum ebb tidal current velocity is 1.6 knots (2.7 fps [0.8 m/sec]), directed toward the southwest near Port Elizabeth, 4 hrs after high water is recorded at the Battery at the southern tip of Manhattan; maximum flood tidal current elocity is 1.8 knots (3.0 fps [0.9 m/sec]), directed toward the northeast near the mouth of the Hackensack River, 4 hrs after low water is recorded at the Battery. Peak tidal currents within Newark Bay vary according to reach and are summarized in Figures 3.02-5 through 3.02-8. The Newark Bay tidal current values presented in the figures were estimated from the USACE Waterways Experiment Station (WES) Harbor Apex Model (HAM) and the Passaic River Numerical Model. HAM results are presented in Figures 3.02-5 and Passaic River model results are presented in Figure 3.02-6 for peak flood and peak ebb, respectively. Figures 3.02-07 and 3.02-8 present velocity over time curves for existing conditions at four locations: Area 1S, Area 2S, Area 2N, and Newark Bay Middle Reach Channel, respectively. The figures show that maximum velocities in the vicinity of the project are on the order of 0.8 fps (0.24 m/sec).

3.02.5.2 Density Currents. Suszkowski (1978) studied the hydrodynamics, salinity, sediment transport, and sedimentation in Newark Bay. This study, which relied primarily on field measurements, advanced the argument that Newark Bay is subject to density-driven flows that result in a "turbidity maximum" in the vicinity of Port Newark. Suszkowski argued that this turbidity maximum contributes to the sedimentation problems in the Harbor and channel areas. He also concluded that the Kill Van Kull and Arthur Kill (and the Hudson River) were the major source of sediments to Newark Bay, although the Passaic River also contributes. The Hackensack River, according to Suszkowski, may be a sediment sink. Suszkowski's study has been used to develop the sedimentation reduction schemes presented in this study. With respect to Suszkowski's conclusions regarding the turbidity maximum, it should be noted that previous physical model studies and velocity measurements have not revealed the presence of stratification in Newark Bay (Simmons and Bobb 1965) to the same extent as seen by Suszkowski. Simmons and Bobb (1965) classified Newark Bay as a partially mixed estuary. Consistent with the behavior of partially mixed estuaries, one might expect a flood predominance of bottom currents and an ebb predominance of surface currents under normal conditions. A review of Suszkowski's data collected in 1976 and 1977 (Figures 3.02-9 and 3.02-10) indicates that relatively high bottom concentrations of suspended sediments (i.e., 30-50 mg/l) occurred during a one-year evaluation period. These high concentrations, attributed to runoff events in the Passaic River, occurred at stations 7, 8, 9, and 10 (Figure 3.02-10), extending from an area opposite Port Newark northward to the Passaic River. The



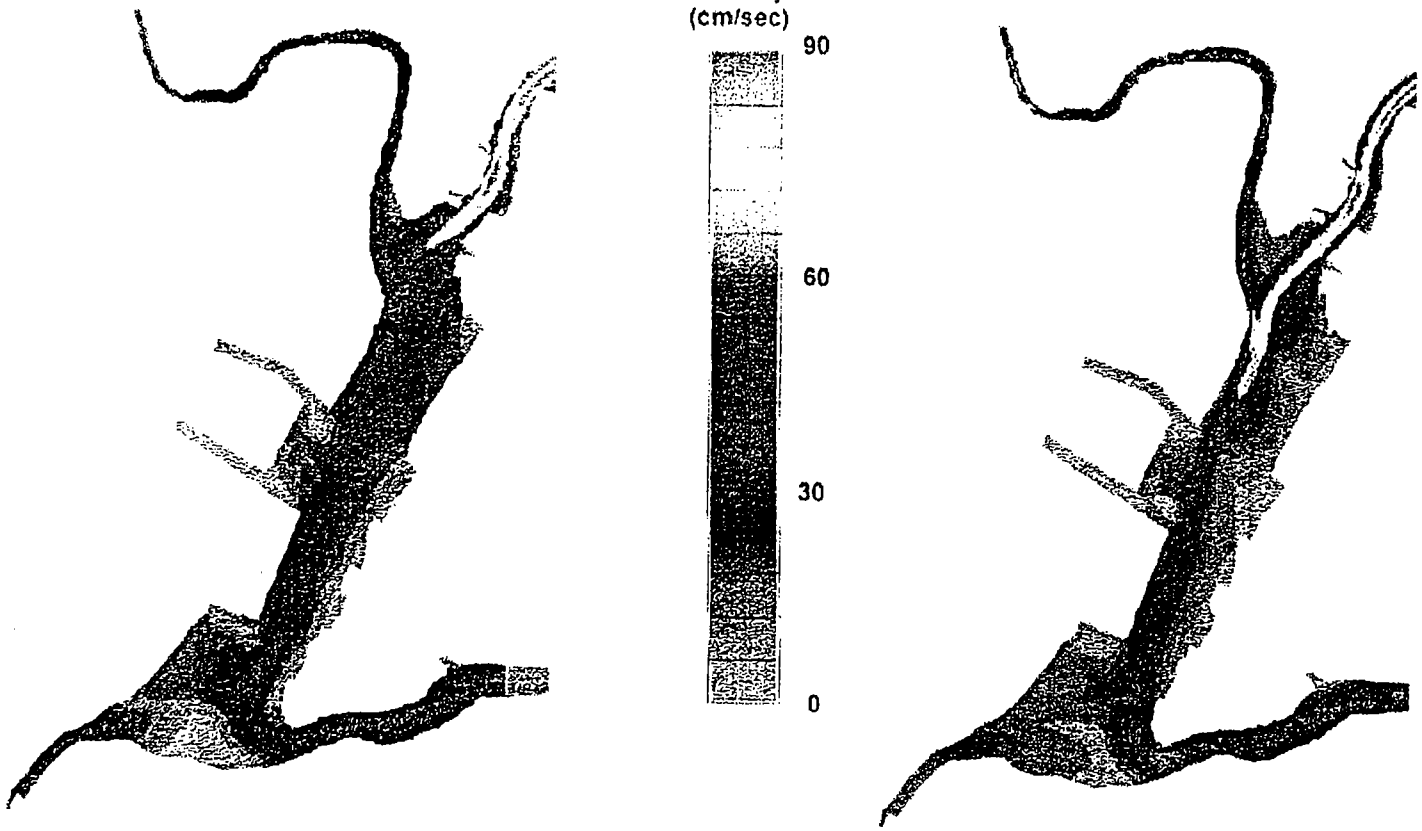
Peak Flood Tidal Currents
in Bottom Layer



Peak Ebb Tidal Currents
in Bottom Layer

Figure 3.02-5
WES HAM Model

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New [illegible]ay Confined Disposal Facility

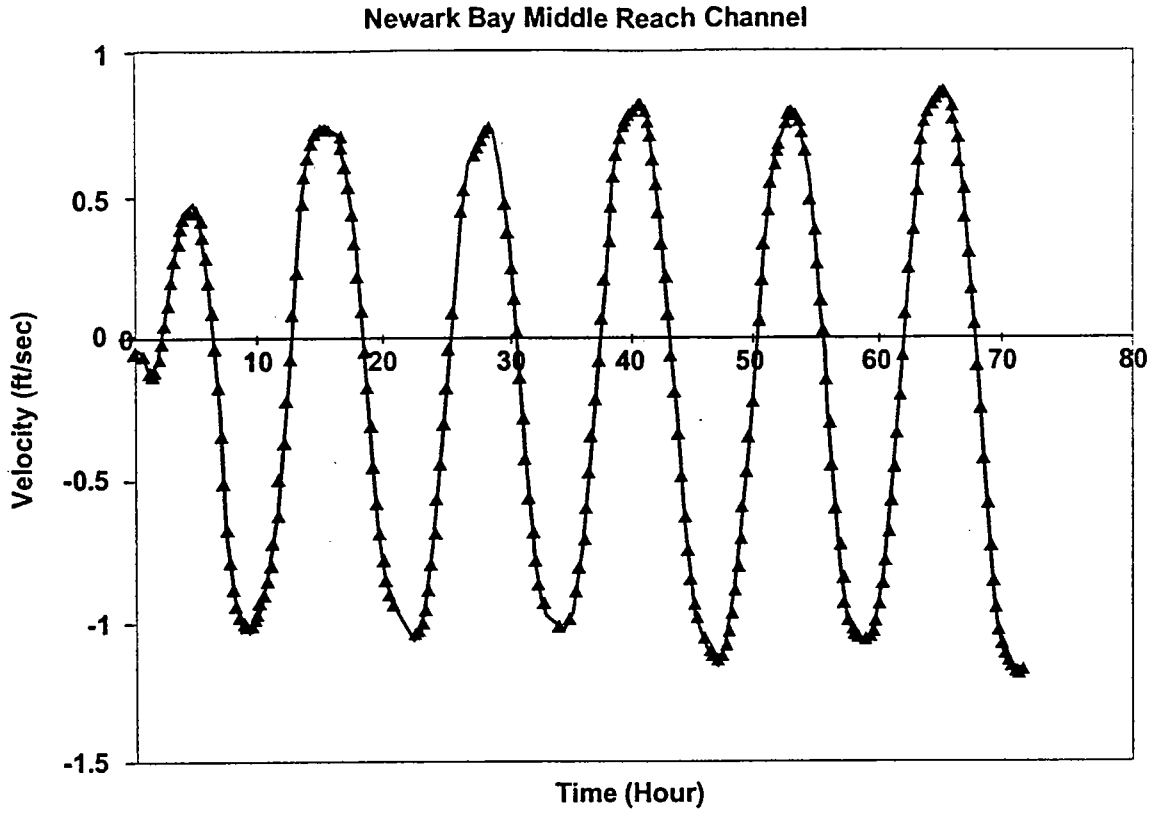


Peak Flood Tidal Currents
in Newark Bay

Peak Ebb Tidal Currents
in Newark Bay

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Figure 3.02-6
WES Passaic River Model



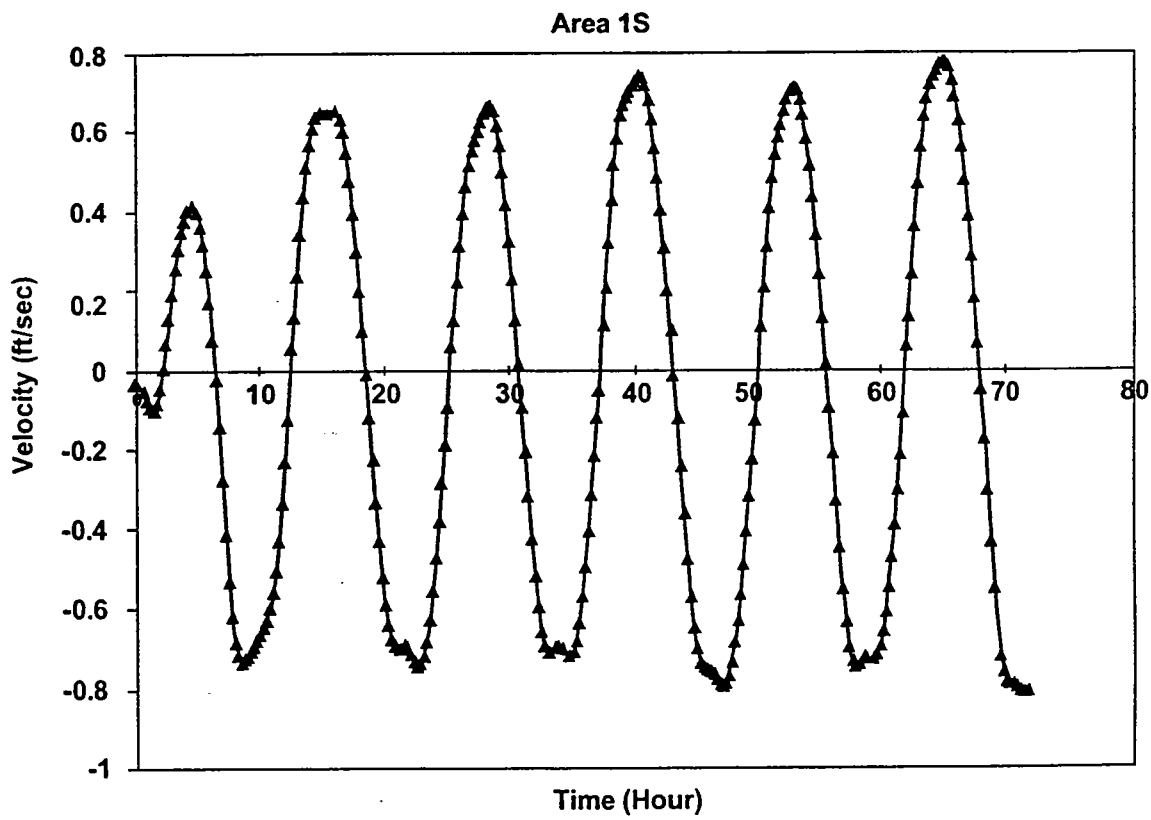
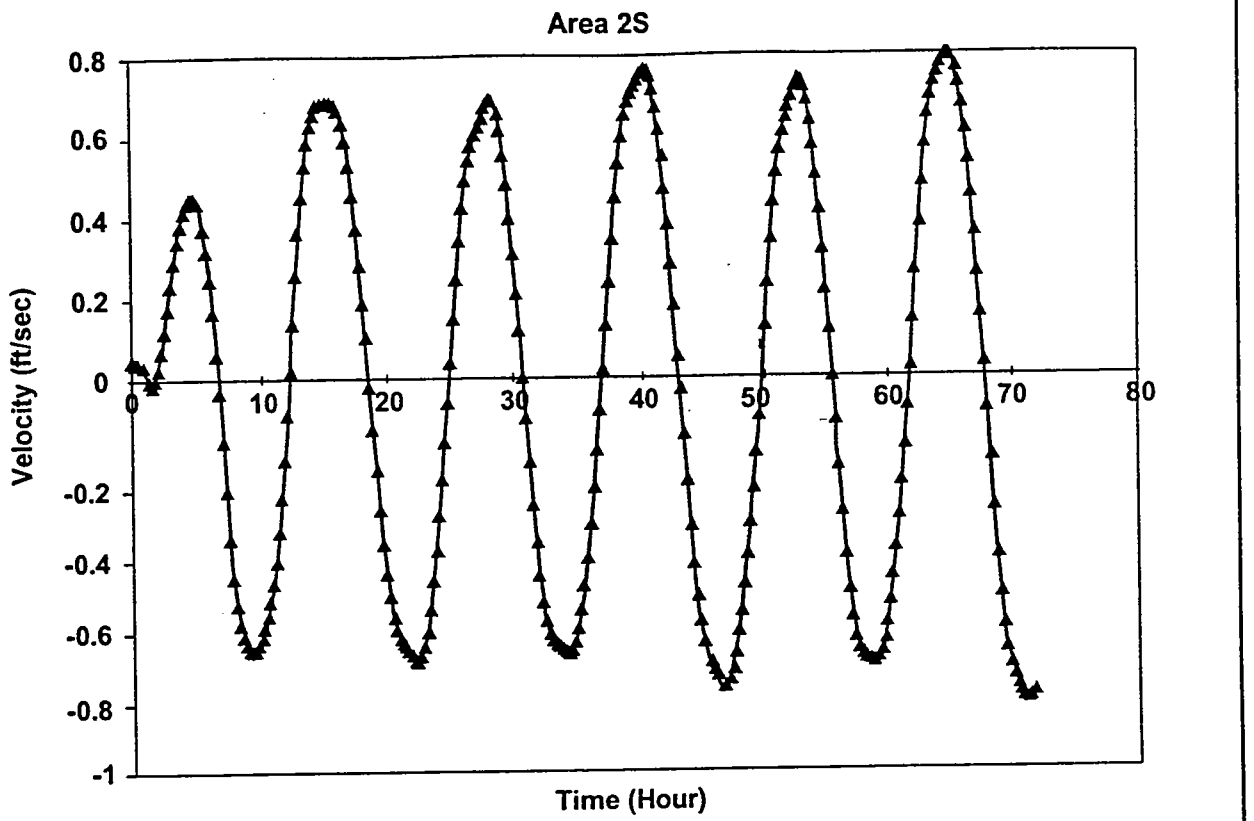


Figure 3.02-7

Velocity vs Time For Existing Conditions



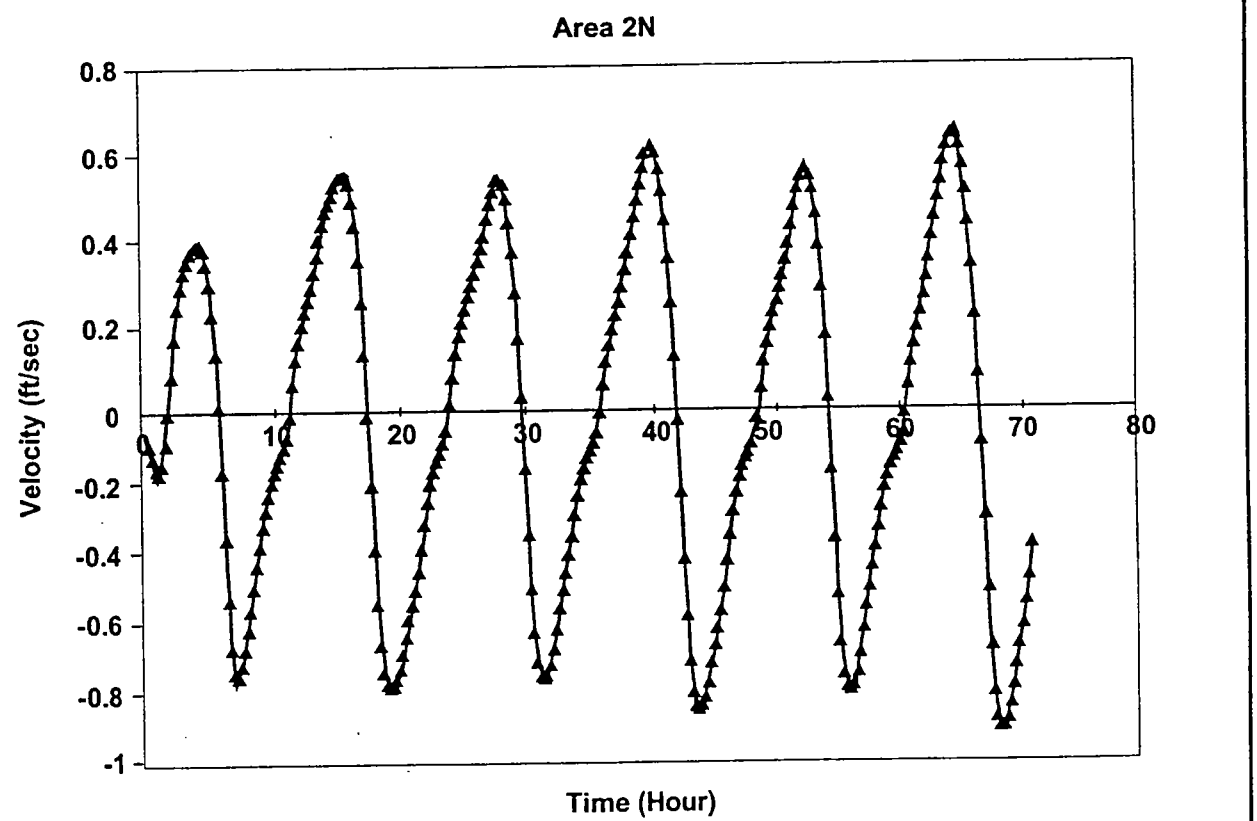
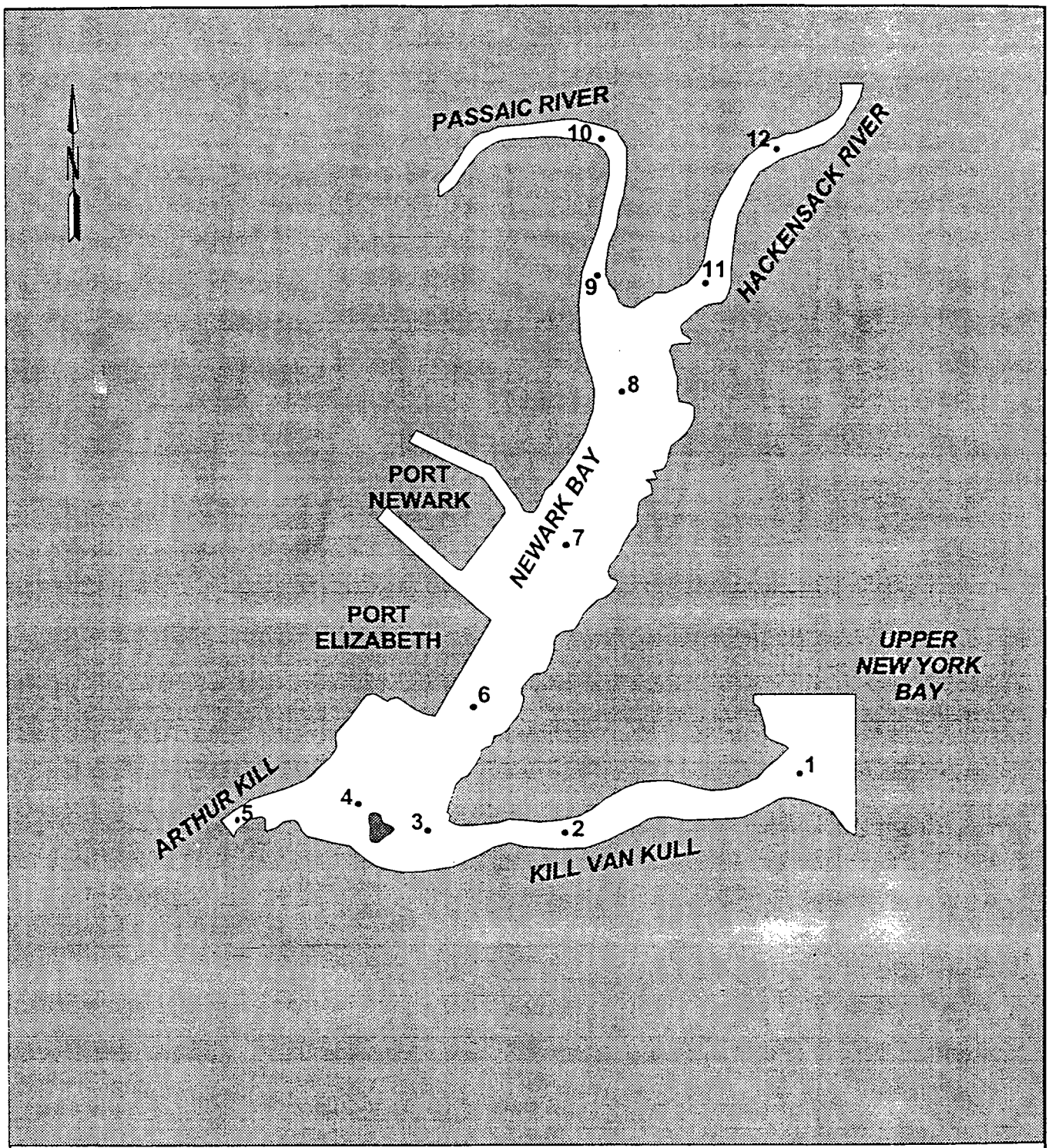


Figure 3.02-8

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Velocity vs Time For Existing Conditions

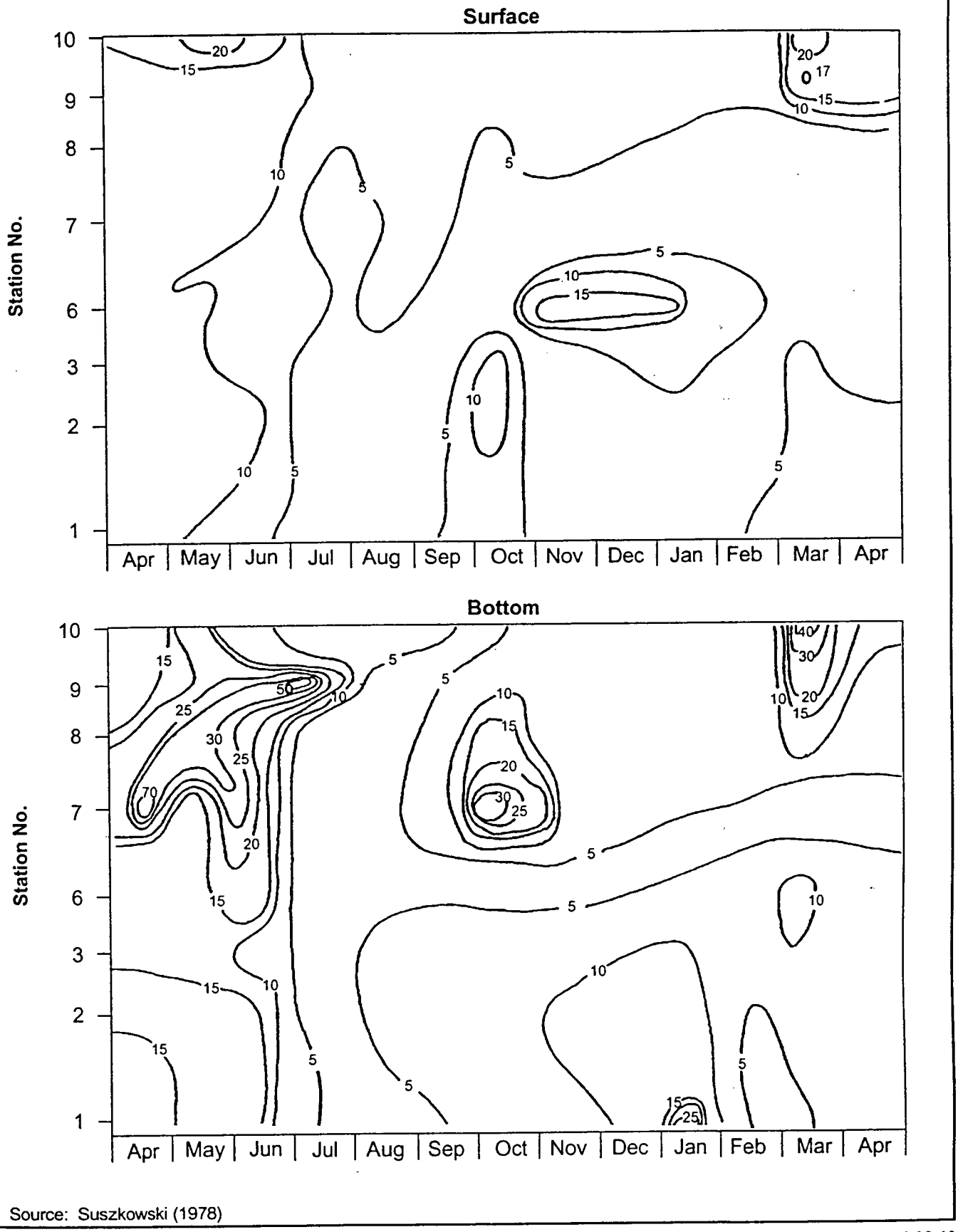


Source: Suszkowski (1978)

Figure 3.02-9

U.S. Army Corps of Engineers
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Suspended Sediment and Salinity Sampling Stations



Source: Suszkowski (1978)

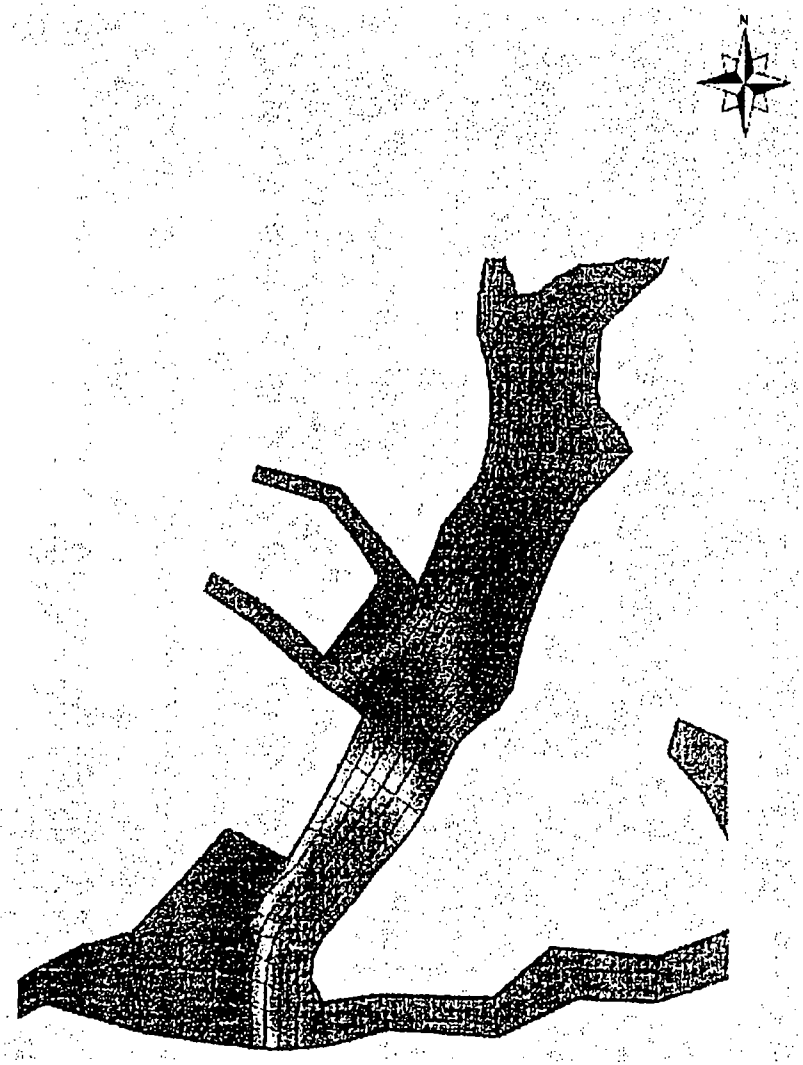
Figure 3.02-10

U.S. Army Corps of Engineers
Newark Bay Confined Disposal Facility

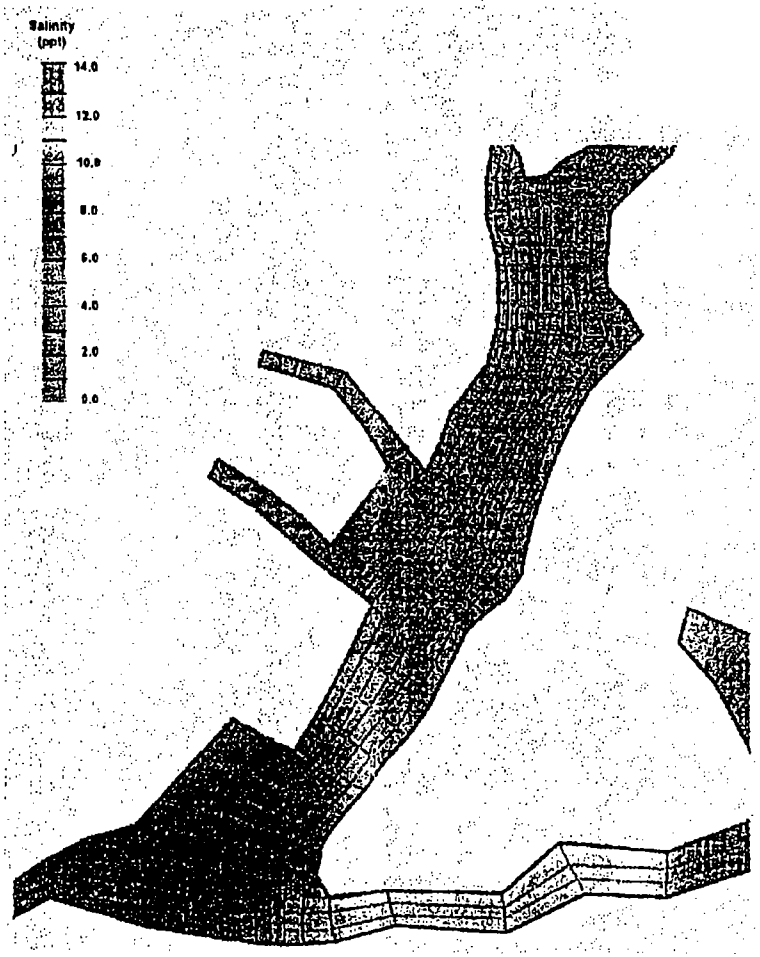
Surface and Bottom Concentrations of Suspended Sediment for Newark Bay

density-driven flow (i.e., bottom flood predominance and surface ebb predominance) could contribute to higher suspended sediment concentrations in the Port Newark area. Nevertheless, the yearly average suspended sediment concentration for Newark Bay was about 10 mg/1, which is relatively low. As a result, it is concluded that while density-driven flows within the Newark Bay channels may be important during Passaic River freshets (elevated freshwater discharge), these currents do not appear to dictate sedimentation processes under normal conditions.

Figure 3.02-11 presents WES HAM salinity results for maximum spring runoff conditions in the Passaic River. These results indicate that salinity values as low as 2 parts per thousand (ppt) can extend to the lower end of the Newark Bay Middle Reach. Additionally, results show that a salinity gradient of 7 ppt exists in Newark Bay during maximum spring runoff. Finally, the HAM results indicate that the difference between the maximum and minimum salinity during a single tide opposite Port Newark and Port Elizabeth is on the order of 5 ppt. This tidal difference can result in strong density-driven flows within the Port Newark and Port Elizabeth Harbor basins.



Peak Flood Salinity Concentrations in
Bottom Layer of Newark Bay



Peak Ebb Salinity Concentrations in
Bottom Layer of Newark Bay

Figure 3.02-11
WES HAM Model Salinity Concentrations

U.S. Army Corps of Engineers
Newark Bay Confined Disposal Facility

3.03 METEOROLOGY

3.03.1 CLIMATE

The climate of New York City and surrounding areas is temperate, with an average annual temperature of 52°F (11.1°C). January and February, the coldest months, have a mean temperature of about 31°F (-0.6°C), and July, the warmest month, has a mean temperature of approximately 73°F (22.8°C). The extreme temperatures observed were 14°F (-10°C) below zero and 102°F (38.9°C) above zero. The relative humidity average is about 70%. The average annual precipitation is approximately 44 in. (111.8 cm); the observed annual extreme values at an individual station were 58.7 and 32.6 in. (149.1 and 82.8 cm) recorded at the Battery in 1889 and 1935, respectively. The distribution of precipitation throughout the year is rather uniform, with a slightly higher amount during the summer months. Maximum precipitation over a 24-hr period, 9.4 in. (23.9 cm), was recorded during a hurricane at the Battery in October 1903.

3.03.2 STORMS

Two types of storms are of primary significance in the project vicinity: (1) tropical storms, which typically affect the NY/NJ area from July to October, and (2) extratropical storms, which are primarily winter storms. Extratropical storms (northeasters) are usually less intense than hurricanes, but tend to be of longer duration. These storms often cause high water levels and intense wave conditions and are responsible for significant damage and flooding.

Tropical storms form in warm, moist air masses over the Caribbean and along the intertropical convergence zone extending from the Caribbean to western Africa. Hurricanes are the most powerful tropical storms to reach the New York area, with wind speeds in excess of 74 mph (119 km/hr) (by definition). Records are available for 24 hurricanes that have affected the New York Harbor area in the past century. Heavy storm damage usually occurs when high astronomical tides and storm surge coincide. The combined water levels allow large waves to penetrate inland, resulting in extreme erosion and flooding. The relatively short duration of hurricanes often results in less damage than that of a major extratropical storm because the storm surge may not coincide with high astronomical tides and can be partly negated by coincidence with low astronomical tides. This has been the case with several hurricanes in the NY/NJ coastal region. Nonetheless, storms of hurricane force have the potential for causing the most severe damage.

Extratropical storms originate outside of the tropics, usually in the middle to upper latitudes during winter months. In the New York Harbor region, these storms are referred to as "northeasters" because of the direction from which the winds originate. Northeasters are less intense than hurricanes but may have localized winds that reach hurricane strength. Extratropical storms cover large areas and are slow moving, with

typical storm durations lasting several days. The long durations greatly enhance the ability of northeasters to cause damage. USACE (1969) states that 65 moderate to severe northeasters have affected the New York area over the 100-year period preceding 1965. More recently, a series of severe northeasters has impacted the New York coastal region in October 1991, December 1992, and March 1993.

A total of 231 storm and hurricane events affected the project vicinity between 1853 and 1988. Hurricanes are the more infrequent of the two types of events, and data suggest that hurricanes affect the New York area approximately once every 5.7 years.

3.03.3 SEA LEVEL RISE

Sea level trends are affected by global, regional, and local factors. Based on available information, the present global rate of sea level rise is between 0.003 and 0.004 ft/year (0.09 and 0.12 cm/year), or 1.6 to 2.3 ft/century (0.5 to 0.7 m/100 years) (USACE-NYD 1991). Along the northeast Atlantic coast, observed rates have averaged 0.009 ft/year (0.27 cm/year). Regionally, the rates of rise vary from 0.009 to 0.006 ft/year (0.27 to 0.18 cm/year) at Port Jefferson and Montauk Point, New York.

3.04 SEDIMENT QUALITY

Stratigraphically, the Newark Bay area is underlain by Passaic Formation bedrock, which consists of interbedded reddish sandstones and shales, with occasional conglomerate units. The Passaic Formation includes igneous intrusions of Triassic basalt manifested as the three Watchung Mountains located to the west, and the Palisades Diabase, which forms the eastern edge of Newark Bay (USACE 1987c; NOAA 1994).

The bedrock is overlain by unlithified glacial sediments of Pleistocene age subdivided into unstratified drift, which is further subdivided into glaciofluvial and glacial lacustrine deposits. Unstratified drift, called till or ground moraine, is composed of a heterogeneous mixture of clay, silt, gravel, cobbles, and boulders released when entrained materials were released and deposited after glacial melting. Unstratified drift forms ridge-like deposits and yields varying amounts of groundwater. Groundwater in bedrock is confined where the bedrock aquifer is overlain by fine-grained unstratified drift.

Stratified drift was deposited by glacial meltwater in streams (glaciofluvial drift) and in lakes (glaciolacustrine drift). Glaciofluvial sediments were deposited under high energy and consequently consist of coarse-grained particles, which form high-yielding aquifers. Stream channels, which incised unstratified drift, are also filled with coarse-grained deposits. Glaciolacustrine sediments are formed in low-energy environments and consist of bedded fine-grained silts and clays, which yield restricted amounts of groundwater. Boring logs from Newark Bay shows a thick bed of varved glaciolacustrine sediments ranging in thickness from 30 to 50 ft (9.1 to 15.2 m) (Suszkowski 1978) overlying glacial outwash deposits. Although well data for this deposit were not found, groundwater in the outwash most likely exists under confined conditions.

Holocene sediments consist of recent shore and marsh deposits, fine-grained wind-blown sand, silt (loess), and artificial fill. The recent shore and marsh deposits that also blanket the bottom of the Bay consist of fine-grained sand and organic clay. Areas of artificial fill exist in areas around the Bay, including the western shoreline in Elizabeth.

The bottom of Newark Bay is generally composed of fine-grained sediments that are characteristic of relatively low-energy systems (Suszkowski 1978). The two dominant size classes of particles are fine sand and fine silt/"coarse" clay. The channel sediments tend to be coarser than the off-channel bottom sediments. Dredging activity between 1944 and 1975 has deepened areas of the Bay. The dredging rate from 1944 to 1976 was 280% of the annual shoaling rate (Suszkowski 1978). Dredging has been curtailed since about 1992, when dredging and disposal regulatory criteria became more restrictive.

A model of suspended sediment transport in Newark Bay was developed by Suszkowski (1978). Model results indicated that approximately 65% of the inorganic suspended sediments come from downstream sources (i.e., Kill Van Kull and Arthur Kill). The riverine sources, the Passaic and Hackensack rivers, accounted for approximately 30% of the total sediment load to Newark Bay. Internal sources, which consist of wastewater

discharge, urban runoff, and phytoplankton production, account for 5% of the total incoming inorganic suspended sediments.

The bottom sediments of Newark Bay have been sampled and analyzed for contaminants since the early 1970s. Data on toxics up to around 1990 were compiled by Squibb et al. (1991) as part of the NY/NJ Harbor Estuary Program. Newark Bay sediments generally have elevated metals concentrations compared to the rest of the Harbor. The average concentrations of cadmium (8.62 ppm), chromium (512.3 ppm), copper (480.8 ppm), lead (331.9 ppm), zinc (610.9 ppm), and mercury (8.64 ppm) in Newark Bay are substantially higher than average concentrations in the remainder of the Harbor (Squibb et al. 1991).

In general, the overall distributions of zinc, copper, and lead in Newark Bay are similar to one another, with the highest concentrations occurring in sediments near the mouths of the Passaic River, Hackensack River, and Arthur Kill and the lowest concentrations in the middle section of the Bay (Olsen et al. 1984).

The sediment of Newark Bay and Arthur Kill have the highest PCB concentrations of any sediment samples taken in the Harbor, with average concentrations of 1.13 and 1.56 ppm, respectively (Squibb et al. 1991). As these concentrations are greater than recorded in sediment samples from the lower Hudson River (which has an average of 0.38 ppm), it might be concluded that there are other PCB sources to the lower estuary than the upper Hudson.

Concentrations of polycyclic aromatic hydrocarbons (PAHs) are also elevated in Newark Bay and Arthur Kill sediments (Squibb et al. 1991). As these waterways are used to transport oil to local oil refinery and storage facilities, local spills and non-point sources, including combined sewer overflows containing oil-contaminated highway run-off, are suspected as major sources of PAHs.

Chlorinated pesticides can be separated into two classes of compounds: DDT and its metabolites (DDD and DDE); and chlorinated pesticides consisting of aldrin, alpha-chlordane, trans-nonchlor, dieldrin, heptachlor, heptachlor epoxide, hexachlorobenzene, gamma-BHC (lindane), and mirex. Hot spots of high DDT concentrations have been found in Newark Bay as well as the adjoining Arthur Kill (Squibb et al. 1991) and Passaic River (Bopp et al. 1991). Past discharges from industrial point source discharges to the Arthur Kill and lower Passaic River are suspected to be the causes. Non-DDT chlorinated pesticide concentrations are also elevated in Newark Bay (Squibb et al. 1991).

Recent sampling and analysis of NY/NJ Harbor sediments for 2,3,7,8-tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD) was reported on by Bopp et al. (1991). Bopp et al. sampled three stations in Newark Bay - two north and one south of the proposed NBCDF - and found 2,3,7,8-TCDD concentrations of 230 and 310 parts per trillion (pptr) (picograms per gram [pg/g]) in the surficial sediments (Bopp et al. 1991). Layers of sediment cores from the Passaic River and Newark Bay were analyzed to establish likely dates of

deposition using time tracers (^{7}Be and ^{137}Cs). The dating of sediment deposition was performed to evaluate historical concentrations of 2,3,7,8-TCDD and p,p'-DDD, a major DDT-derived compound found in anaerobic sediments. The distribution of TCDD and DDD in the sediments pointed to a chemical manufacturing facility located in Newark at 80 Lister Avenue on the southwest bank of the Passaic River as the source. The plant produced sodium 2,4,5-trichlorophenate, which was used to synthesize major components in Agent Orange, between approximately 1948 and 1969. DDT was synthesized at this plant between the early 1940s and 1959. The maximum concentration of p,p'-DDD in Newark Bay sediments was approximately 450 pg/g (at approximately 15 in. [39 cm] below the top of the sediment core collected in 1985), and deposition of these sediments took place prior to 1954. Concentrations of 2,3,7,8-TCDD were at peak concentrations of 1100 and 2900 pg/g in layers approximately 12.5 in. [32 cm] below the sediment-water interface corresponding to sediments deposited in the mid-1960s. The dioxin and DDT chronology of Newark Bay sediments was closely related to the chemical production at the 80 Lister Avenue site. As this plant was identified as a major source of 2,3,7,8-TCDD, the site has been identified as a Superfund site and is undergoing remediation (see Section 4.9 of this FEIS).

The distribution of PAHs in the Hackensack and Passaic rivers and Arthur Kill was investigated by the collection and analysis of deep sediment cores in December 1991 (Huntley et al. 1993). Peak concentrations of PAHs and total extractable petroleum hydrocarbons (TEPH) were generally found in the deeper sediments. This is similar to the findings of Bopp et al. (1991) for dioxin and DDT and indicates that contaminant sources have diminished during the past few decades. The concentrations of PAHs in surficial and deep sediments exceeded NOAA's guidelines (1990) for fluorene (0.035 ppm), fluoranthene (0.60 ppm), and total PAHs (35.0 ppm).

The sediments of Newark Bay have been analyzed for physical properties and chemical concentrations as well as toxicity as part of NOAA's National Standard Trends and Status Program (Long et al. 1995). Phase 2 sampling for the NOAA program, focused on Newark Bay and adjacent waterways (Hackensack and Passaic rivers and Kill Van Kull) as shown in Figure 3.04-1. Surficial sediments were analyzed for total (recoverable) metals (i.e., silver, arsenic, aluminum, cadmium, chromium, copper, iron, mercury, nickel, lead, antimony, tin, selenium, and zinc), acid-volatile sulfides (AVS), organochlorine pesticides (hexachlorobenzene, alpha-BHC, beta-BHC, delta-BHC, oxychlordanes, trans-chlordane, cis-chlordane, dieldrin, o,p'-DDT, p,p'-DDT total), PAHs, PCBs, and dioxin-furan congeners. The three toxicity tests performed on sediment samples were:

- 10-day, solid-phase test of survival with the amphipod *Ampelisca abdita*
- 48-hr, elutriate-/liquid-phase test of normal development and survival with the larvae of the clam *Mulina lateralis*

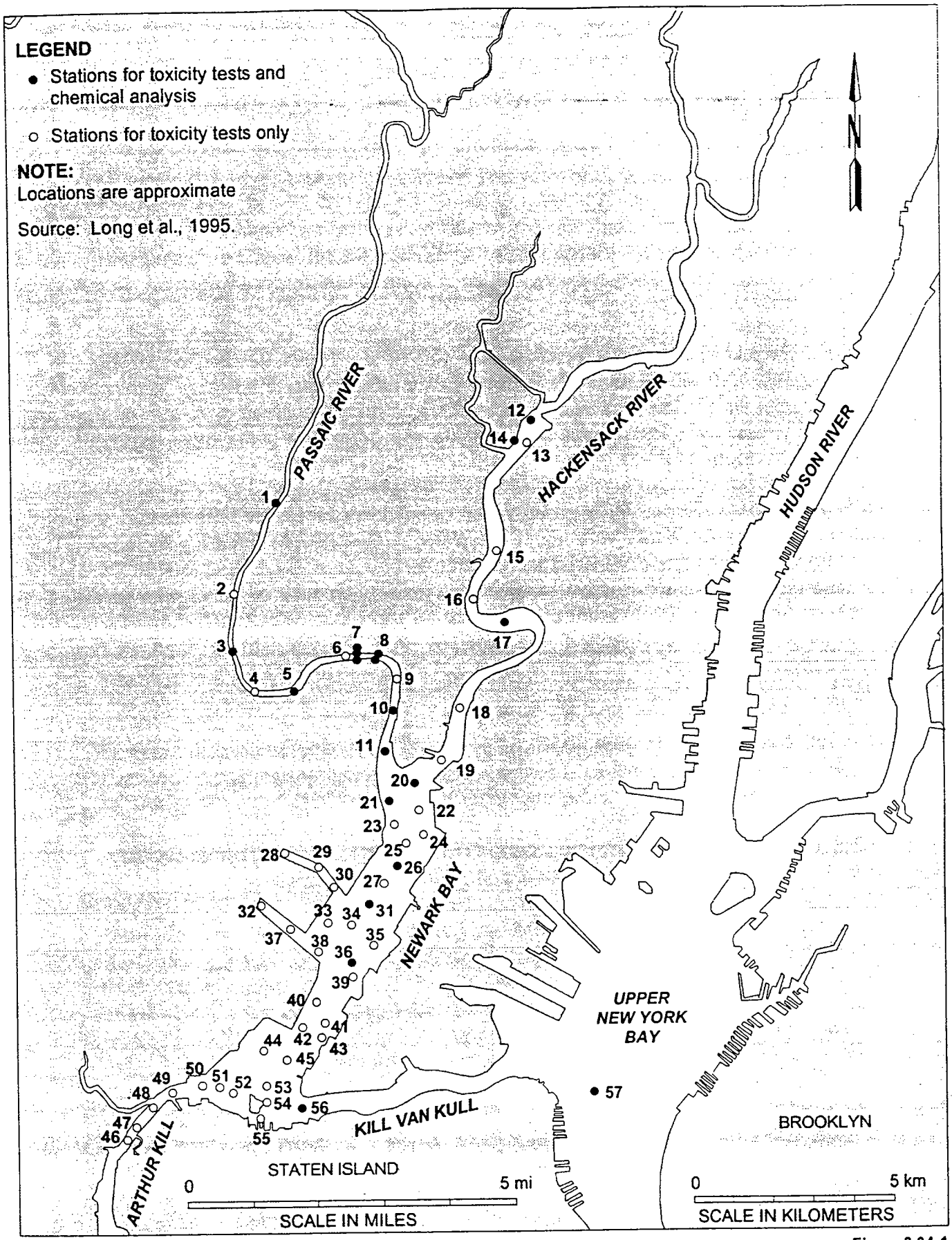


Figure 3.04-1

U.S. Army Corps of Engineers
Newark Bay Confined Disposal Facility

Stations Sampled in the Passaic River, Hackensack River, Newark Bay, Upper Arthur Kill, Kill van Kull, and Upper New York Harbor During Phase 2

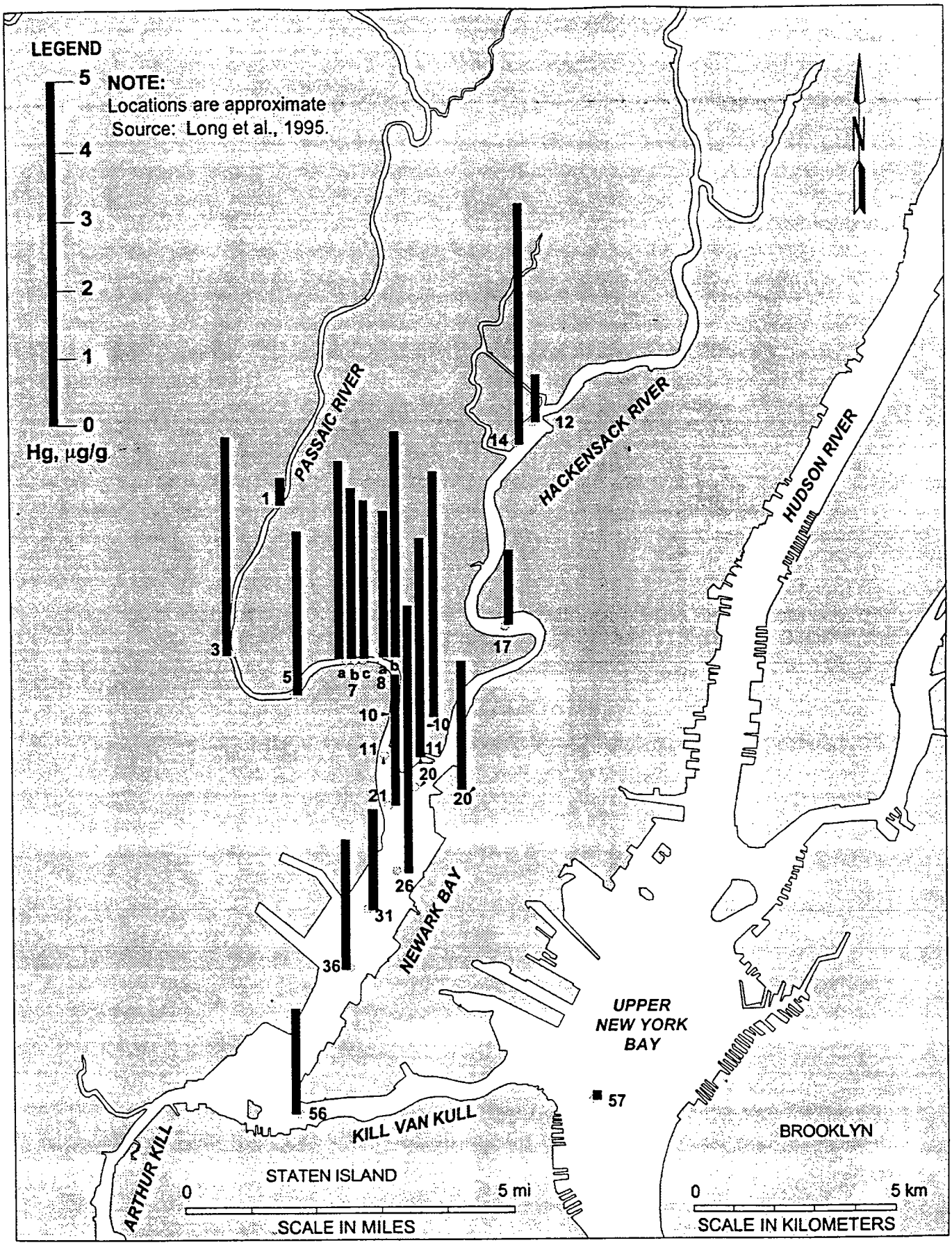


Figure 3.04-3
Concentrations of Mercury at Selected Stations in Newark Bay and Vicinity

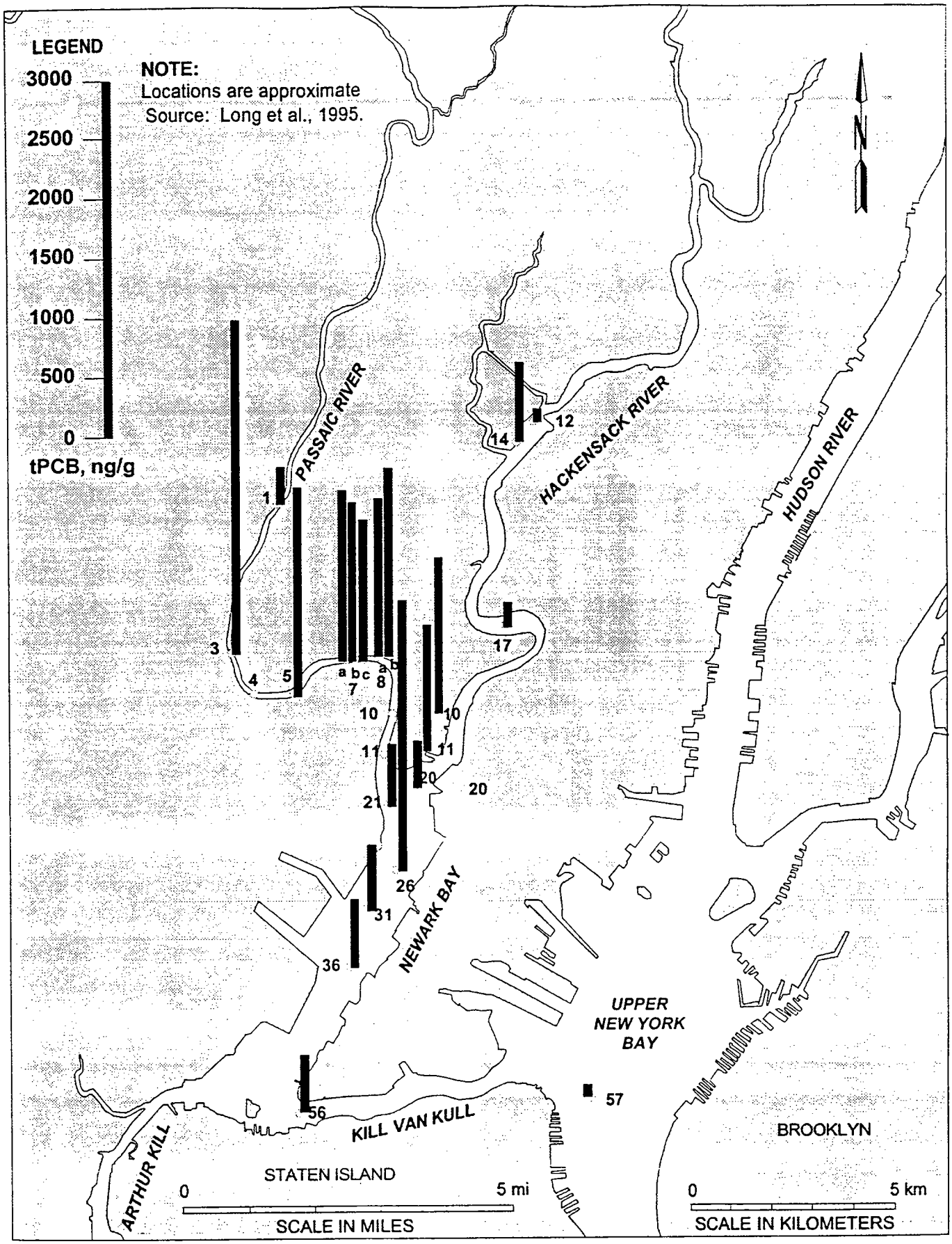


Figure 3.04-4
Concentrations of Total PCBs at Selected Stations in Newark Bay and Vicinity

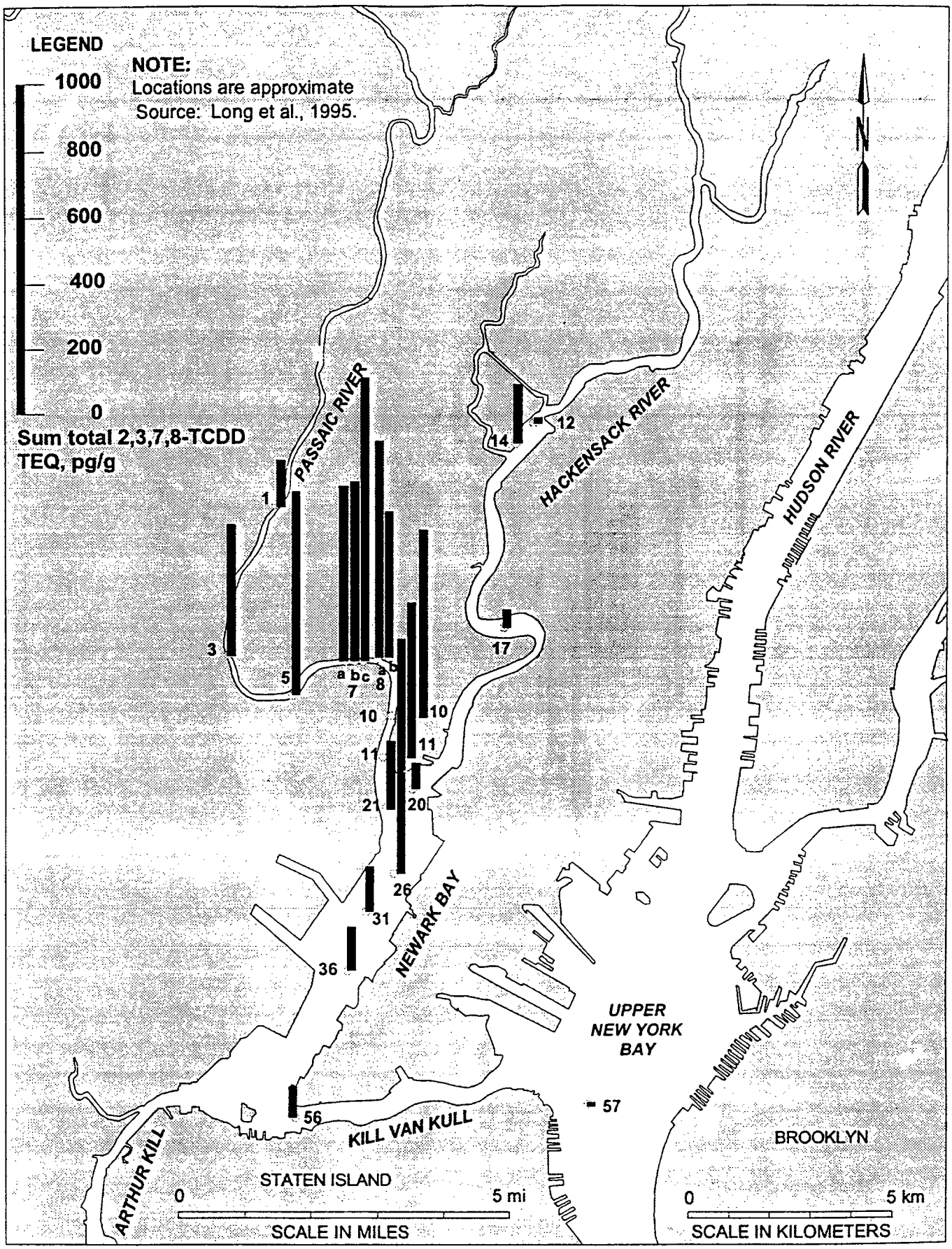


Figure 3.04-5

U.S. Army Corps of Engineers
Newark Bay Confined Disposal Facility

Concentrations of Total 2,3,7,8-TCDD Toxicity Equivalency Quotients at Selected Stations in Newark Bay and Vicinity

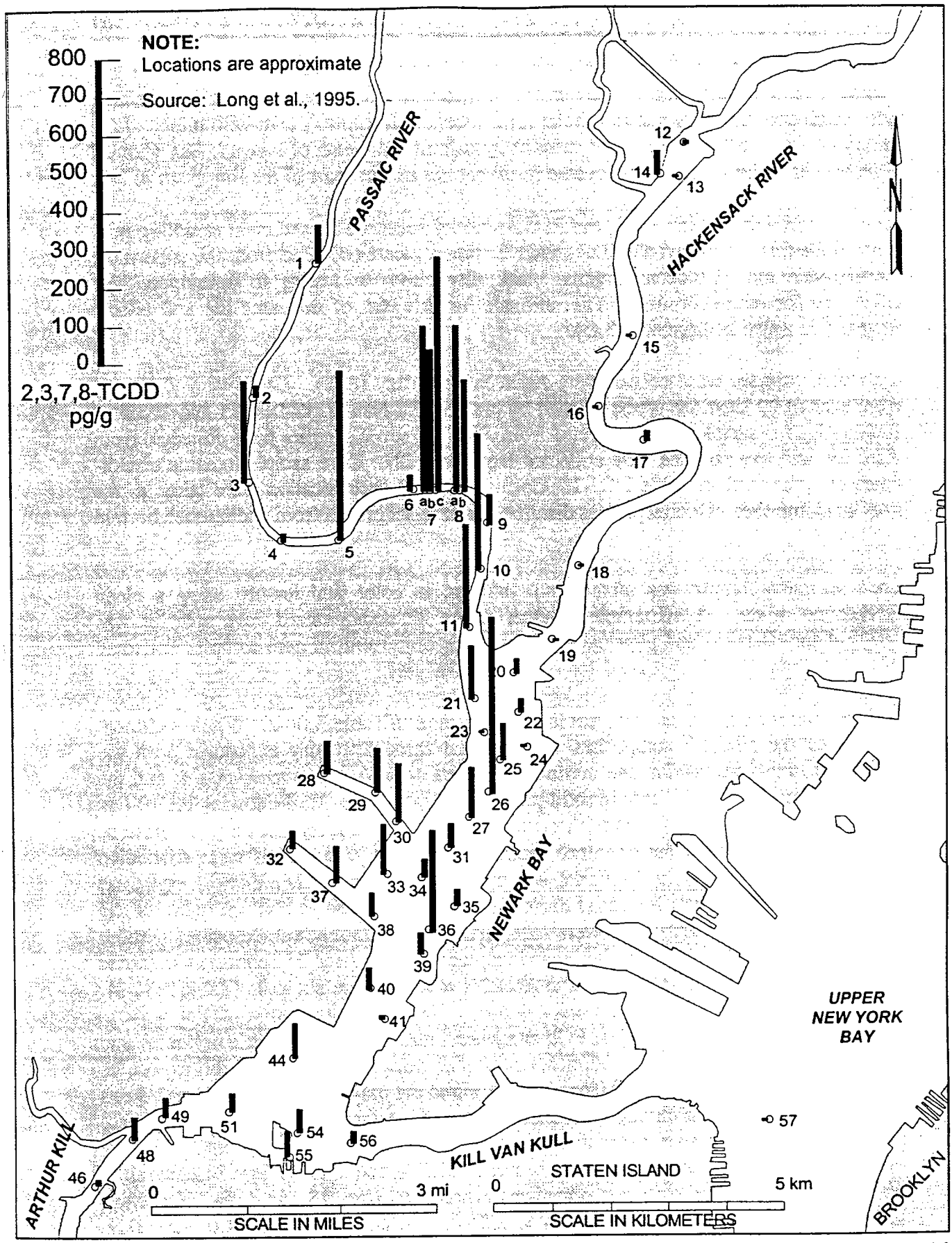


Figure 3.04-6

U.S. Army Corps of Engineers
Newark Bay Confined Disposal Facility

Concentrations of 2,3,7,8-TCDD at 53 Selected Stations in Newark Bay and Vicinity

While the results of the four toxicity tests showed different patterns in toxicity, they did overlap to a significant degree. Chemical concentrations were more strongly correlated with amphipod mortality and microbial luminescence (Microtox) than with either of the embryo tests. The distribution of most chemicals in sediments of Newark Bay showed peak concentrations at a station located in the central eastern part of the Bay (station 26).

From 10 through 14 May 1996, the Port Authority sponsored a sediment sampling program at the three proposed NBCDF areas. Sediments were collected from the uppermost stratigraphic unit (Holocene organic black silty clay) for testing to determine their suitability for ocean disposal. The rationale for this part of the sampling and testing program is given in Appendix 3.04.

Vibracore samples were collected by Aqua Survey, Inc. (ASI). Cores were collected from each of 22 locations preestablished by the USACE New York District and USEPA-Region II. Ten samples were collected from Area 1S, seven samples were collected from Area 2S, and five samples were collected from Area 2N. Core sample location coordinates are presented in Table 3.04-1. Core samples at each location were taken to the gray sand interface, which separates disturbed surface sediments from undisturbed bottom sediments.

Each sediment sample was mixed until uniform in color and texture using a clean mechanical mixer. A subsample of each of the 22 homogenized core samples was reserved for chemical and physical analyses. The homogenized core samples collected from each area were composited for biological analyses.

Bulk sediment chemical analysis results are presented in Table 3.04-2. Whole sediment toxicity of the NBCDF composites was assessed through 10-day exposures with the amphipod *Ampelisca abdita*, the marine polychaete *Neanthes arenaceodentata*, and the mysid shrimp *Mysidopsis bahia* in solid-phase tests (Table 3.04-2). Following the 10-day exposure, *A. abdita* and *N. aranaceodentata* survival was not significantly different as compared to survival in the reference sediment chambers. Two trials were conducted with the mysid shrimp; the first trial was conducted as a static nonrenewal exposure, however; ammonia levels increased during testing and resulted in high mortality of the test organisms, the toxicity tests were then rerun as a static renewal exposure, without pretest purging. The results of the second test indicate that Area 2S sediments are toxic to *Mysidopsis bahia*, while Area 1S and Area 2N sediments are not toxic (Table 3.04-3).

The bioaccumulation of pesticides, PCB congeners, metals, PAHs, volatile organics, and dioxin/furans from the NBCDF sediment composites was assessed using 28-day exposures of the clams *Macoma nasuta* and *Tapes japonica* and the polychaete *Nereis virens*. Tests were conducted as flow-through exposures. Based on the results of the solid-phase toxicity tests, only tissues from those organisms exposed to Area 1S and Area 2N sediment composites were analyzed for bioaccumulation potential. Tissue bioaccumulation test results for the three test organisms exposed to Area 1S and Area 2N surface sediment composites are presented in Table 3.04-4. Overall the test results indicate that

Table 3.04-1

Newark Bay Confined Disposal Facility Sediment Core Sample Collection Location Coordinates

NBCDF Area	Sample Number	Sample Date	Sample Location Coordinates	
			Latitude	Longitude
Area 1S	1	10 May 96	40° 40′ 44.273"N	74° 08′ 24.110"W
	2	10 May 96	40° 40′ 42.996"N	74° 08′ 19.938"W
	3	10 May 96	40° 40′ 42.180"N	74° 08′ 17.329"W
	4	10 May 96	40° 40′ 41.248"N	74° 08′ 14.975"W
	5	10 May 96	40° 40′ 47.780"N	74° 08′ 17.509"W
	6	10 May 96	40° 40′ 46.967"N	74° 08′ 14.803"W
	7	10 May 96	40° 40′ 46.249"N	74° 08′ 11.983"W
	8	10 May 96	40° 40′ 50.805"N	74° 08′ 14.061"W
	9	10 May 96	40° 40′ 50.107"N	74° 08′ 10.679"W
	10	10 May 96	40° 40′ 53.312"N	74° 08′ 10.137"W
Area 2S	11	11 May 96	40° 41′ 20.223"N	74° 07′ 50.199"W
	12	11 May 96	40° 41′ 19.360"N	74° 07′ 45.981"W
	13	11 May 96	40° 41′ 23.606"N	74° 07′ 48.709"W
	14	11 May 96	40° 41′ 21.423"N	74° 07′ 43.661"W
	15	11 May 96	40° 41′ 25.372"N	74° 07′ 46.424"W
	16	13 May 96	40° 41′ 45.611"N	74° 07′ 40.669"W
	17	13 May 96	40° 41′ 28.009"N	74° 07′ 43.373"W
Area 2N	18	13 May 96	40° 41′ 34.021"N	74° 07′ 36.604"W
	19	13 May 96	40° 41′ 34.321"N	74° 07′ 31.600"W
	20	13 May 96	40° 41′ 37.405"N	74° 07′ 34.139"W
	21	13 May 96	40° 41′ 41.612"N	74° 07′ 30.839"W
	22	13 May 96	40° 41′ 39.525"N	74° 07′ 28.206"W

Table 3.04-2 (Page 1 of 3)

Newark Bay Confined Disposal Facility Bulk Sediment Chemical Analysis
Surface Sediment Evaluation Program 10-14 May 1996

Analyte	Value	Sediment Composite Sample		
		Area 1S	Area 2S	Area 2N
Metals				
Arsenic	mg/kg	8.6	10.4	17.4
Cadmium	mg/kg	0.54	0.09u	0.43
Chromium	mg/kg	80.3	43.4	117
Copper	mg/kg	49.3	50.8	96.6
Lead	mg/kg	115	58.8	112
Mercury	mg/kg	0.90	1.3	2.8
Nickel	mg/kg	15.7	16.7	21.9
Silver	mg/kg	0.41	0.34	1.0
Zinc	mg/kg	252	107	192
PAHs				
Naphthalene	µg/kg	17U	41	46
Acenaphthylene	µg/kg	41U	41U	41U
Acenaphthene	µg/kg	230	790	290
Fluorene	µg/kg	48	260	120
Phenanthrene	µg/kg	100	510	130
Anthracene	µg/kg	64	150	74
Fluoranthene	µg/kg	170	530	190
Pyrene	µg/kg	190	600	240
Benzo[a]anthracene	µg/kg	110	370	130
Chrysene	µg/kg	110	330	130
Benzo[b]fluoranthene	µg/kg	280	270	170
Benzo[k]fluoranthene	µg/kg	73	69	63
Benzo[a]pyrene	µg/kg	190	120	220
Dibenzo[a,h]anthracene	µg/kg	16	32	21
Benzo[g,h,i]perylene	µg/kg	140	220	150
Indeno[1,2,3-cd]pyrene	µg/kg	80	160	82
Volatile Organics				
1,4-dichlorobenzene	µg/kg	0.40U	0.40U	1.8
PCB				
BZ008	µg/kg	0.97U	0.97U	0.97U
BZ018	µg/kg	0.72U	0.72U	2.2P
BZ028	µg/kg	0.84U	0.84U	3.7

Newark Bay Confined Disposal Facility Bulk Sediment Chemical Analysis
Surface Sediment Evaluation Program 10-14 May 1996

Analyte	Value	Sediment Composite Sample		
		Area 1S	Area 2S	Area 2N
PCB (continued)				
BZ052	µg/kg	1.3U	1.3U	2.7
BZ049	µg/kg	0.97U	0.97U	1.7
BZ044	µg/kg	0.72U	0.72U	2.1
BZ065	µg/kg	0.89U	0.89U	2.3
BZ101	µg/kg	0.83U	0.83U	2.0P
BZ087	µg/kg	0.82U	0.82U	1.0P
BZ118	µg/kg	1.0U	1.0U	1.9
BZ105	µg/kg	0.86U	0.86U	0.86U
BZ184	µg/kg	0.79U	0.79U	0.79U
BZ153	µg/kg	0.99U	0.99U	0.99U
BZ138	µg/kg	1.0U	1.0U	1.7
BZ187	µg/kg	0.78U	0.78U	0.78U
BZ183	µg/kg	0.634	0.634	0.83
BZ128	µg/kg	1.0U	1.0U	1.0U
BZ180	µg/kg	1.1U	1.1U	1.1U
BZ170	µg/kg	0.98U	0.98U	0.98U
BZ195	µg/kg	1.2U	1.2U	1.2U
BZ206	µg/kg	1.2U	1.2U	1.2U
BZ209	µg/kg	1.0U	1.0U	1.0U
Dioxins and Furans				
2378-TCDD	pg/g	8.6	11.4	99.6
12378-PeCDD	pg/g	0.71	(1.2)	1.8
123478-HxCDD	pg/g	1.1	{0.79}	{2.0}
123678-HxCDD	pg/g	3.3	2.3	8.4
123789-HxCDD	pg/g	3.0PR	{2.0}PR	{5.9}
1234678-HpCDD	pg/g	59.5	43.0	122
OCDD	pg/g	1350	991	1630
2378-TCDF	pg/g	15.1	14.6	98.2
12378-PeCDF	pg/g	{1.3}	1.1	5.0
23478-PeCDD	pg/g	2.0	1.5	7.4
123478-HxCDF	pg/g	{13.3}E	{9.9}E	{80.2}E
123678-HxCDF	pg/g	2.4	{1.2}	11.2
234678-HxCDF	pg/g	1.9B,PR	{1.1}B,PR	5.7B,PR
123789-HxCDF	pg/g	(0.7)	(1.0)	(3.4)

Newark Bay Confined Disposal Facility Bulk Sediment Chemical Analysis
Surface Sediment Evaluation Program 10-14 May 1996

Analyte	Value	Sediment Composite Sample		
		Area 1S	Area 2S	Area 2N
Dioxins and Furans				
1234678-HpCDF	pg/g	27.6	19.6	209
124789-HpCDF	pg/g	1.8	1.8	6.5
ODCF	pg/g	72.7	41.7	469
Pesticides				
Heptachlor	µg/kg	0.43U	0.43U	0.43U
Aldrin	µg/kg	0.43U	0.43U	0.43U
Heptachlor epoxide	µg/kg	0.44U	0.44U	0.44U
trans-Nonachlor	µg/kg	0.53U	0.53U	0.53U
alpha-Chlordane	µg/kg	0.45U	0.45U	0.45U
Endosulfan I	µg/kg	0.53U	0.53U	0.53U
2,4'-DDE	µg/kg	0.44U	0.44U	0.44U
4,4'-DDE	µg/kg	0.98U	0.60U	4.1P
Dieldrin	µg/kg	0.44U	0.44U	0.44U
2,4'-DDD	µg/kg	0.55U	0.55U	0.55U
4,4'-DDD	µg/kg	0.68U	0.68U	0.82U
2,4'-DDT	µg/kg	0.53U	0.53U	0.53U
Endosulfan II	µg/kg	0.48U	0.48U	0.48U
4,4'-DDT	µg/kg	0.43P	0.37U	1.9P
Endolsulfan sulfate	µg/kg	0.79U	0.78U	0.79U

U = Analyte analyzed for but not detected.
B = Analyte detected in laboratory method blank and an associated field sample.
P = Lower value between GC column results when >25% difference between column values recorded.
E = PCDF peak has eluted as the associated DPE.
PR = Poorly resolved GC peak.

Table 3.04-3

Newark Bay Confined Disposal Facility Preliminary Laboratory Results

Species	Matrix (Data Type)	Control	Reference	Area 1S	Area 2S	Area 2N
Solid Phase Toxicity Test - 10 Day Bioassay Test						
Ampelisca abdita (flow through)	Percent Survival	96, 100%	93%	81% NT	93% NT	97% NT
Neanthes arenaceodentata (static)	Percent Survival	100%	100%	96% NT	88% NT	84% NT
Mysidopsis bahia (flow through)	Percent Survival	94%	97%	91% NT	79%[a] NT	87% NT
Twenty-eight (28) Day Bioaccumulation Exposure						
Tapes japonica	Percent Survival	100%	100%	100%	100%	98.4%
Macoma nasuta	Percent Survival	97%	90%	70%	80%	63%[a]
Nereis virens	Percent Survival	98%	99%	100%	99%	99%
Supsended Particulate Phase Toxicity Test - Water Column Testing						
Menidia berylilina	SPP (LC50)	100%, 98%, 98%	NA	65.2%	≥100%	31.6%
Mysidopsis bahia	SPP (LC50)	95%, 92%, 93%	NA	58.1	≥100%	71.6%
Mytilus edulis	SPP (LC50)	100%	NA	22.6%	22.5%	20.8%

[a]Statistically lower than reference @$p \leq 0.05$.

Table 3.04-3

Newark Bay Confined Disposal Facility Preliminary Laboratory Results

Species	Matrix (Data Type)	Control	Reference	Area 1S	Area 2S	Area 2N
Solid Phase Toxicity Test - 10 Day Bioassay Test						
Ampelisca abdita (flow through)	Percent Survival	96, 100%	93%	81%	93%	97%
Neanthes arenaceodentata (static)	Percent Survival	100%	100%	96%	88%	84%
Mysidopsis bahia (flow through)	Percent Survival	94%	97%	91%	79%[a]	87%
Twenty-eight (28) Day Bioaccumulation Exposure						
Tapes japonica	Percent Survival	100%	100%	100%	100%	98.4%
Macoma nasuta	Percent Survival	97%	90%	70%	80%	63%[a]
Nereis virens	Percent Survival	98%	99%	100%	99%	99%
Supsended Particulate Phase Toxicity Test - Water Column Testing						
Menidia berylilina	SPP (LC50)	100%, 98%, 98%	NA	65.2%	≥100%	31.6%
Mysidopsis bahia	SPP (LC50)	95%, 92%, 93%	NA	58.1	≥100%	71.6%
Mytilus edulis	SPP (LC50)	100%	NA	22.6%	22.5%	20.8%

[a]Statistically lower than reference @$p \leq 0.05$.

Table 3.04-4 (Page 1 of 2)

Newark Bay Confined Disposal Facility Results of Tissue
Bioaccumulation Analysis Surface Sediment Evaluation Program 10-14 May 1996

Analyte	Value	Area 1S			Area 2N		
		Tapes japonica	*Macoma nasuta*	*Nereis virens*	*Tapes japonica*	*Macoma nasuta*	*Nereis virens*
Metals							
Arsenic	mg/kg	1.39	2.1	2.02	1.22	2.6	2.26
Cadmium	mg/kg	0.11	(0.41)	(0.16)	(0.09)	(0.48)	(0.1)
Chromium	mg/kg	0.36	0.55	0.46	0.41	0.29	0.2
Copper	mg/kg	1.95	1.14	1.5	0.63	0.80	1.5
Lead	mg/kg	0.12	0.62	0.63	0.11	0.25	0.26
Mercury	mg/kg	0.11	0.11	(0.09)	0.11	(0.10)	(0.09)
Nickel	mg/kg	0.98	0.36	0.32	0.59	0.37	0.30
Silver	mg/kg	(0.09)	0.09	(0.1)	(0.09)	(0.10)	(0.09)
Zinc	mg/kg	10.22	11.0	32.06	9.0	9.9	9.74
Volatile Organics							
1,4-Dichlorobenzene	µg/kg	(0.4)	(0.4)	(0.4)	(0.4)	(0.4)	(0.4)
PCB							
BZ008	µg/kg	(0.36)	(0.36)	0.80	(0.36)	(0.36)	1.16
BZ018	µg/kg	(0.7)	(0.7)	0.80	0.44	1.10	3.61
BZ028	µg/kg	(0.55)	(0.55)	1.19	1.15	1.86	4.66
BZ044	µg/kg	(0.46)	(0.46)	0.79	0.59	0.60	2.47
BZ049	µg/kg	(0.39)	(0.39)	0.40	0.36	0.53	2.42
BZ052	µg/kg	(0.51)	0.54	1.47	0.77	1.4	5.73
BZ066	µg/kg	(1.1)	(1.1)	0.81	0.69	(1.1)	3.11
BZ087	µg/kg	(0.5)	(0.5)	0.42	0.33	(0.5)	0.92
BZ101	µg/kg	(0.51)	(0.51)	1.13	0.45	0.70	3.77
BZ105	µg/kg	(0.4)	(0.4)	0.41	0.22	(0.4)	1.43
BZ118	µg/kg	(0.59)	(0.59)	1.00	0.40	0.63	2.66
BZ128	µg/kg	(0.67)	(0.67)	(0.67)	(0.67)	(0.67)	0.62
BZ138	µg/kg	(0.42)	(0.42)	0.92	0.25	0.60	2.62
BZ153	µg/kg	0.31	(0.39)	1.58	0.29	0.78	2.96
BZ170	µg/kg	(0.36)	(0.36)	0.23	(0.36)	0.43	0.56
BZ180	µg/kg	(0.35)	(0.35)	0.67	(0.35)	0.64	1.29
BZ183	µg/kg	(0.43)	(0.43)	(0.43)	(0.43)	(0.43)	(0.43)
BZ184	µg/kg	(0.58)	(0.58)	1.22	0.32	0.64	1.38
BZ187	µg/kg	(0.33)	(0.33)	(0.57)	(0.18)	(0.33)	(1.03)
BZ195	µg/kg	(0.33)	(0.33)	(0.33)	(0.33)	(0.33)	(0.33)
BZ206	µg/kg	(0.33)	(0.33)	0.66	(0.33)	(0.33)	0.39
BZ209	µg/kg	(0.33)	(0.33)	0.47	(0.33)	(0.33)	0.36
PAHs							
Acenaphthene	µg/kg	(22)	22.8	(26)	(22)	80.4	(31)
Acenaphthylene	µg/kg	55.14	34.8	324.1	17.4	(27)	452.1
Anthracene	µg/kg	(2.7)	15.16	8.04	6.0	47.4	25.07
Benzo[a]anthracene	µg/kg	(1.4)	11.56	1.92	(9.28)	45.6	6.12
Benzo[a]pyrene	µg/kg	(2.7)	9.3	2.51	4.73	26.4	10.78
Benzo[b]fluoranthene	µg/kg	(5.9)	13.1	8.9	(5.9)	19.6	7.5
Benzo[g,h,i]perylene	µg/kg	(5.1)	(5.1)	(6.08)	(5.1)	(5.1)	4.14
Benzo[k]fluoranthene	µg/kg	(2.7)	2.8	(3.24)	(2.7)	5.4	2.81
Chrysene	µg/kg	1.60	22.9	(3.0)	5.66	47.2	7.27
Dibenzo[a,h]anthracene	µg/kg	(5.2)	(5.2)	(6.2)	(5.2)	(5.2)	(5.1)
Fluoranthene	µg/kg	(5.1)	220	8.48	13.8	105	30.31

Newark Bay Confined Disposal Facility Results of Tissue Bioaccumulation Analysis Surface Sediment Evaluation Program 10-14 May 1996

Analyte	Value	Area 1S			Area 2N		
		Tapes japonica	*Macoma nasuta*	*Nereis virens*	*Tapes japonica*	*Macoma nasuta*	*Nereis virens*
PAHs (*continued*)							
Fluorene	µg/kg	(2.9)	(2.9)	2.53	(2.9)	3.6	3.35
Indeno[1,2,3-cd]pyrene	µg/kg	0.61	0.89	(1.04)	(0.87)	1.2	0.87
Naphthalene	µg/kg	(12)	13.6	(14.4)	(12)	34.4	(6.8)
Phenanthrene	µg/kg	(2.7)	4.5	2.0	2.66	28.2	6.61
Pyrene	µg/kg	2.34	28.8	15.6	23.06	98.0	36.9
Dioxins and Furans							
2,3,7,8-TCDD	pg/kg	0.27	(0.42)	1.94	1.86	(2.12)	8.72
1,2,3,7,8-PeCDD	pg/kg	(0.89)	(0.90)	(1.4)	(1.06)	(0.59)	(0.9)
1,2,3,4,7,8-HxCDD	pg/kg	(0.97)	(1.06)	(1.2)	(1.00)	(0.62)	(0.7)
1,2,3,6,7,8-HxCDD	pg/kg	(0.89)	(0.90)	(1.12)	(0.87)	1.02	(0.40)
1,2,3,7,8,9-HxCDD	pg/kg	(0.84)	(0.90)	(1.1)	(0.86)	1.02	(0.29)
1,2,3,4,6,7,8-HpCDD	pg/kg	(1.08)	1.11	0.86	1.01	1.31	0.99
OCDD	pg/kg	2.76	4.5	7.0	3.96	4.22	5.2
2,3,7,8-TCDF	pg/kg	0.35	(0.53)	0.81	0.59	(0.51)	1.08
1,2,3,7,8-PeCDF	pg/kg	(0.57)	(0.62)	(0.86)	(0.67)	(0.66)	0.54
2,3,4,7,8-PeCDF	pg/kg	(0.56)	(0.58)	(0.82)	(0.67)	(0.47)	0.77
1,2,3,4,7,8-HxCDF	pg/kg	(0.69)	(0.80)	0.45	(0.79)	1.07	1.60
1,2,3,6,7,8-HxCDF	pg/kg	(0.56)	(0.64)	(0.33)	(0.51)	(0.71)	0.49
2,3,4,6,7,8-HxCDF	pg/kg	0.67	0.82	0.53	0.62	0.96	0.48
1,2,3,7,8,9-HxCDF	pg/kg	(0.77)	(0.88)	(0.90)	(0.73)	(0.53)	(0.48)
1,2,3,4,6,7,8-HpCDF	pg/kg	(0.55)	(0.67)	0.58	0.32	0.95	1.27
1,2,4,7,8,9-HpCDF	pg/kg	(1.03)	(1.10)	(1.0)	(0.86)	1.14	0.24
ODCF	pg/kg	(1.62)	(1.30)	1.95	1.39	1.90	1.30
Pesticides							
2,4'-DDD	µg/kg	(0.33)	0.25	(0.33)	(0.33)	0.30	(0.33)
2,4'-DDE	µg/kg	(0.33)	0.28	0.69	(0.33)	0.25	0.68
2,4'-DDT	µg/kg	(0.56)	(0.56)	0.99	(0.56)	0.35	0.53
4,4'-DDD	µg/kg	0.81	0.81	0.92	1.16	0.51	0.81
4,4'-DDE	µg/kg	0.49	1.24	2.36	0.78	0.89	2.21
4,4'-DDT	µg/kg	0.60	1.52	0.22	0.79	0.28	0.21
Aldrin	µg/kg	0.62	1.27	0.43	0.69	0.71	0.93
α-Chlorodane	µg/kg	0.71	0.39	0.66	0.39	(0.33)	0.56
Dieldrin	µg/kg	0.30	0.72	0.50	0.24	1.25	0.75
Endosulfan I	µg/kg	0.30	0.90	0.89	0.84	0.39	2.90
Endosulfan II	µg/kg	0.30	0.32	0.42	0.47	0.31	0.60
Endosulfan sulfate	µg/kg	0.66	(1.2)	(1.2)	1.84	(1.2)	0.72
Heptachlor	µg/kg	0.33	1.27	0.33	(0.33)	0.86	0.76
Heptachlor epoxide	µg/kg	0.31	0.45	2.39	0.31	0.39	1.10
trans-Nonachlor	µg/kg	(0.33)	0.76	0.53	0.24	0.21	1.25

() Indicates not detected at that concentration.
{} Indicates estimated maximum concentration.

Area 1S surface sediments would be Category II and surface sediments from Area 2N would be Category III.

3.05 WATER QUALITY

Newark Bay is a partially stratified estuary with lower-salinity at the surface and higher-salinity at the bottom. Surface salinity is lowest (2 to 20 ppt) near the mouth of the Passaic River, which has greater freshwater flow than the Hackensack River (Suszkowski 1978). The vertical gradient in salinity is most pronounced in the northern part of Newark Bay, particularly near the Passaic River, and decreases to the south. The highest surface water salinity (13 to 21 ppt) is found at the confluence of Newark Bay and the Kill Van Kull.

The distribution of total suspended sediment (TSS) in Newark Bay for a 12-month period was shown graphically by Suszkowski (1978) (see Figure 3.02-10). The highest TSS concentration in the surface water generally occurs during the spring in the Passaic River. The TSS concentrations in near-bottom water in Newark Bay are higher in the northern portion of the Bay than in the southern. These higher concentrations are known as the turbidity maximum. The turbidity maximum is caused by estuarine-type circulation wherein the bottom water has an average upstream velocity during flood tide equal to its average downstream velocity during ebb tide (net velocity equals zero) and suspended sediment is circulated. The turbidity maximum generally breaks down during low river flow when stratification is reduced.

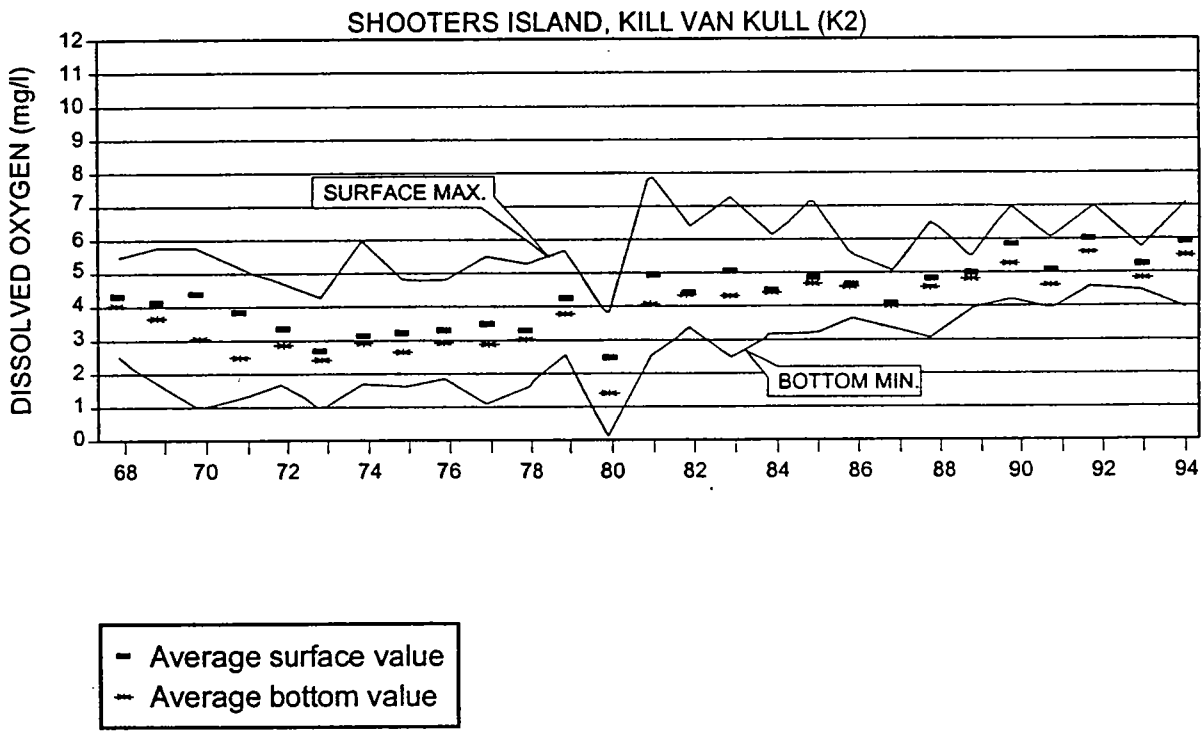
Newark Bay is classified as SE3 saline estuarine waters with designated uses: (1) secondary contact recreation; (2) maintenance and migration of fish populations; (3) migration of diadromous fish; (4) maintenance of wildlife; and (5) any other reasonable uses by NJDEP; the criteria for water quality constituents are provided in Table 3.05-1. Although historical data on conventional water quality constituents in Newark Bay are sparse, there are data for NYCDEP's Harbor survey sampling station K2, Shooters Island in Kill Van Kull, which is at the southern end of the Bay (Figure 3.05-1). The trend in dissolved oxygen (DO) since 1968 (recorded at Shooters Island) shows a steady increase attributable to upgraded wastewater treatment. In the last 10 years the DO at Shooters Island exceeded the NYCDEP criterion of 3.0 mg/l. Recent data for other conventional water quality constituents are presented in Table 3.05-2. The seasonal variations in temperature, DO, salinity, and conductivity in Newark Bay between April 1995 and April 1996 are shown in Figure 3.05-2. The surface and bottom water measurements at four stations in Newark Bay were averaged in these plots. These variations reflect typical meteorological and hydrological conditions in Newark Bay and the waters that flow into it (Arthur Kill, Kill Van Kull, Hackensack, and Passaic rivers).

According to water quality standards established by the NJDEP, fecal coliforms in Class SE3 waters shall not exceed a geometric mean of 1500 counts/100 ml. The geometric mean fecal coliform concentrations in the surface and bottom waters at NYCDEP's sampling station K2 were 67 and 68 counts/100 ml, respectively, during summer 1994

Table 3.05-1

Surface Water Quality Standards and Criteria for Newark Bay (Class SE3)

Parameters	Value	Criteria
Dissolved oxygen	mg/l	Not less than 3.0 at any time
Fecal coliforms	counts/100 ml	Not to exceed geometric mean of 1500
Turbidity	NTU	50
Aldrin	mg/l	1.3
Dieldrin	mg/l	0.71 (0.0019)
Arsenic	mg/l	0.136
Benzene	mg/l	71
Benzopyrene	mg/l	0.031
Chlordane	mg/l	0.09 (0.004)
Chlorobenzene	mg/l	21,000
Chromium	mg/l	3,230
Cyanide	mg/l	1.0 (1.0)
DDT	mg/l	0.13 (0.001)
Endosulfans	mg/l	
Endrin	mg/l	0.034 (0.0084)
Heptachlor	mg/l	0.037 (0.0023)
Mercury	mg/l	0.053 (0.0036)
Mirex	mg/l	0.146
Nickel	mg/l	0.001 3900
Polychlorinated biphenyls	mg/l	0.03
Tetrachloroethylene	mg/l	4.29
Toxaphene	mg/l	0.21 (0.002)
Trichlorobenzene	mg/l	113
Trichloroethylene	mg/l	81



Source: NYCDEP 1995.

Figure 3.05-1

U.S. Army Corps of Engineers
Newark Bay Confined Disposal Facility

Dissolved Oxygen Concentration Trends in Surface and Bottom Waters Summer Minima, Maxima, and Averages, 1968-1994

Table 3.05-2

Water Quality Concentrations in the Kill Van Kull at Shooters Island (K2)

Parameter	Value	1991	1992	1993	1994
DO	(mg/l)	5.0	5.9	8.5	7.0
TSS	(mg/l)	15[a]	-	20	13
Secchi disk	(ft)	4.4	4.8	5.0	4.3
Dissolved ammonia	(mg/l)	0.54	0.49	0.49	0.50
Nitrate & nitrite nitrogen	(mg/l)	0.49	0.57	0.68	0.55
Total phosphorus	(mg/l)	0.23	0.17	0.18	0.20
Ortho-phosphate	(mg/l)	0.16	0.16	0.12	0.15
BOD 5-Day	(mg/l)	1.3	1.4	1.5	1.2

Source: NYCDEP (1993, 1994, 1995)

Note: Concentrations are yearly averages of available surface and bottom samples collected primarily during the summer.

[a]Samples collected during January 1991.

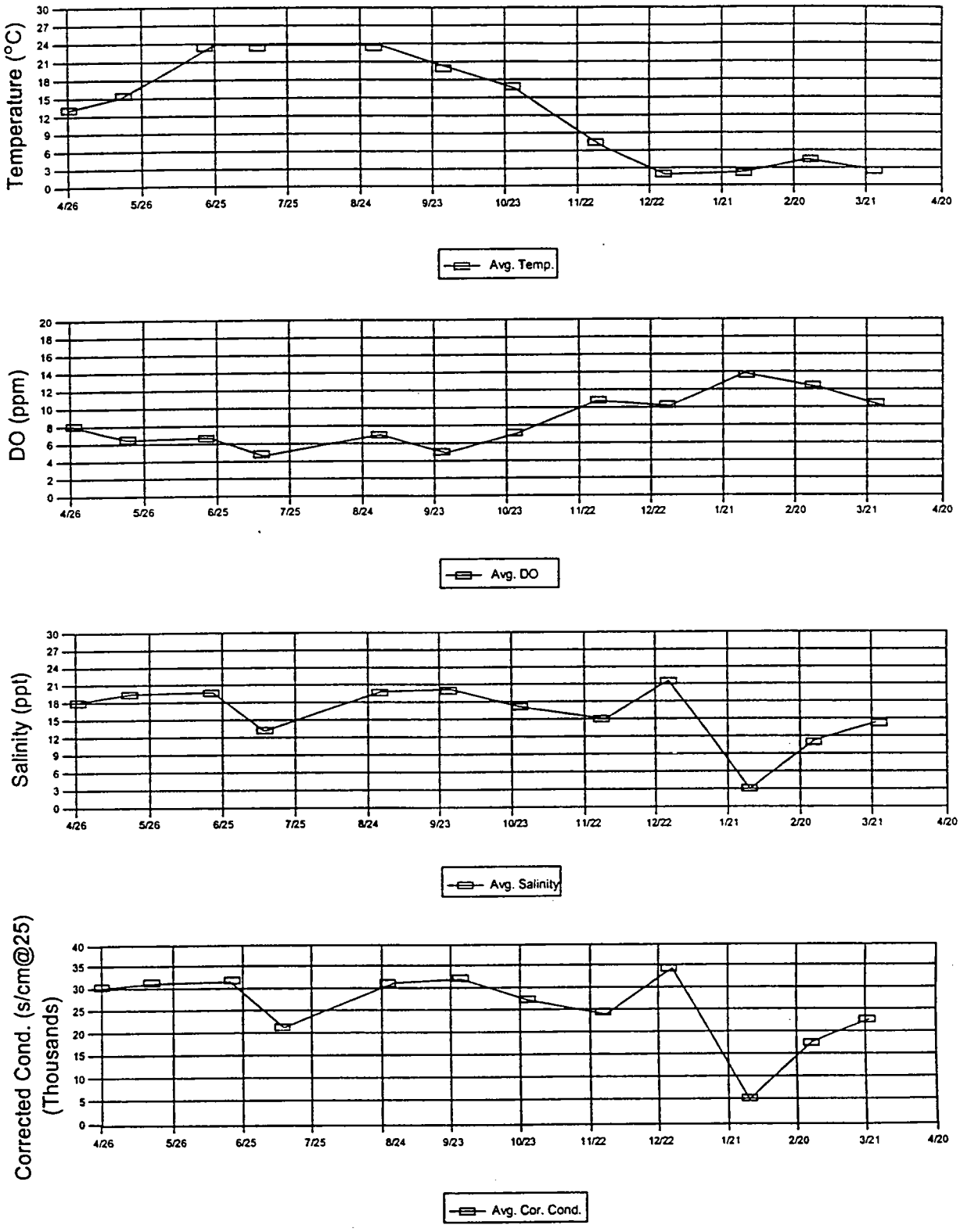


Figure 3.05-2

U.S. Army Corps of Engineers
Newark Bay Confined Disposal Facility

Temperature, Dissolved Oxygen, and Salinity in Newark Bay

(latest year of available data). The 1994 data reflect an improvement over previously collected data.As part of EPA's development of a wasteload allocation for metals in NY/NJ Harbor, Newark Bay was sampled and analyzed for metals in 1991. Three surveys that analyzed Newark Bay waters for metals data are briefly described below:

Survey	Month	Station Name (Number)
Ambient	January	Newark Bay (A7), Shooters Island (A5), Passaic River (A8)
Ambient	October	Newark Bay (A7), Shooters Island (A5), Passaic River (A8)
Intensive Ambient	May	Newark Bay (A7), Shooters Island (A5), Passaic River (A8)

Samples collected during the January 1991 survey were analyzed for four forms (total recoverable, acid soluble, dissolved, and particulate) of arsenic, cadmium, copper, mercury, nickel, lead, silver, and zinc. Total suspended solids, particulate organic carbon, and dissolved organic carbon were also analyzed. The May and October surveys were similar except that only total recoverable and dissolved forms were analyzed. Arsenic was not analyzed in the October survey.

The criteria used by EPA Region II for the NY/NJ Harbor are provided in the table below. The copper value of 5.7 μg/l was derived from a site-specific criteria investigation in the NY/NJ Harbor carried out as part of this study (HydroQual 1994).

Ambient Water Quality Criteria Used by EPA Region II for Heavy Metals in NY/NJ Harbor

Metal	Criterion (μg/l)	Phase	Compliance Frequency
Cu	5.7	Dissolved	Acute
Hg	0.025	Total recoverable	Chronic
Ni	7.1	Total recoverable	Chronic
Pb	8.5	Total recoverable	Chronic
Ag	0.92	Total recoverable	Chronic
As	36	Total recoverable	Chronic
Cd	2.7	Total recoverable	Chronic
Zn	58	Total recoverable	Chronic

The results of January and October 1991 ambient surveys are presented in Tables 3.05-3 and 3.05-4. The results of the May 1991 intensive ambient survey are presented in Table 3.05-5.

Concentrations of arsenic, cadmium, nickel, lead, silver, and zinc in all water samples from Newark Bay were lower than the EPA criteria. The copper concentration in the dissolved phase was below the site-specific criterion of 5.7 μg/l. Total recoverable mercury concentrations in Newark Bay, the Kill Van Kull, and the Hackensack and Passaic rivers were consistently above the criterion of 0.025 μg/l.

Table 3.05-3 (Page 1 of 2)

Metals Concentrations in the Water Column of
Newark Bay and Adjacent Waterways, January 1991

Metal	Station Name (Number)			
	Shooters Island (A5)	Newark Bay (A7)	Passaic River (A8)	Hackensack River (A9)
Arsenic (µg/l)				
Total recoverable	1.3	NA	NA	NA
Acid soluble	1.1	NA	NA	NA
Dissolved	0.98	NA	NA	NA
Particulate	0.136	0.123	0.106	0.118
Cadmium (µg/l)				
Total recoverable	0.129	0.103	0.172	0.456
Acid soluble	0.118	0.123	0.209	0.192
Dissolved	0.094	0.099	0.140	0.129
Particulate	0.026	0.019	0.038	0.034
Copper (µg/l)				
Total recoverable	4.70	4.2	5.1	5.1
Acid soluble	3.88	4.04	5.04	4.16
Dissolved	1.66	1.92	2.45	1.68
Particulate	2.328	2.1866	2.4816	1.7
Mercury (µg/l)				
Total recoverable	0.048	0.036	0.025	0.039
Acid soluble	0.012	0.0184	0.0073	0.012
Dissolved	0.005	0.0038	0.0037	0.0031
Particulate	<0.00024	<.00016	<.00015	<.00019
Nickel (µg/l)				
Total recoverable	2.1	2.2	1.9	6.3
Acid soluble	1.69	2.02	2.08	6.00
Dissolved	1.95	1.92	2.19	4.47
Particulate	0.184	0.1282	0.1699	0.2

Table 3.05-3 (Page 2 of 2)

Metals Concentrations in the Water Column of
Newark Bay and Adjacent Waterways, January 1991

Metal	Station Name (Number)			
	Shooters Island (A5)	Newark Bay (A7)	Passaic River (A8)	Hackensack River (A9)
Lead (µg/l)				
Total recoverable	3.200	2.8	4.2	3
Acid soluble	2.76	2.60	4.03	2.72
Dissolved	0.54	0.388	0.418	0.413
Particulate	2.03	2.0896	3.1567	2
Silver (µg/l)				
Total recoverable	0.033	0.056	0.046	NA
Acid soluble	0.051	0.042	0.038	0.036
Dissolved	0.01	0.0084	0.025	0.021
Particulate	0.0013	0.0012	0.0005	<0.0004
Zinc (µg/l)				
Total recoverable	13.40	14.8	21.4	22.5
Acid soluble	8.80	12.40	17.94	23.38
Dissolved	10.11	11.14	14.24	18.42
Particulate	2.237	1.8212	3.8	3.1
TSS (mgc/l)	14.77	10.59	9.05	10.93
PC (mgc/l)	0.785	0.799	0.788	0.724
DOC (mg/l)	2.41	2.43	3.77	5.15

Source: NYCDEP (1993).

Note: Samples were collected from below pycnocline, if present; if not present, sampled at mid-depth.
TSS = total suspended solids
PC = particulate carbon
DOC = dissolved organic carbon

Table 3.05-5 (Page 2 of 2)

Newark Bay Confined Disposal Facility - Site Water Chemical Analysis
Surface Sediment Evaluation Program: 10-14 May 1996

Analyte	Value	Sediment Composite Sample		
		Area 1S	Area 2S	Area 2N
PCB (continued)				
BZ#128	ng/l	2.7U	2.7U	2.7U
BZ#180	µg/l	1.4U	1.4U	1.4U
BZ#170	µg/l	2.4U	2.4U	2.4U
BZ#195	µg/l	3.4U	3.4U	3.4U
BZ#206	µg/l	3.3U	3.3U	3.3U
BZ#209	µg/l	2.7U	2.7U	2.7U
Pesticides				
Heptachlor	ng/l	1.4U	1.4U	1.4U
Aldrin	ng/l	0.85U	0.85U	0.85U
Heptachlor epoxide	ng/l	2.2U	2.2U	2.2U
trans-Nonachlor	ng/l	1.7U	1.7U	1.7U
alpha-Chlordane	ng/l	0.98U	0.98U	0.98U
Endosulfan I	ng/l	0.37U	0.37U	0.37U
2,4'-DDE	ng/l	0.14U	0.14U	0.14U
4,4'-DDE	ng/l	0.25U	7.0	0.25U
Dieldrin	ng/l	0.27U	0.27U	0.27U
2,4'-DDD	ng/l	0.54U	0.54U	0.54U
4,4'-DDD	ng/l	1.0U	1.0U	1.0U
2,4'-DDT	ng/l	0.70U	0.70U	0.70U
Endosulfan II	ng/l	0.52U	0.52U	0.52U
4,4'-DDT	ng/l	0.55U	0.55U	0.55U
Endolsulfan sulfate	ng/l	2.4U	2.4U	2.4U

U = Compound on target list (TCI) was not detected.
P = Lower value between GC column results when >25% difference between column values recorded.

Results from the analysis of a water sample collected from a depth of 3.0 ft (1.0 m) in the center of each proposed NBCDF area during the 10-14 May 1996 sediment sampling program are presented in Table 3.05-5. The water quality values recorded during the May 1996 survey period were generally similar to results reported from other recent Newark Bay quality surveys.

3.06 FISH AND SHELLFISH

Recent sampling data are available that can be used to characterize the fish and shellfish community of Newark Bay. Data available from adjacent water bodies provide information on species that might be expected to occur in Newark Bay. Fish sampling was conducted in Newark Bay in 1984-1985 (USACE 1987b), in 1987-1988 (Will and Houston 1992), from May 1993 to April 1994 (NMFS 1994), and from April 1995 to March 1996 (LMS 1996b). The sampling equipment used and methods varied from study to study, however, bottom trawl gear was used in each of the studies and each of the sampling programs extended over a period of one year. The data from these programs are the primary source of information on the Newark Bay fish community. Bottom trawling is an efficient method for sampling blue crabs, the primary shellfish species in Newark Bay. These studies are used to characterize the abundance and seasonal occurrence of blue crabs and other large invertebrates that were collected along with fish.

In addition to the studies of Newark Bay, a number of fish sampling programs have been conducted in the Arthur Kill/Kill Van Kull and the Hackensack River. These studies include both conventional net sampling of fishes and sampling of fish impinged on the cooling water intake screens of power plants located on the Arthur Kill and Hackensack River. The intake screens of large-volume circulating water systems represent an efficient sampler of the species composition of a water body. A number of studies have shown that, because the intake screens sample a much larger volume than net sampling (trawling for example, the most commonly used technique in New York Harbor waters), they collect substantially more of the uncommon and rare species occurring in a water body than net sampling. The impingement sampling from power plants on the Arthur Kill and Hackensack River are used here to show the fish species that have been found in the near vicinity of Newark Bay.

Summary of 1995-1996 Study Program

Trawl samples were collected in Newark Bay from April 1995 to March 1996 in order to describe the species composition and relative abundance of fishes in shoal areas (LMS 1996b; Figure 3.06-1). Shoal areas were the focus because they are the habitat type that could be used for a CDF. In addition, two channel stations were sampled near the Bayonne and Goethals bridges to provide information on the fish community in deep water near Newark Bay. The Goethals Bridge station was the same station used in a recent study for an impact assessment of a new bridge crossing (USCG 1996). Resampling of the Goethals Bridge station provides continuity with the database for that study.

Fish were sampled monthly with a bottom trawl, sampling gear that has been effective in sampling a wide range of species in the New York Harbor area. Bottom trawls were towed for approximately 10 min at each station. The fish were identified by species, counted, and individuals measured for total length. The collection information was adjusted to a 10-min trawl effort when the actual sampling was not 10 min.

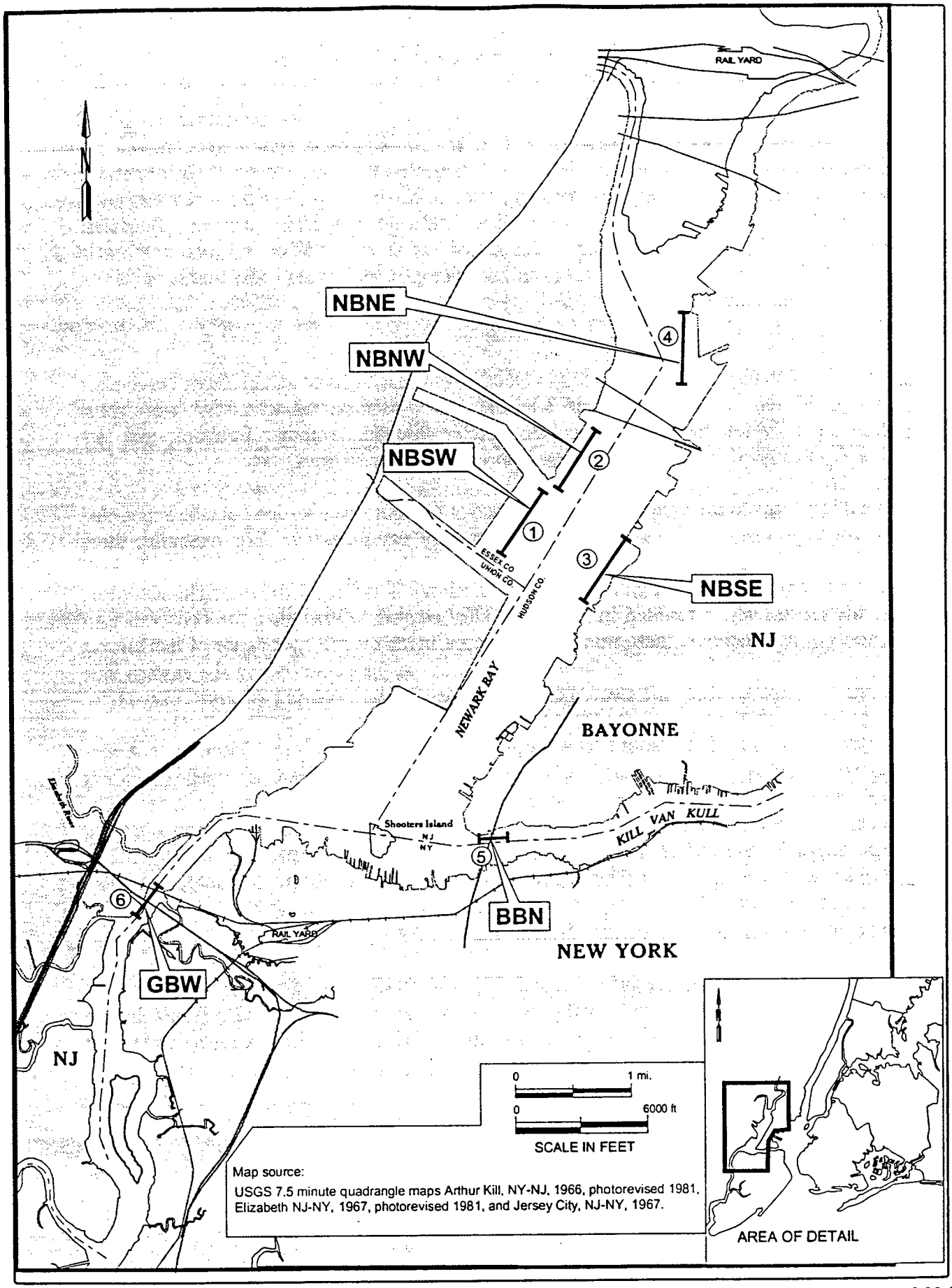


Figure 3.06-1

U.S. Army Corps of Engineers
Newark Bay Confined Disposal Facility

Newark Bay Area Trawl and Epibenthic Sled Sample Locations

TABLE 3.06-2

NUMBER OF FISH AND BLUE CRAB COLLECTED PER TEN MINUTES OF TRAWL EFFORT

Station: NBNW 3-5'														
Appx. Depth at MLW														
Date	APR 1995	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN 1996	FEB	MAR	TOTAL	Percent Comp.
Species Collected														
30 ft Bottom Trawl														
Alewife							1.00						1.00	0.07
American shad			1.00			7.00	2.00						10.00	0.68
Atlantic croaker														
Atlantic herring		3.00											3.00	0.20
Atlantic silverside						4.00	19.00						23.00	1.56
Atlantic tomcod														
Bay anchovy		3.00	7.00	4.00	25.00	1300.00	1.00						1340.00	90.85
Blueback herring			2.00										2.00	0.14
Bluefish					5.00	15.00	1.00						21.00	1.42
Butterfish														
Crevalle jack						1.00							1.00	0.07
Cunner														
Gizzard shad														
Grubby														
Northern puffer					1.00								1.00	0.07
Northern kingfish						8.00							8.00	0.54
Northern pipefish														
Scup														
Spot														
Spotted hake		1.00											1.00	0.07
Striped anchovy							1.00						1.00	0.07
Striped bass	12.00	18.00	2.00	5.00			6.00						43.00	2.92
Summer flounder			2.00										2.00	0.14
Weakfish		1.00											1.00	0.07
White perch	1.00							1.00					2.00	0.14
Windowpane														
Winter flounder	3.00	5.00	2.00	1.00		3.00		1.00					15.00	1.02
Number of species	3	6	6	3	3	7	7	2	0	0	0	0	17	
Total number (individuals)	16.00	31.00	16.00	10.00	31.00	1338.00	31.00	2.00	0.00	0.00	0.00	0.00	1475.00	100.00
Blue crab	4.00	184.00	204.00	373.00	30.00	105.00	72.00	0.00	0.00	0.00	0.00	0.00	972.00	

Station: NBNE 3-5'														
Appx. Depth at MLW														
Date	APR 1995	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN 1996	FEB	MAR	TOTAL	Percent Comp.
Species Collected														
30 ft Bottom Trawl														
Alewife														
American shad														
Atlantic croaker														
Atlantic herring														
Atlantic silverside						74.00	24.00	1.00					99.00	22.00
Atlantic tomcod		1.00											1.00	0.22
Bay anchovy			3.00	20.00	95.00	78.00	1.00						197.00	43.78
Blueback herring														
Bluefish						8.00	4.00						12.00	2.67
Butterfish														
Crevalle jack						2.00							2.00	0.44
Cunner														
Gizzard shad														
Grubby														
Northern puffer														
Northern kingfish														
Northern pipefish		2.00		3.00									5.00	1.11
Scup														
Spot														
Spotted hake		4.00											4.00	0.89
Striped anchovy														
Striped bass	47.00	29.00	9.00	4.00		1.00	5.00				2.00		97.00	21.56
Summer flounder			1.00	1.00	5.00								7.00	1.56
Weakfish				4.00									4.00	0.89
White perch		1.00				4.00			1.00				6.00	1.33
Windowpane														
Winter flounder	2.00	4.00			1.00	2.00	2.00				2.00	3.00	16.00	3.56
Number of species	2	6	3	5	3	7	5	1	1	0	2	1	12.00	
Total number (individuals)	49.00	41.00	13.00	32.00	101.00	169.00	36.00	1.00	1.00	0.00	4.00	3.00	450.00	100.00
Blue crab	12.00	309.00	57.00	196.00	34.00	114.00	55.00	0.00	0.00	0.00	0.00	0.00	777.00	

TABLE 3.06-3

NUMBER OF FISH AND BLUE CRAB COLLECTED PER TEN MINUTES OF TRAWL EFFORT

Station: NBSW 3-5'														
Appx. Depth at MLW														
Date	APR 1995	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN 1996	FEB	MAR	TOTAL	Percent Comp.
Species Collected														
30 ft Bottom Trawl														
Alewife						2.00	1.00						3.00	0.27
American shad					1.00				1.00				2.00	0.18
Atlantic croaker		1.00											1.00	0.09
Atlantic herring							1.00	3.00					4.00	0.36
Atlantic silverside		1.00											1.00	0.09
Atlantic tomcod			1.00	7.00	665.00	322.00	7.00						1002.00	90.58
Bay anchovy				1.00									1.00	0.09
Blueback herring						9.00	1.00						10.00	0.90
Bluefish														
Butterfish						1.00							1.00	0.09
Crevalle jack														
Cunner														
Gizzard shad														
Grubby														
Northern puffer						6.00							6.00	0.54
Northern kingfish			1.00										1.00	0.09
Northern pipefish														
Scup														
Spot														
Spotted hake														
Striped anchovy							4.00						36.50	3.30
Striped bass	2.50	20.00	6.00	4.00									13.00	1.18
Summer flounder		4.00	3.00	2.00	3.00	1.00							1.00	0.09
Weakfish						1.00								
White perch													1.00	0.09
Windowpane				1.00										
Winter flounder	3.75	1.00	6.00	2.00		4.00	3.00	3.00					22.75	2.06
Number of species	2	5	5	6	3	8	6	2	1	0	0	0	16	
Total number (individuals)	6.25	27.00	17.00	17.00	669.00	346.00	17.00	6.00	1.00	0.00	0.00	0.00	1106.25	100.00
Blue crab	2.50	150.00	122.00	173.00	39.00	155.00	85.00	1.00	0.00	0.00	1.00	0.00	728.50	

Station: NBSE 3-5'														
Appx. Depth at MLW														
Date	APR 1995	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN 1996	FEB	MAR	TOTAL	Percent Comp.
Species Collected														
30 ft Bottom Trawl														
Alewife														
American shad														
Atlantic croaker														
Atlantic herring							6.00	3.00					9.00	4.62
Atlantic silverside														
Atlantic tomcod		1.00	12.50	116.00	2.00	3.00	1.00	2.00					137.50	70.60
Bay anchovy														
Blueback herring						1.00	1.00						2.00	1.03
Bluefish														
Butterfish														
Crevalle jack														
Cunner										1.00			1.00	0.51
Gizzard shad														
Grubby														
Northern puffer						1.00							1.00	0.51
Northern kingfish													2.00	1.03
Northern pipefish		1.00		1.00										
Scup														
Spot														
Spotted hake		2.00											2.00	1.03
Striped anchovy														
Striped bass	2.00	2.00											4.00	2.05
Summer flounder		1.00	1.25	4.00		1.00							7.25	3.72
Weakfish				1.00									1.00	0.51
White perch						1.00							1.00	0.51
Windowpane														
Winter flounder	1.00	5.00		4.00	1.00	6.00	4.00	4.00			1.00	1.00	27.00	13.86
Number of species	2	6	2	5	2	6	4	3	0	1	1	1	12	
Total number (individuals)	3.00	12.00	13.75	126.00	3.00	13.00	12.00	9.00	0.00	1.00	1.00	1.00	194.75	100.00
Blue crab	22.00	127.00	70.00	167.00	0.00	142.00	207.00	0.00	1.00	0.00	0.00	0.00	736.00	

Summary of 1993-1994 Study Program

The National Marine Fisheries Service (NMFS) undertook a major fish sampling program in Newark Bay as part of an evaluation of a flood control project for the Passaic River Basin (NMFS 1994). Monthly fish sampling was conducted from May 1993 through April 1994. Juvenile and adult fish were sampled with bottom trawls and gill nets. Larval fish were sampled with two different mesh sizes of plankton nets. In addition, blue crabs and other invertebrates in the fish sampling gear was reported. The distribution of sampling stations included a trawl station and an ichthyoplankton station in the channel in the mouth of the Passaic River, just upstream of Newark Bay. The shoal stations were confined to the east side of the main channel, except for one gill net station.

This study provided more extensive coverage of Newark Bay than the 1995-1996 study (LMS 1996b), direct comparisons of the two studies are not possible because different gear types were used, the sampling effort differed substantially between studies, and the 1993-1994 study report did not provide individual sampling station data. However, the 1993-1994 study is useful for the identification of species, the relative abundance of species, and the seasonal occurrence of fishes. Direct comparisons of the shoal and channel stations in the 1993-1994 study cannot be made because different size trawls were used for the two locations. The following discussion of the 1993-1994 study includes limited comparisons with the 1995-1996 study.

Twenty-eight species of fish were collected with a bottom trawl from seven shoal stations on the east side (relative to main channel) of Newark Bay in 1993-1994 (Table 3.06-4). Six species - striped bass, winter flounder, bay anchovy, Atlantic herring, Atlantic tomcod, and Atlantic silverside - accounted for 1% or more of the total number collected at the shoal stations combined. The 1995-1996 study collected 23 species from four shoal stations. Twelve species were not common to the two studies, but all of these species were a minor component of the catch in both studies. The dominant species were similar in the two studies, and no substantial differences were observed in the species composition or relative abundance in the two studies.

The seasonal occurrence of fishes on the shoals in Newark Bay were similar in the two studies. Fish were abundant from May through October in 1993-1994, with very low numbers from January through April. There was low to moderate abundance in November and December. The 1995-1996 study showed a very similar seasonal pattern, with slightly fewer fish in November and December and more fish in April.

The total catch of blue crabs was smaller in 1993-1994 than in 1995-1996, even though more stations were sampled in 1993-1994. However, the seasonal occurrence of blue crabs was similar in the two studies. Blue crabs were abundant from June through October in 1993-1994 and from May to October in 1995-1996. In both studies blue crab abundance was very low during the remainder of the year on the shoals.

Table 3.06-4

Monthly catch in number of fish and megainvertebrates collected with a 4.9-m otter trawl fished in Newark Bay, New Jersey between May 1993 and April 1994.

Common Name	Scientific Name	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	Species Total	Percent Comp.
Blueback herring	*Alosa aestivalis*	-	-	-	-	-	-	2	7	-	-	-	-	9	0.32
Alewife	*Alosa pseudoharengus*	2	-	-	1	-	-	-	2	-	-	-	-	5	0.18
American shad	*Alosa sapidissima*	1	-	-	3	2	-	-	2	-	-	-	-	8	0.29
Atlantic herring	*Clupea harengus*	50	616	-	-	-	-	-	-	-	-	-	-	666	23.88
Bay anchovy	*Anchoa mitchilli*	1	79	171	398	750	-	-	8	-	-	-	1	1408	50.48
Rainbow smelt	*Osmerus mordax*	-	-	-	-	-	-	-	-	-	-	1	-	1	0.04
Atlantic tomcod	*Microgadus tomcod*	48	246	-	-	-	-	-	-	-	-	-	-	294	10.54
Spotted hake	*Urophycis regia*	-	2	-	-	-	-	-	-	-	-	-	-	2	0.07
Atlantic silverside	*Menidia menidia*	-	-	-	-	-	30	3	8	1	-	2	-	44	1.58
Threespine stickleback	*Gasterosteus aculeatus*	-	-	-	-	-	-	-	-	-	-	2	-	2	0.07
Lined seahorse	*Hippocampus erectus*	-	1	-	-	-	-	-	-	-	-	-	-	1	0.04
Northern pipefish	*Syngnathus fuscus*	1	3	4	1	1	-	-	-	-	-	-	-	10	0.36
Northern searobin	*Prionotus carolinus*	1	-	-	-	-	-	-	-	-	-	-	-	1	0.04
Striped searobin	*Prionitus evolans*	-	-	-	2	1	-	-	-	-	-	-	-	3	0.11
Grubby	*Myoxocephalus aenaeus*	-	-	-	-	-	-	1	-	-	-	-	-	1	0.04
White perch	*Morone americana*	-	-	-	-	-	-	-	8	-	-	2	-	10	0.36
Striped bass	*Morone saxatilis*	6	1	8	23	33	37	1	23	-	-	-	-	132	4.73
Bluefish	*Pomatomus saltatrix*	-	-	2	4	9	-	-	-	-	-	-	-	15	0.54
Weakfish	*Cynoscion regalis*	-	-	-	3	-	3	-	-	-	-	-	-	6	0.22
Spot	*Leiostomus xanthurus*	-	-	-	1	-	-	-	-	-	-	-	-	1	0.04
Northern kingfish	*Menticirrhus saxatilis*	-	-	-	2	-	-	-	-	-	-	-	-	2	0.07
Goby	*Gobiidae sp.*	-	1	-	-	-	-	-	-	-	-	-	-	1	0.04
Butterfish	*Peprilus triacanthus*	-	-	-	-	-	1	-	-	-	-	-	-	1	0.04
Smallmouth flounder	*Etropus microstomus*	-	-	-	-	2	-	1	-	-	-	-	-	3	0.11
Summer flounder	*Paralichthys dentatus*	1	5	9	6	-	-	-	-	-	-	-	-	21	0.75

Table 3.06-4 (continued)

Monthly catch in number of fish and megainvertebrates collected with a 4.9-m otter trawl fished in Newark Bay, New Jersey between May 1993 and April 1994.

Common Name	Scientific Name	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	Species Total	Percent Comp.
Windowpane	*Scophthalmus aquosus*	-	-	4	-	-	-	-	-	-	-	-	-	4	0.14
Winter flounder	*Pleuronectes americanus*	25	53	21	14	1	8	6	5	1	-	-	3	137	4.91
Northern puffer	*Sphaeroides maculatus*	-	-	-	-	1	-	-	-	-	-	-	-	1	0.04
Eastern oyster	*Crassostrea virginica*	-	1	-	-	-	-	-	-	-	-	-	-	1	
Blue crab (M)	*Callinectes sapidus*	2	13	51	27	13	17	-	-	-	3	11	-	137	
Blue crab (F)	*Callinectes sapidus*	-	4	41	6	5	8	1	1	-	-	1	1	68	
Blue crab (U)	*Callinectes sapidus*	-	1	-	-	-	-	-	-	-	-	-	-	1	
	Fish totals	138	1025	311	491	818	104	15	64	2	3	19	5	2789	100.00
	Invertebrate totals	2	18	92	33	18	25	1	1	0	3	12	1	206	

(Source NOAA 1995)
A dash (-) indicates no catch, U = unclassified to sex, M = Male, and F = Female.

With the exceptions of Atlantic menhaden, a gill net sampling at seven shoal stations in 1993-1994 revealed a species composition similar to the bottom trawl shoal stations Atlantic menhaden occurred from May through November (Table 3.06-5). A large catch of menhaden was made in May. This species was not collected by bottom trawling efforts in either the 1993-1994 or 1995-1996 studies.

Forty-three species of fish were collected in the 10 Newark Bay channel stations (Table 3.06-6), compared to 23 species taken on the shoals. The occurrence of species that prefer deep water, as well as increased sampling effort in the channels, accounted for the greater number of species collected in the deeper water.

Twelve species made up at least 1% of the catch for all channel stations combined: alewife, gizzard shad, bay anchovy, rainbow smelt, Atlantic tomcod, spotted hake, grubby, white perch, striped bass, weakfish, summer flounder, and winter flounder. Among the major species, striped bass, white perch, Atlantic tomcod, weakfish, and winter flounder were the most abundant.

Among the species that accounted for less than 1% of the annual combined catch, only windowpane flounder occurred in all months. The other less abundant species occurred infrequently.

There was a distinct difference in the seasonal occurrence of fish between channel and shoal stations. Fish were abundant in every month at the channel stations, while they were nearly absent from the shoals from November through April. Striped bass and white perch were particularly abundant at channel stations during the winter months. With the exception of winter flounder and grubby, the most abundant species at the channel stations showed the following seasonal abundance peaks:

Alewife	-	fall
Gizzard shad	-	fall and winter
Bay anchovy	-	summer
Rainbow smelt	-	winter
Atlantic tomcod	-	summer
Spotted hake	-	May and June
White perch	-	late fall and winter
Striped bass	-	November to April
Weakfish	-	August to October
Summer flounder	-	summer

Bottom trawling in the channel produced more large invertebrates than shoal sampling. Blue crab, soft clam, longfin squid, horseshoe crab, mantis shrimp, spider crabs, American rock crab, and lady crab were collected from channel stations. Only blue crabs were collected in abundance at the channel stations, accounting for 98.6% of the total number of invertebrates collected. Blue crabs were collected during every month of the year, but were most abundant from May through November. In contrast, blue crabs were abundant

Table 3.06-5

Monthly catch in number of fish and megainvertebrates collected with experimental gill nets set in Newark Bay, New Jersey between May 1993 and April 1994.

Common Name	Scientific Name	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	Species Total	Percent Comp.
Blueback herring	*Alosa aestivalis*	44	8	-	-	-	2	-	-	-	-	-	-	54	8.78
Alewife	*Alosa pseudoharengus*	14	-	-	-	-	-	-	-	-	-	-	-	14	2.28
American shad	*Alosa sapidissima*	3	-	-	-	-	-	-	-	-	-	-	1	4	0.65
Atlantic herring	*Clupea harengus*	-	-	-	-	-	1	15	-	-	-	-	6	22	3.58
Atlantic menhaden	*Brevoortia tyrannus*	250	17	15	15	-	28	2	-	-	-	-	2	329	53.50
Atlantic tomcod	*Microgadus tomcod*	-	-	-	-	-	-	1	-	-	-	-	-	1	0.16
Northern pipefish	*Syngnathus fuscus*	-	-	-	-	-	-	-	-	-	-	-	1	1	0.16
White perch	*Morone americana*	1	1	-	-	-	-	-	-	-	1	1	1	5	0.81
Striped bass	*Morone saxatilis*	36	59	17	1	3	2	5	1	-	-	-	3	127	20.65
Bluefish	*Pomatomus saltatrix*	8	16	1	2	7	1	-	-	-	-	-	-	35	5.69
Crevalle jack	*Caranx hippos*	-	-	-	-	1	1	-	-	-	-	-	-	2	0.33
Weakfish	*Cynoscion regalis*	6	6	-	1	1	2	-	-	-	-	-	-	16	2.60
Chub mackerel	*Scomber japonicus*	-	1	-	-	-	-	-	-	-	-	-	-	1	0.16
Butterfish	*Peprilus triacanthus*	-	-	-	-	-	3	-	-	-	-	-	-	3	0.49
Summer flounder	*Paralichthys dentatus*	-	1	-	-	-	-	-	-	-	-	-	-	1	0.16
Blue crab (M)	*Callinectes sapidus*	-	22	25	10	7	3	2	-	-	-	2	2	73	11.87
Blue crab (F)	*Callinectes sapidus*	-	8	10	5	-	1	-	-	-	-	-	1	25	4.07
	Fish totals	362	109	33	19	12	40	23	1	0	1	1	14	615	100.00
	Invertebrate totals	0	30	35	15	7	4	2	0	0	0	2	3	98	

(Source NOAA 1995)
A dash (-) indicates no catch, U = unclassified to sex, M = Male, and F = Female.

Table 3.06-6

Monthly catch in number of fish and megainvertebrates collected with an 8.5-m otter trawl fished in Newark Bay, New Jersey between May 1993 and April 1994.

Common Name	Scientific Name	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	Species Total	Percent Comp.
Little skate	*Raja erinacea*	-	-	-	-	-	-	1	-	-	-	-	1	2	0.01
Atlantic sturgeon	*Acipenser oxyrhynchus*	-	1	-	-	-	-	-	-	-	-	-	-	1	0.00
American eel	*Anguilla rostrata*	1	1	-	1	-	-	2	1	2	1	-	1	10	0.05
Conger eel	*Conger oceanicus*	-	-	-	-	-	-	-	-	1	-	-	-	1	0.00
Blueback herring	*Alosa aestivalis*	-	-	-	-	-	-	-	1	-	-	-	1	2	0.01
Alewife	*Alosa pseudoharengus*	1	2	31	3	3	31	161	2	9	-	-	9	252	1.25
American shad	*Alosa sapidissima*	-	1	-	-	-	-	5	-	-	-	-	2	8	0.04
Atlantic menhaden	*Brevoortia tyrannus*	2	8	68	7	2	2	2	-	-	-	-	-	91	0.45
Atlantic herring	*Clupea harengus*	-	3	-	-	-	-	2	-	-	-	1	1	7	0.03
Gizzard shad	*Dorosoma cepedianum*	-	-	-	2	-	13	196	18	47	1	-	-	277	1.37
Bay anchovy	*Anchoa mitchilli*	-	16	282	11	8	2	5	1	-	-	-	-	325	1.61
Rainbow smelt	*Osmerus mordax*	1	-	-	-	-	-	-	5	313	25	27	2	373	1.85
Atlantic tomcod	*Microgadus tomcod*	167	852	1226	684	15	91	276	110	9	8	7	102	3547	17.60
Red hake	*Urophycis chuss*	45	33	1	-	-	-	-	13	3	-	1	3	99	0.49
Spotted hake	*Urophycis regia*	288	450	31	-	-	17	20	15	-	-	-	26	847	4.20
Striped killifish	*Fundulus majalis*	-	-	-	-	-	-	-	-	1	1	-	-	2	0.01
Threespine stickleback	*Gasterosteus aculeatus*	-	-	-	-	-	-	-	-	1	6	11	-	18	0.09
Northern pipefish	*Syngnathus fuscus*	-	-	-	-	1	-	-	-	-	-	-	1	2	0.01
Northern searobin	*Prionotus carolinus*	-	9	7	10	-	2	-	-	-	-	-	-	28	0.14
Striped searobin	*Prionotus evolans*	2	5	3	7	44	25	7	-	-	-	-	-	93	0.46
Grubby	*Myoxocephalus aenaeus*	13	28	13	8	-	4	5	23	66	44	54	13	271	1.34
White perch	*Morone americana*	3	1	-	-	-	1	507	264	244	737	666	354	2777	13.78
Striped bass	*Morone saxatilis*	22	22	323	23	-	41	1742	181	215	1021	1844	1006	6440	31.95
Bluefish	*Pomatomus saltatrix*	-	-	-	1	2	2	-	-	-	-	-	-	5	0.02
Crevalle jack	*Caranx hippos*	-	-	-	-	1	-	-	-	-	-	-	-	1	0.00
Scup	*Stenotomus chrysops*	1	1	-	-	-	1	-	-	-	-	-	-	3	0.01
Silver perch	*Bairdiella chrysura*	-	-		-	-	8	13	-	-	-	-	-	21	0.10
Weakfish	*Cynoscion regalis*	5	14	9	804	1128	735	104	4	-	-	-	-	2803	13.91

Table 3.06-6 (continued)

Monthly catch in number of fish and megainvertebrates collected with an 8.5-m otter trawl fished in Newark Bay, New Jersey between May 1993 and April 1994.

Common Name	Scientific Name	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	Species Total	Percent Comp.
Spot	*Leiostomus xanthurus*	-	-	-	2	2	1	-	-	-	-	-	-	5	0.02
Northern kingfish	*Menticirrhus saxatilis*	-	-	-	1	-	-	-	-	-	-	-	-	1	0.00
Atlantic croaker	*Micropogonias undulatus*	-	-	-	7	3	4	5	3	-	-	-	-	22	0.11
Tautog	*Tautoga onitis*	-	-	-	1	-	-	3	1	-	-	-	1	6	0.03
Cunner	*Tautogolabrus adspersus*	-	1	-	-	-	-	-	-	1	-	2	2	6	0.03
Rock gunnel	*Pholis gunnellus*	-	-	-	-	-	-	-	-	-	-	-	1	1	0.00
Butterfish	*Peprilus triacanthus*	-	-	-	42	18	19	1	-	-	-	-	-	80	0.40
Smallmouth flounder	*Etropus microstomus*	-	-	-	-	-	-	2	2	-	-	-	1	5	0.02
Summer flounder	*Paralichthys dentatus*	28	52	80	40	10	1	-	-	-	-	-	8	219	1.09
Fourspot flounder	*Paralichthys oblongus*	-	1	-	-	-	-	-	-	-	-	-	-	1	0.00
Windowpane	*Scophthalmus aquosus*	1	2	9	4	2	19	19	5	1	2	4	10	78	0.39
Winter flounder	*Pleuronectes americanus*	17	59	161	271	53	108	365	164	51	33	57	69	1408	6.99
Hogchoker	*Trinectes maculatus*	1	2	1	2	7	-	-	2	-	-	1	1	17	0.08
Planehead filefish	*Monacanthus hispidus*	-	-	-	-	-	1	-	-	-	-	-	-	1	0.00
Northern puffer	*Sphaeroides maculatus*	-	-	-	1	-	-	-	-	-	-	-	-	1	0.00
Soft clam	*Mya arenaria*	-	-	-	-	-	-	4	-	2	5	5	29	45	0.78
Longfin squid	*Loligo pealei*	-	-	1	-	-	-	-	-	-	-	-	-	1	0.02
Horseshoe crab (U)	*Limulus polyphemus*	1	1	-	1	-	1	-	-	2	1	-	1	8	0.14
Mantis shrimp	*Squilla empusa*	-	-	-	-	2	11	2	-	6	-	-	-	21	0.36
Spider crab (U)	*Libina emarginata*	-	-	-	-	-	-	-	-	-	1	1	-	2	0.03
Atlantic rock crab (U)	*Cancer irroratus*	-	-	-	-	-	-	-	1	-	-	-	-	1	0.02
Atlantic rock crab (M)	*Cancer irroratus*	-	1	-	-	-	-	-	-	3	-	1	-	5	0.09
Lady crab (F)	*Ovalipes acellatus*	-	-	-	-	-	-	-	1	-	-	-	-	1	0.02
Blue crab (M)	*Callinectes sapidus*	336	876	894	163	171	368	100	69	30	54	75	23	3159	54.75
Blue crab (F)	*Callinectes sapidus*	228	647	1093	147	199	62	64	32	13	9	17	16	2527	43.80
	Fish totals	598	1564	2245	1932	1299	1128	3443	815	964	1879	2675	1615	20157	100.00
	Invertebrate totals	565	1525	1988	311	372	442	170	103	56	70	99	69	5770	100.00

only from June through October on the shoals and absent or in very low numbers at shallow water stations during the other months.

The larvae of 20 fish species were collected during the 1993-1994 study (Table 3.06-7). Two different mesh sizes were used in the study: 0.01-in. (0.333 mm) and 0.02-in. (0.505 mm). The smaller mesh collected the larvae of more species than the larger mesh, but the additional species all occurred in very low numbers.

Only two species, bay anchovy and an unidentified goby (*Gobiosoma* sp.), were collected in the ichthyoplankton sampling in substantial numbers at any time during the study year. Both species were present from June through September. The occurrence of these species in substantial numbers over several months is indicative of spawning in Newark Bay, whereas the low numbers and infrequent occurrence of the larvae of other species suggest they were spawned elsewhere and carried by tidal currents into Newark Bay.

Other Study Programs

The results of fish study programs conducted in 1984-1985 (USACE 1987b) and in 1987-1988 (Will and Houston 1989) were reviewed to determine whether there were any significant differences with the more recent studies. The results of the two earlier studies were consistent with the recent studies in terms of species composition and seasonal occurrence of species. In addition, Will and Houston (1989) found a similar pattern in the distribution of fish on the shoals and in the channels in the 1984-1985 study.

The 1987-1988 study collected fewer striped bass and white perch at channel stations than did the 1993-1994 study. This was due in part to a lower sampling effort in 1987-1988. The differences in relative abundance of species among the studies is within the expected variability seen in estuarine fish communities.

The fish sampling programs conducted in the Arthur Kill and Hackensack River (see reference list on Table 3.06-8) provide lists of fish species for these connecting waters. The combined list shows the occurrence of 108 species representing 51 families from the lower Hackensack River through Newark Bay and the Arthur Kill. Of this total, 54 species have been collected in Newark Bay. All the species listed on Table 3.06-8 could be expected to occur in Newark Bay. The vast majority of species occur in very low numbers. Many of these rare species are freshwater fish carried into the Bay by high freshwater runoff in the Passaic and Hackensack rivers or are marine species that wander into the New York Harbor Complex. Many of the marine species are semitropical forms that move north along the Atlantic coast during summer.

Table 3.06-7

Monthly catch in number of larval fish collected with 0.333 mm and 0.505 mm plankton nets towed in Newark Bay, New Jersey between May 1993 and April 1994.

Common Name	Scientific Name	May	June	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	Total
Conger eel	*Conger oceanicus*	-	2	-	-	-	-	-	-	-	-	-	-	2
Atlantic menhaden	*Brevoortia tyrannus*	-	1	-	-	-	-	-	-	-	-	-	-	1
Atlantic herring	*Clupea harengus*	1	-	-	-	-	-	-	-	-	-	-	-	1
Anchovy sp.	*Engraulidae*	-	45	603	5	1	-	-	-	-	-	-	-	654
Bay anchovy	*Anchoa mitchilli*	-	33	236	79	26	-	-	1	-	-	-	-	375
Atlantic tomcod	*Microgadus tomcod*	-	-	-	-	-	-	-	-	-	-	3	-	3
Atlantic silverside	*Menidia menidia*	-	1	-	-	-	-	-	-	-	-	-	-	1
Northern pipefish	*Syngnathus fuscus*	-	8	2	-	2	-	-	-	-	-	-	-	12
Pipefish	*Syngnathus sp.*	-	2	-	-	-	-	-	-	-	-	-	-	2
Grubby	*Myoxocephalus aenaeus*	-	-	-	-	-	-	-	-	-	1	3	13	17
Tautog	*Tautoga onitis*	-	1	6	-	-	-	-	-	-	-	-	-	7
Cunner	*Tautogolabrus adspersus*	-	2	3	-	-	-	-	-	-	-	-	-	5
Rock gunnel	*Pholis gunnellus*	-	-	-	-	-	-	-	-	1	-	1	1	3
Feather blenny	*Hypsoblennius hentz*	-	-	2	-	-	-	-	-	-	-	-	-	2
Sand launce	*Ammodytes sp.*	-	-	-	-	-	-	-	-	-	-	1	-	1
Goby sp.	*Gobiidae*	-	18	199	56	62	1	-	-	-	-	-	-	336
Chub mackerel	*Scomber japonicus*	-	-	1	-	-	-	-	-	-	-	-	-	1
Butterfish	*Peprilus triacanthus*	-	-	1	-	-	-	-	-	-	-	-	-	1
Fourspot flounder	*Paralichthys oblongus*	-	2	1	-	-	-	-	-	-	-	-	-	3
Windowpane	*Scophthalmus aquosus*	-	3	-	-	-	-	-	-	-	-	-	-	3
Winter flounder	*Pleuronectes americanus*	3	-	-	-	-	-	-	-	-	-	-	29	32
Hogchoker	*Trinectes maculatus*	-	-	3	-	-	-	-	-	-	-	1	8	12
Unidentified	Unidentified	-	13	148	-	1	-	-	-	-	-	2	-	164
	Fish totals	4	131	1205	140	92	1	0	1	1	1	11	51	1638

(Source NOAA 1995)
A dash (-) indicates no catch.

Fish Species Collected in Newark Bay and Adjacent Waters[a]

Family Genus Species	Common Name	A 1972-73	B 1972-73	C 1972	D 1984-85	E 1987-88	F 1987-88	G 1987-88	H 1988
Carcharhinidae	**Requiem sharks**								
Mustelus canis	Smooth dogfish					X			
Rajidae	**Skates**								
Raja erinacea	Little skate								
Acipenseridae	**Sturgeons**								
Acipenser oxyrhyncus	Atlantic sturgeon		X						
Anguillidae	**Freshwater Eels**								
Anguilla rostrata	American eel	X	X		X	X	X	X	X
Ophichthidae	**Snake eels**								
Myrophis punctatus	Speckled worm eel								
Congridae	**Conger Eels**								
Conger oceanicus	Conger eel					X			
Clupeidae	**Herrings**								
Alosa aestivalis	Blueback herring	X	X			X	X	X	
Alosa pseudoharengus	Alewife	X	X		X	X	X	X	X
Alosa sapidissima	American shad	X	X		X	X	X	X	X
Alosa mediocris	Hickory shad					X	X	X	
Brevoortia tyrannus	Atlantic menhaden			X		X	X		
Clupea harengus	Atlantic herring					X	X		
Dorosoma cepedianum	Gizzard shad					X	X	X	
Engraulidae	**Anchovies**								
Anchoa mitchilli	Bay anchovy	X	X	X	X	X	X	X	X
Anchoa hepsetus	Striped anchovy					X		X	
Cyprinidae	**Carps & Minnows**								
Carassius auratus	Goldfish	X				X	X		
Notropis amoenus	Comely shiner								
Cyprinus carpio	Carp					X			

Fish Species Collected in Newark Bay and Adjacent Waters[a]

Family Genus Species	Common Name	A 1972-73	B 1972-73	C 1972	D 1984-85	E 1987-88	F 1987-88	G 1987-88	H 1988
Cyprinidae (Continued)	**Carps & Minnows (Continued)**								
Notemigonus crysoleucas	Golden shiner					X			
Notropis atherinoides	Emerald shiner					X			
Catostomidae	**Suckers**								
Catostomus commersoni	White sucker						X		
Ictaluridae	**Bullhead catfishes**								
Ameiurus nebulosus	Brown bullhead					X	X		
Ameiurus catus	White catfish					X	X		
Osmeridae	**Smelts**								
Osmerus mordax	Rainbow smelt	X	X			X	X		
Synodontidae	**Lizardfishes**								
Synodus foetens	Inshore lizardfish								
Gadidae	**Cods**								
Merluccius bilinearis	Silver hake	X	X			X	X	X	
Microgadus tomcod	Atlantic tomcod	X	X	X	X	X	X		X
Urophycis chuss	Red hake	X	X	X		X	X	X	X
Urophycis regia	Spotted hake					X	X	X	X
Urophycis tenuis	White hake							X	X
Gadus morhua	Atlantic cod							X	X
Enchelyopus cimbrius	Fourbeard rockling					X		X	
Pollachius virens	Pollock					X			
Ophidiidae	**Cusk-eels**								
Ophidion marginatum	Striped cusk-eel								
Lophiidae	**Goosefishes**								
Lophius americanus	Goosefish								
Batrarchoididae	**Toadfishes**								
Opsanus tau	Oyster toadfish								

Fish Species Collected in Newark Bay and Adjacent Waters[a]

Family Genus Species	Common Name	A 1972-73	B 1972-73	C 1972	D 1984-85	E 1987-88	F 1987-88	G 1987-88	H 1988
Belonidae	**Needlefishes**								
Strongylura marina	Atlantic needlefish		X						
Cyprinodontidae	**Killifishes**								
Fundulus heteroclitus	Mummichog	X	X	X	X			X	X
Fundulus majalis	Striped killifish					X	X	X	X
Fundulus diaphanus	Banded killifish								
Atherinidae	**Silversides**								
Menidia peninsulae	Tidewater silverside	X	X	X		X	X		
Menidia menidia	Atlantic silverside								
Membras martinica	Rough silverside								
Gasterosteidae	**Sticklebacks**								
Gasterosteus aculeatus	Threespine stickleback	X	X			X	X		
Apeltes quadracus	Fourspine stickleback								
Syngnathidae	**Pipefishes**								
Hippocampus erectus	Lined seahorse	X	X					X	
Syngnathus fuscus	Northern pipefish	X	X	X	X	X	X	X	X
Triglidae	**Searobins**								
Prionotus carolinus	Northern searobin	X	X			X	X	X	
Prionotus evolans	Striped searobin		X		X	X	X	X	X
Cottidae	**Sculpins**								
Myoxocephalus aeneaus	Grubby	X			X	X	X	X	
Myoxocephalus octodecemspinosus	Longhorn sculpin					X	X		
Percichthyidae	**Temperate Basses**								
Morone americana	White perch	X	X			X	X		
Morone saxatilis	Striped bass	X	X	X	X	X	X		
Serranidae	**Sea Basses**								
Centropristis striata	Black sea bass		X			X	X		

Fish Species Collected in Newark Bay and Adjacent Waters[a]

Family Genus Species	Common Name	A 1972-73	B 1972-73	C 1972	D 1984-85	E 1987-88	F 1987-88	G 1987-88	H 1988
Centrarchidae	**Sunfishes**								
Lepomis gibbosus	Pumpkinseed	X	X			X	X	X	
Lepomis macrochirus	Bluegill	X	X			X	X		
Pomoxis nigromaculatus	Black crappie	X				X			
Micropterus salmoides	Largemouth bass					X			
Pomoxis annularis	White crappie								
Lepomis gulosus	Warmouth					X	X		
Percidae	**Perches**								
Perca flavescens	Yellow perch					X			
Malacanthidae	**Tilefishes**								
Lopholatilus chamaeleonticeps	Tilefish								
Pomatomidae	**Bluefishes**								
Pomatomus saltatrix	Bluefish	X	X		X	X	X	X	X
Carangidae	**Jacks**								
Caranx hippos	Crevalle jack	X	X			X	X		
Selene vomer	Lookdown		X						
Selene setapinnis	Atlantic moonfish		X			X	X		
Caranx crysops	Blue runner								
Decapterus punctatus	Rough scad								
Lutjanidae	**Snappers**								
Lutjanus griseus	Gray snapper								
Sparidae	**Porgies**								
Lagodon rhomboides	Pinfish							X	
Stenotomus chrysops	Scup					X		X	
Sciaenidae	**Drums**								
Cynoscion regalis	Weakfish	X	X		X	X	X	X	X
Leiostomus xanthurus	Spot	X	X			X	X		X

Fish Species Collected in Newark Bay and Adjacent Waters[a]

Family Genus Species	Common Name	A 1972-73	B 1972-73	C 1972	D 1984-85	E 1987-88	F 1987-88	G 1987-88	H 1988
Sciaenidae (Continued)	**Drums (Continued)**								
Menticirrhus saxatilis	Northern kingfish								
Bairdiella chryosura	Silver perch								
Micropogon undulates	Atlantic croaker						X		
Chaetodontidae	**Butterflyfishes**								
Chaetodon ocellatus	Spotfin butterflyfish								
Mugilidae	**Mullets**								
Mugil cephalus	Striped mullet					X	X		
Mugil curema	White mullet					X	X		
Sphyraenidae	**Barracudas**								
Sphyraena borealis	Northern sennet								
Labridae	**Wrasses**								
Tautoga onitis	Tautog		X			X	X		
Tautogolabrus adspersus	Cunner	X				X	X		
Pholidae	**Gunnels**								
Pholis gunnellus	Rock gunnel					X			
Uranoscopidae	**Stargazers**								
Astroscopus guttatus	Northern stargazer								
Blenniidae	**Combtooth Blennies**								
Hypsoblennius hentz	Feather blenny								
Ammodytidae	**Sand Launces**								
Ammodytes americanus	American sand launce					X			
Gobiidae	**Gobies**								
Gobiosoma bosci	Naked goby	X	X	X		X			
Gobiosoma ginsburghi	Seaboard goby	X		X		X			
Scombridae	**Mackerels**								
Scomberomorus maculatus	Spanish mackerel								

Fish Species Collected in Newark Bay and Adjacent Waters[a]

Family Genus Species	Common Name	A 1972-73	B 1972-73	C 1972	D 1984-85	E 1987-88	F 1987-88	G 1987-88	H 1988
Scombridae (Continued)	**Mackerels (Continued)**								
Scomber japonicus	Chub mackerel								
Scomber scombrus	Atlantic mackerel								
Stromateidae	**Butterfishes**								
Peprilus triacanthus	Butterfish	X	X			X	X		
Bothidae	**Lefteye Flounders**								
Etropus microstomus	Smallmouth flounder		X			X	X	X	
Paralichthys dentatus	Summer flounder					X	X	X	
Scopthalmus aquosus	Windowpane		X					X	X
Paralicthys oblongus	Fourspot flounder								
Pleuronectidae	**Righteye Flounders**								
Limanda ferruginea	Yellowtail flounder								
Hippoglossoides platessoides	American plaice	X	X		X			X	X
Pleuronectes americanus	Winter flounder					X	X		
Pleuronectes putnami	Smooth flounder							X	
Soleidae	**Soles**								
Trinectes maculatus	Hogchoker					X	X	X	X
Symphurus plagiusa	Blackcheek tonguefish								
Balistidae	**Leatherjackets**								
Aluterus schoepfi	Orange filefish		X						
Cantherhines pullus	Orangespotted filefish								
Monacanthus hispidus	Planehead filefish								
Ostraciidae	**Boxfishes**								
Lactophrys quadricornis	Scrawled cowfish								
Tetraodontidae	**Puffers**								
Sphoeroides maculatus	Northern puffer							X	X
Chilomycterus schoepfi	Striped burrfish					X	X	X	X

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Fish Species Collected in Newark Bay and Adjacent Waters[a]

Family Genus Species	Common Name	I 1988-89	J 1988-89	K 1988-89	L 1991-92	M 1993-94	N 1994	O 1995-96
Carcharhinidae	**Requiem sharks**							
Mustelus canis	Smooth dogfish							
Rajidae	**Skates**							
Raja erinacea	Little skate				X	X		
Acipenseridae	**Sturgeons**							
Acipenser oxyrhyncus	Atlantic sturgeon					X		
Anguillidae	**Freshwater Eels**							
Anguilla rostrata	American eel	X	X	X	X	X	X	
Ophichthidae	**Snake eels**							
Myrophis punctatus	Speckled worm eel				X			
Congridae	**Conger Eels**							
Conger oceanicus	Conger eel	X			X	X		
Clupeidae	**Herrings**							
Alosa aestivalis	Blueback herring	X	X	X	X	X		X
Alosa pseudoharengus	Alewife	X	X	X	X	X	X	X
Alosa sapidissima	American shad	X	X	X	X	X	X	X
Alosa mediocris	Hickory shad				X		X	
Brevoortia tyrannus	Atlantic menhaden	X	X	X	X	X		
Clupea harengus	Atlantic herring	X	X	X		X		X
Dorosoma cepedianum	Gizzard shad	X	X	X	X	X		X
Engraulidae	**Anchovies**							
Anchoa mitchilli	Bay anchovy	X	X	X	X	X	X	X
Anchoa hepsetus	Striped anchovy	X	X	X				X
Cyprinidae	**Carps & Minnows**							
Carassius auratus	Goldfish							
Notropis amoenus	Comely shiner	X	X					
Cyprinus carpio	Carp							

Fish Species Collected in Newark Bay and Adjacent Waters[a]

Family Genus Species	Common Name	I 1988-89	J 1988-89	K 1988-89	L 1991-92	M 1993-94	N 1994	O 1995-96
Cyprinidae (Continued)	**Carps & Minnows (Continued)**							
Notemigonus crysoleucas	Golden shiner							
Notropis atherinoides	Emerald shiner							
Catostomidae	**Suckers**							
Catostomus commersoni	White sucker							
Ictaluridae	**Bullhead catfishes**							
Ameiurus nebulosus	Brown bullhead							
Ameiurus catus	White catfish							
Osmeridae	**Smelts**							
Osmerus mordax	Rainbow smelt					X		
Synodontidae	**Lizardfishes**							
Synodus foetens	Inshore lizardfish				X			
Gadidae	**Cods**							
Merluccius bilinearis	Silver hake	X	X	X	X		X	
Microgadus tomcod	Atlantic tomcod	X	X	X	X	X		X
Urophycis chuss	Red hake	X	X	X	X	X	X	
Urophycis regia	Spotted hake	X	X	X		X		X
Urophycis tenuis	White hake							
Gadus morhua	Atlantic cod							
Enchelyopus cimbrius	Fourbeard rockling	X			X			
Pollachius virens	Pollock	X	X	X	X			
Ophidiidae	**Cusk-eels**							
Ophidion marginatum	Striped cusk-eel				X			
Lophiidae	**Goosefishes**							
Lophius americanus	Goosefish	X		X				
Batrarchoididae	**Toadfishes**							
Opsanus tau	Oyster toadfish	X	X		X			

Fish Species Collected in Newark Bay and Adjacent Waters[a]

Family Genus Species	Common Name	I 1988-89	J 1988-89	K 1988-89	L 1991-92	M 1993-94	N 1994	O 1995-96
Belonidae	**Needlefishes**							
Strongylura marina	Atlantic needlefish	X	X		X			
Cyprinodontidae	**Killifishes**							
Fundulus heteroclitus	Mummichog				X		X	
Fundulus majalis	Striped killifish	X	X	X	X	X	X	
Fundulus diaphanus	Banded killifish				X			
Atherinidae	**Silversides**							
Menidia peninsulae	Tidewater silverside				X			
Menidia menidia	Atlantic silverside	X	X	X		X		X
Membras martinica	Rough silverside	X						
Gasterosteidae	**Sticklebacks**							
Gasterosteus aculeatus	Threespine stickleback	X	X	X	X	X		
Apeltes quadracus	Fourspine stickleback	X			X			
Syngnathidae	**Pipefishes**							
Hippocampus erectus	Lined seahorse				X	X		
Syngnathus fuscus	Northern pipefish	X	X	X	X		X	X
Triglidae	**Searobins**							
Prionotus carolinus	Northern searobin	X	X	X	X			
Prionotus evolans	Striped searobin	X	X	X	X			
Cottidae	**Sculpins**							
Myoxocephalus aeneaus	Grubby	X	X	X	X		X	X
Myoxocephalus octodecemspinosus	Longhorn sculpin							
Percichthyidae	**Temperate Basses**							
Morone americana	White perch	X	X	X	X	X	X	X
Morone saxatilis	Striped bass	X	X	X	X	X	X	X
Serranidae	**Sea Basses**							
Centropristis striata	Black sea bass	X	X	X	X			

Fish Species Collected in Newark Bay and Adjacent Waters[a]

Family Genus Species	Common Name	I 1988-89	J 1988-89	K 1988-89	L 1991-92	M 1993-94	N 1994	O 1995-96
Scombridae (Continued)	**Mackerels (Continued)**							
Scomber japonicus	Chub mackerel					X		
Scomber scombrus	Atlantic mackerel	X	X	X				
Stromateidae	**Butterfishes**							
Peprilus triacanthus	Butterfish	X	X	X		X		X
Bothidae	**Lefteye Flounders**							
Etropus microstomus	Smallmouth flounder	X	X	X	X	X		
Paralichthys dentatus	Summer flounder	X	X	X	X	X		X
Scopthalmus aquosus	Windowpane				X			
Paralicthys oblongus	Fourspot flounder	X	X	X		X		
Pleuronectidae	**Righteye Flounders**							
Limanda ferruginea	Yellowtail flounder		X					
Hippoglossoides platessoides	American plaice	X			X		X	
Pleuronectes americanus	Winter flounder	X	X	X		X		X
Pleuronectes putnami	Smooth flounder							
Soleidae	**Soles**							
Trinectes maculatus	Hogchoker	X	X		X	X		
Symphurus plagiusa	Blackcheek tonguefish				X			
Balistidae	**Leatherjackets**							
Aluterus schoepfi	Orange filefish	X		X				
Cantherhines pullus	Orangespotted filefish				X			
Monacanthus hispidus	Planehead filefish					X		
Ostraciidae	**Boxfishes**							
Lactophrys quadricornis	Scrawled cowfish				X			
Tetraodontidae	**Puffers**							
Sphoeroides maculatus	Northern puffer				X			
Chilomycterus schoepfi	Striped burrfish	X	X	X	X			

[a]See pages 13 and 14 of this table for study locations and citations.

Fish Species Collected in Newark Bay and Adjacent Waters[a]

ITEM No.	STUDY LOCATION	REFERENCE
A	Linden Generating Station	Ichthyological Associates (IA). 1979. Demonstration for Section 316(b) of the Federal Water Pollution Control Act Amendments of 1972, PL92-500, Linden Generating Station. Report to: Public Service Electric & Gas Company, New Jersey.
B	Sewaren Generating Station	Ichthyological Associates (IA). 1979. Demonstration for Section 316(b) of the Federal Water Pollution Control Act Amendments of 1972, PL92-500, Sewaren Generating Station. Report to: Public Service Electric & Gas Company, New Jersey.
C	Arthur Kill Generating Station	Lawler, Matusky & Skelly Engineers (LMS). 1975. Arthur Kill Generating Station Study, Section 316(a) Demonstration. Prepared for Consolidated Edison Company of New York, Inc.
D	Newark Bay and Kill Van Kull	U.S. Army Corps of Engineers (USACE). 1987b. Feasibility Report, Navigation Study on Improvements to Existing Navigation Channel. Technical Appendices.
E	Hackensack River	EA Engineering, Science and Technology (EA). 1988. Hudson Generating Station Units 1 and 2. Supplemental 316(b) Report. Prepared for Public Service Electric & Gas Company.
F	Hudson Generating Station	EA Engineering, Science and Technology (EA). 1988. Hudson Generating Station Units 1 and 2. Supplemental 316(b) Report. Prepared for Public Service Electric & Gas Company.
G	Newark Bay	Will, R., and L.J. Houston. 1992. Fish Distribution Survey of Newark Bay, May 1987-April 1988. *In*: Estuarine Research in the 1980s (Edited by C. Lavett Smith). The Hudson River Environmental Society, Seventh Annual Symposium on Hudson River Ecology.
H	Arthur Kill and Old Place Creek	Louis Berger & Associates, Inc. (LBA). 1992. Staten Island Bridges Program Environmental Report. Submittal to the Port Authority of New York/New Jersey.
I	Arthur Kill	EA Engineering, Science and Technology. 1989. Sewaren Generating Station, Units 1 through 4 Supplemental 316(b) Report. Report to Public Service Electric & Gas Company.
J	Sewaren Generating Station	EA Engineering, Science and Technology. 1989. Sewaren Generating Station, Units 1 through 4 Supplemental 316(b) Report. Report to Public Service Electric & Gas Company.
K	Linden Generating Station	EA Engineering, Science and Technology. 1989. Linden Generating Station Supplemental 316(b) Report. Report to Public Service Electric & Gas Company.

Fish Species Collected in Newark Bay and Adjacent Waters[a]

ITEM No.	STUDY LOCATION	REFERENCE
L	Arthur Kill Generating Station	Lawler, Matusky & Skelly Engineers (LMS). 1993. Arthur Kill Impingement and Entrainment Report, September 1991-September 1992. Report to Consolidated Edison Company of New York, Inc.
M	Newark Bay	National Marine Fisheries Service. Undated. Results of a Biological and Hydrological Characterization of Newark Bay, New Jersey, May 1993-April 1994.
N	Arthur Kill and Old Place Creek	U.S. Coast Guard (USCG). 1995. Draft Environmental Impact Statement/Draft Section 4(f) Statement. Staten Island Bridges Program, Modernization and Capacity Enhancement Project.
O	Newark Bay	Lawler, Matusky & Skelly Engineers LLP (LMS). 1996. Newark Bay Biological Monitoring Program April 1995-March 1996. Report prepared for the Port Authority of NY/NJ.

Summary

The available data present a consistent picture of the fish and shellfish communities in Newark Bay. There is a diverse fish community dominated numerically by relatively few species. The dominant species - striped bass, winter flounder, bay anchovy, and Atlantic tomcod - were abundant or common in each study. A number of other species occur commonly, but on an annual basis are generally present in smaller numbers, or were present only for short periods of time. The majority of species were present infrequently, and occurred in very low numbers from summer through fall.

Shortnose sturgeon is the only (Federally listed) threatened or endangered fish species in New Jersey. This species has not been collected in any of the studies conducted in Newark Bay and adjacent waters.

Shoal areas are used by fishes from late spring through fall, but fish are nearly absent from the shoals during winter. The 1995-1996 study did not find a difference in species representation or abundance among the four Newark Bay shoal stations sampled over a one-year period. The deeper navigation channels, on the other hand, are used throughout the year. During winter, fish abundance can be high in channel areas, but the fish community is dominated by few species, particularly striped bass and white perch.

Bottom trawls of the size used for studies in Newark Bay do not catch large individuals efficiently, thus the occurrence of large fish in Newark Bay is not well established. Large striped bass, an important game fish, may occur in the Bay. The presence of large numbers of the smaller individuals of the dominant species shows that Newark Bay is an important nursery area for some species.

Blue crabs were abundant in the trawl samples in the studies reviewed. They occur on the shoals from April through October and are not present during the remainder of the year. They were present in the channel during the winter months, but their relative abundance may not be well represented because they burrow in to the bottom. Other large invertebrates were collected in the fish sampling gear, but all were present in low abundance and confined to the channel stations.

3.07 WILDLIFE

3.07.1 EXISTING CONDITIONS

Newark Bay has several habitat types and areas that support wildlife. The residential and industrial areas located along the eastern and western shoreline of the Bay provide habitat for passerine birds, pigeons, gulls, and other wildlife species that tolerate disturbed habitats and frequent disturbance from people, vehicles, and machinery. These species have adapted to an environment dominated by humans and may be common in or adjacent to residential and industrial areas. The Newark Bay shoal areas and deepwater areas (channels and interpier areas) provide roosting, foraging, and overwintering areas for gulls, waterfowl, and cormorants. The Newark Bay shoreline has small beach areas and some wetlands, but mostly bulkheaded banks, that provide minimal quality and quantity of habitat for shorebirds, waders, ducks, geese, and other species found in the ecozone between bay/estuary and upland beach, wetland, and spoil areas.

Information on Newark Bay wildlife was taken from a variety of sources, including resource agency contacts, published literature, unpublished reports, and field surveys. A computerized literature search that was conducted covered published literature dating back to 1964. Unpublished reports were found in environmental assessment statements (EAS), environmental impact statements (EIS), and in 316(b) documents.

Agency contacts were made by letter during 1995; the agencies contacted and the response dates are found below:

Agency Contacted	Response Format	Respondent and Title	Date of Response
NJDEPE-NHP	Letter	Mr. Thomas F. Breden, Supervisor	6 Jun 1995
USDI-FWS	Letter	Mr. John C. Staples, Assistant Supervisor	6 Sep 1995
USDC-NOAA	Letter	Mr. Stanley W. Gorski, Assistant Coordinator	14 Dec 1995

Agency responses typically provide information on species and habitats considered threatened, endangered, or unique and do not provide information on wildlife in general. Information obtained from resource agencies and literature searches indicates a concern for several species or groups of species and habitat types that occur in the project area. Copies of agency correspondence are presented in Appendix 3.07.

Shooters Island, located to the south of Newark Bay in the Kill Van Kull, provides nesting habitat for wading birds, gulls, and waterfowl. To the north, the Raritan and Hackensack rivers provide tidal creeks, mudflats, shorelines, and marsh habitats for

foraging wading birds, waterfowl, gulls, muskrat, meadow voles, diamondback terrapins, and other wildlife species.

Over 227 species of mammals, birds, reptiles, and amphibians have been identified in the Newark Bay area (Table 3.07-1) (NYCDPR 1994, 1995; TI 1976; LMS 1996b; HHR 1990). The majority of wildlife observed was birds (195 species); most of these species are migratory, with limited breeding activity in Newark Bay. Transients and post-breeding wanderers pass through the area and may or may not forage or rest there. The same species also occur throughout the NY/NJ estuary. Other groups of birds include resident breeders, species of wading birds, waterfowl, gulls, and cormorants, which nest nearby and use the Newark Bay shallows as foraging habitat. Some species, predominantly waterfowl and gulls, overwinter in protected areas where they may also forage. Several species of passerines breed and forage near the shores of Newark Bay, including grackles, starlings, sparrows, and wrens.

Thirty-two species of mammals, reptiles, and amphibians occur in the area: 15 the total includes species of mammals, seven species of reptiles, and 10 species of amphibians. The majority of these are terrestrial species found close to disturbed areas and are highly tolerant of an urban-industrial environment.

A list of confirmed, probable, and possible species of wildlife in the Newark Bay area is presented in Table 3.07-2, with expected seasonal occurrence and habitat preference. A detailed discussion of the major groups of wildlife present or suspected of being present in Newark Bay follows:

3.07.1.1 Diving Ducks. Large overwintering rafts of diving ducks forage and rest within the NY/NJ estuary. About 15 species of diving ducks can be expected to pass through and use portions of the NY/NJ estuary for migration stopovers and for overwintering (Nichols 1995). Concentrations are composed primarily of canvasbacks, greater scaup, and buffleheads, with lesser numbers of mergansers (TI 1976; LMS 1984a, 1984b, 1987). These species and others are found along the mid-Atlantic Coasts during winter with breeding occurring farther north and west in the Northeast, Midwest, Canada, and Alaska (Bellrose 1980).

These species move throughout the estuary in search of food and protected resting areas on a daily basis. Large, shallow, open-water areas with abundant food supplies (primarily bivalves) near mouths of estuaries are preferred foraging sites for these species (Stott and Olson 1973). Benthic worms, isopods, amphipods, snails, shrimp, crabs, and small fish are also eaten by a variety of diving ducks that overwinter in areas along the East Coast (TI 1976; Stott and Olson 1973).

Many diving ducks overwinter in coastal areas; others overwinter on large water bodies, including lakes, impoundments, and slow-moving rivers where fish and invertebrates are plentiful. Diving ducks begin the fall migration to overwintering areas in October and November after recruitment of young. Large concentrations move south to open-water

Table 3.07-1 (Page 1 of 6)

Wildlife Species Likely to Use the Newark Bay Area as Identified During Studies in the NY/NJ Harbor Area

		Upland, Marine and Adjacent Shoreline Sites					Marine and Adjacent Shoreline Sites Hudson River Waterfront LMS Unpublished			Marine and Open Water Sites Pany/NJ Newark Bay LMS (1996b)
Common Name	Scientific Name	USCG 1995	Harbor Herons Report (1990) Individuals	Andrle and Carroll (1988) Breeding Birds	Aquila and Alderson (1984) Overwintering Birds	Liberty State Park TI (1976)	LMS (1984 a)	LMS (1984 b)	LMS (1984 c)	
Mammals										
Virginia opossum	*Didelphis virginiana*	x	x							
Eastern mole	*Scalopus aquaticus*		x							
Unidentified bat	*Unidentified bat*	x	x							
Red bat	*Lasiurus borealis*		x							
Hoary bat	*Lasiurus cinereus*		x							
Little brown bat	*Myotis lucifugus*		x							
Eastern cottontail	*Sylvilagus floridanus*	x	x							
Grey squirrel	*Sciurus carolinensis*	x	x							
White-footed mouse	*Peromyscus leucopus*	x								
Meadow vole	*Microtus pennsylvanicus*	x	x							
Muskrat	*Ondatra zibethica*	x	x							
Norway rat	*Rattus norvegicus*	x	x							
House mouse	*Mus musculus*	x								
Raccoon	*Procyon lotor*	x	x							
White-tailed deer	*Odocoileus virginianus*	x								
Number of species:		11	12	Not Applicable	Not Applicable					
Birds										
Common loon	*Gavia immer*				x	x				
Red-throated loon	*Gavia stellata*				x	x				
Pied-billed grebe	*Podilymbus podiceps*	x	x	x	x	x				x
Horned grebe	*Podiceps auritus*				x	x				
Great cormorant	*Phalacrocorax carbo*				x					x
Double-crested cormorant	*Phalacrocorax auritus*	x	x		x	x	x	x	x	x
Great blue heron	*Ardea herodias*	x	x		x	x	x		x	
Green heron	*Butorides virescens*	x	x	x		x	x		x	
Little blue heron	*Egretta caerulea*		x	x						
Cattle egret	*Bulbucus ibis*		x	x						
Great egret	*Ardea albus*	x	x	x						
Snowy egret	*Egretta thula*	x	x	x		x	x			
Black-crowned night heron	*Nycticorax nycticorax*	x	x	x	x	x	x		x	
Yellow-crowned night heron	*Nycticorax violacea*	x	x							
Least bittern	*Ixobrychus exilis*		x	x						
American bittern	*Botaurus lentiginosus*		x	x						
Glossy ibis	*Plegadis falcinellus*	x	x	x		x				
Louisiana heron	*Hydranassa tricolor*		x							
White-faced ibis	*Plegadis chihi*		x							
Brant goose	*Branta bernicla*		x		x	x	x			x
Snow goose	*Chen caerulescens*					x				
Canada goose	*Branta canadensis*	x	x	x	x	x	x		x	x
Mallard	*Anas platyrhynchos*	x	x	x	x	x	x	x	x	x
Black duck	*Anas rubripes*	x	x	x	x	x	x	x	x	x
Gadwall	*Anas strepera*	x	x	x	x	x	x	x	x	x
Northern pintail	*Anas acuta*		x			x				

Wildlife Species Likely to Use the Newark Bay Area as Identified During Studies in the NY/NJ Harbor Area

Common Name	Scientific Name	Upland, Marine and Adjacent Shoreline Sites					Marine and Adjacent Shoreline Sites			Marine and Open Water Sites
		USCG (1995)	Harbor Herons Report (1990) Individuals	Andrle and Carroll (1988) Breeding Birds	Aquila and Alderson (1994) Overwintering Birds	Liberty State Park TI (1976)	Hudson River Waterfront LMS Unpublished LMS (1984 a)	LMS (1984 b)	LMS (1984 c)	Pany/NJ Newark Bay LMS (1986b)
Birds										
Ruddy duck	*Oxyura jamaicensis*		x		x	x	x			
Canvasback	*Aythya vallisineria*		x		x	x	x		x	x
Lesser scaup	*Aythya affinis*		x			x	x			
Greater scaup	*Aythya marila*		x		x	x	x		x	
Common goldeneye	*Bucephala clangula*				x	x				
Green-winged teal	*Anas crecca*	x	x	x	x	x				
Blue-winged teal	*Anas discors*	x	x	x		x				
American wigeon	*Anas americana*	x	x		x	x	x		x	x
Northern shoveler	*Anas clypeata*		x	x						
Wood duck	*Aix sponsa*		x	x						
Redhead	*Aytha americana*				x	x	x			
Ring-necked duck	*Aytha collaris*					x	x			
Bufflehead	*Bucephala albeola*		x		x	x	x		x	x
White-winged scoter	*Melanitta deglandi*					x	x			
Oldsquaw	*Clangula hyemalis*				x					
Hooded merganser	*Lopyodytes mergus*	x	x		x	x	x			
Common merganser	*Mergus merganser*								x	
Red-breasted merganser	*Mergus serrator*		x		x	x				x
Whistling swan	*Cygnus olor columbianus*		x							
Turkey vulture	*Cathartes aura*	x								
Cooper's hawk	*Accipiter cooperii*				x					
Sharp-shinned hawk	*Accipiter striatus*	x	x		x					
Red-tailed hawk	*Buteo jamaicensis*	x	x		x	x	x		x	
Red-shouldered hawk	*Buteo lineatus*				x					
Northern harrier	*Circus cyaneus*	x	x		x	x	x			
Rough-legged hawk	*Buteo lagopus*		x							
Osprey	*Pandion haliaetus*		x			x				
Peregrine falcon	*Falco peregrinus*	x	x	x						x
Merlin	*Falco columbarius*	x								
American kestrel	*Falco sparverius*	x	x	x	x	x				
Ring-necked pheasant	*Phasianus colchicus*	x	x	x	x	x	x	x		
King rail	*Rallus elegans*		x							
Clapper rail	*Rallus longirostris*	x	x			x				
Virginia rail	*Rallus limicola*	x	x	x		x				
Sora rail	*Porzana carolina*		x							
Common gallinule	*Gallinula chloropus*	x	x	x						
American coot	*Fulicia americana*		x	x	x	x	x		x	
Semipalmated plover	*Charadrius semipalmatus*	x					x		x	
Killdeer	*Charadrius vociferus*	x	x	x		x	x		x	
Black-bellied plover	*Pluvialis squatarola*					x				
American woodcock	*Scolopax minor*	x	x	x	x	x				
Common snipe	*Gallinago gallinago*			x		x				
Ruddy turnstone	*Arenaria interpres*				x					
Spotted sandpiper	*Actitis macularia*	x	x	x		x	x		x	
Solitary sandpiper	*Tringa solitaria*	x	x							
Willet	*Catoptrophorus semipalmatus*									

Table 3.07-1 (Page 3 of 6)

Wildlife Species Likely to Use the Newark Bay Area as Identified During Studies in the NY/NJ Harbor Area

Common Name	Scientific Name	Upland, Marine and Adjacent Shoreline Sites					Marine and Adjacent Shoreline Sites Hudson River Waterfront			Marine and Open Water Sites
		USCG (1995)	Harbor Herons Report (1990) Individuals	Andrle and Carroll (1988) Breeding Birds	Aquila and Alderson (1994) Overwintering Birds	Liberty State Park TI (1978)	LMS Unpublished LMS (1984 a)	LMS (1984 b)	LMS (1984 c)	Pany/NJ Newark Bay LMS (1996b)
Birds										
Purple sandpiper	*Calidris maritima*				x	x				
Greater yellowlegs	*Tringa melanoleuca*	x	x			x				
Lesser yellowlegs	*Tringa flavipes*	x	x							
Pectoral sandpiper	*Calidris melanotos*	x	x							
Least sandpiper	*Calidris minutilla*	x				x	x		x	
Dunlin	*Calidris alpina*				x	x				
Short-billed dowitcher	*Limnodromus griseus*									
Stilt sandpiper	*Micropalama himantopus*									
Semipalmated sandpiper	*Calidris pusilla*	x	x			x				
Black-bellied plover	*Pluvialis squatarola*		x							
Red knot	*Calidris canutus*		x							
Sanderling	*Calidris alba*		x		x					
Dowitcher sp.	*Limnodromus sp.*		x							
Wilson's phalarope	*Steganopus tricolor*		x							
Great black-backed gull	*Larus marinus*	x	x	x		x	x	x	x	x
Herring gull	*Larus argentatus*	x	x	x	x	x	x	x	x	x
Ring-billed gull	*Larus delawarensis*	x	x		x	x	x	x	x	x
Laughing gull	*Larus atricilla*	x	x	x		x	x	x	x	x
Bonaparte's gull	*Larus philadelphia*		x		x	x	x		x	
Common tern	*Sterna hirundo*		x			x			x	
Roseate tern	*Sterna dougallii*		x							
Least tern	*Sterna antillarum*		x			x			x	
Arctic tern	*Sterna paradisaea*								x	
Black skimmer	*Rynchops niger*		x			x				
Rock dove	*Columba livia*	x	x	x	x	x	x	x	x	x
Mourning dove	*Zenaida macroura*	x	x	x	x	x	x	x	x	
Yellow-billed cuckoo	*Coccyzus americanus*	x		x						
Common barn-owl	*Tyto alba*	x	x	x						
Screech-owl	*Otus asio*		x		x					
Great horned owl	*Bubo virginianus*		x		x					
Snowy owl	*Nyctea scandiaca*		x							
Short-eared owl	*Asio flammeus*		x		x	x				
Ruby-throated hummingbird	*Archilochus colubris*		x							
Chimney swift	*Chaetura pelagica*	x		x		x				
Belted kingfisher	*Ceryle alcyon*	x	x		x	x	x		x	
Northern flicker	*Colaptes auratus luteus*	x	x	x	x	x				
Red-bellied woodpecker	*Melanerpes centurus*				x					
Yellow-bellied sapsucker	*Sphyrapicus varius vrius*				x					
Hairy woodpecker	*Dendrocopus villosus*	x	x	x	x					
Downy woodpecker	*Dendrocopus pubescens*	x		x	x					
Eastern kingbird	*Tyrannus tyrannus*	x	x	x						
Flycatcher sp.	*Empidonax sp.*	x	x							
Great crested flycatcher	*Mylarchus crinitus*	x	x							
Eastern phoebe	*Sayornis phoebe*	x				x				
Eastern wood-pewee	*Contopus virens*	x	x	x						

Table 3.07-1 (Page 4 of 6)

Wildlife Species Likely to Use the Newark Bay Area as Identified During Studies in the NY/NJ Harbor Area

		Upland, Marine and Adjacent Shoreline Sites					Marine and Adjacent Shoreline Sites Hudson River Waterfront LMS Unpublished			Marine and Open Water Sites
Common Name	Scientific Name	USCG (1995)	Harbor Herons Report (1990) Individuals	Andrle and Carroll (1988) Breeding Birds	Aquila and Alderson (1994) Overwintering Birds	Liberty State Park TI (1976)	LMS (1984 a)	LMS (1984 b)	LMS (1984 c)	Pany/NJ Newark Bay LMS (1996b)
Birds										
Willow flycatcher	*Empidonax traillii*	x		x		x				
Horned lark	*Eremophila alpestris*				x					
Tree swallow	*Iridoprocne bicolor*	x	x	x		x	x		x	
Bank swallow	*Riparia riparia*	x	x							
Rough-winged swallow	*Stelgidopteryx ruficollis*	x								
Barn swallow	*Hirundo rustica*	x	x	x		x	x	x	x	
Blue jay	*Cyanocitta cristata*	x	x	x	x					
American crow	*Corvus brachyrynchos*	x	x	x	x	x	x	x	x	x
Fish crow	*Corvus ossifragus*	x	x		x	x	x			
Black-capped chickadee	*Parus atricapillus*	x	x	x	x	x				
Tufted titmouse	*Parus bicolor*	x		x	x					
White-breasted nuthatch	*Sitta carolinensis*				x					
Red-breasted nuthatch	*Sitta canadensis*				x					
Brown creeper	*Certhia familiaris*									
House wren	*Troglodytes aedon*	x	x	x		x				
Winter wren	*Troglodytes troglodytes*				x					
Carolina wren	*Thryothorus ludovicianus*	x			x					
Marsh wren	*Cistothorus palustris*	x	x	x						
Northern mockingbird	*Mimus polyglottos*	x	x	x	x	x	x	x	x	
Gray catbird	*Dumetella carolinensis*	x	x	x		x				
Brown thrasher	*Toxostoma rufum*	x	x	x		x				
American robin	*Turdus migratorius*	x	x	x	x	x	x	x		
Wood thrush	*Hylocichla mustelina*	x		x			x			
Swainson's thrush	*Catharus ustulatus*					x				
Veery	*Catharus fuscescens*	x	x							
Eastern bluebird	*Sialia sialis*									
Blue-gray gnatcatcher	*Polioptila caerulea*									
Golden-crowned kinglet	*Regulus satrapa*	x	x		x					
Ruby-crowned kinglet	*Regulus calendula*	x				x				
Loggerhead shrike	*Lanius ludovicianus*					x				
Cedar waxwing	*Bombycilla cedrorum*	x		x	x					
European starling	*Sturnus vulgaris*	x	x	x	x	x	x	x	x	x
Yellow-throated vireo	*Vireo flavifrons*									
Solitary vireo	*Vireo solitarius*	x								
Red-eyed vireo	*Vireo olivaceus*	x	x	x						
Philadelphia vireo	*Vireo philadelphicus*									
Black-&-white warbler	*Mniotilta varia*	x	x							
Nashville warbler	*Vermivora ruficapilla*	x								
Northern parula	*Parula americana*	x								
Yellow warbler	*Dendroica petechia*	x		x	x					
Magnolia warbler	*Dendroica magnolia*	x	x							
Yellow-rumped warbler	*Dendroica coronata*	x	x		x	x				
Chestnut-sided warbler	*Dendroica pensylvanica*	x								
Bay-breasted warbler	*Dendroica castanea*	x								

Table 3.07-1 (Page 5 of 6)

Wildlife Species Likely to Use the Newark Bay Area as Identified During Studies in the NY/NJ Harbor Area

Common Name	Scientific Name	Upland, Marine and Adjacent Shoreline Sites					Marine and Adjacent Shoreline Sites			Marine and Open Water Sites
		USCG (1995)	Harbor Herons Report (1990) Individuals	Andrle and Carroll (1988) Breeding Birds	Aquila and Alderson (1994) Overwintering Birds	Liberty State Park TI (1976)	Hudson River Waterfront LMS Unpublished LMS (1984 a)	LMS (1984 b)	LMS (1984 c)	Pany/NJ Newark Bay LMS (1996b)
Birds										
Blackpoll warbler	*Dendroica striata*	x								
Pine warbler	*Dendroica pinus*	x								
Prairie warbler	*Dendroica discolor*									
Palm warbler	*Dendroica palmarum*	x								
Ovenbird	*Seiurus aurocapillus*	x		x						
Common yellowthroat	*Geothlypis trichas*	x	x	x		x				
American redstart	*Setophaga ruticilla*	x	x							
Connecticut warbler	*Oporornis agilis*		x							
Blue-winged warbler	*Vermivora pinus*		x							
House sparrow	*Passer domesticus*	x	x	x		x	x	x		
Bobolink	*Dolichonyx oryzivorus*		x							
Eastern meadowlark	*Sturnella magna*	x								
Red-winged blackbird	*Agelaius phoeniceus*	x	x	x	x	x				
Orchard oriole	*Icterus spurius*									
Northern oriole	*Icterus galbula*	x	x			x				
Boat-tailed grackle	*Quiscalus major*									
Common grackle	*Quiscalus quiscula*	x	x	x		x	x	x	x	
Brown-headed cowbird	*Molothrus ater*	x		x	x	x				
Scarlet tanager	*Piranga olivacea*	x								
Boat-tailed grackle	*Quiscalus major*									
Northern cardinal	*Cardinalis cardinalis*	x	x	x	x					
Rose-breasted grosbeak	*Pheucticus ludovicianus*	x								
Indigo bunting	*Passerina cyanea*	x		x		x				
Purple finch	*Carpodecus purpureus*									
House finch	*Carpodacus mexicanus*	x		x	x	x				
Common redpoll	*Carduelis flammea*		x							
American goldfinch	*Spinus carduelis tristis*	x	x	x	x	x				
Rufous-sided towhee	*Pipilo erythrophthalmus*	x	x	x	x	x				
Savannah sparrow	*Passerculus sandwichensis*	x				x				
Dark-eyed junco	*Junco hyemalis*				x	x				
American tree sparrow	*Spizella arborea*	x	x		x	x				
Chipping sparrow	*Spizella passerina*									
Field sparrow	*Spizella pusilla*	x			x	x				
White-crowned sparrow	*Zanotrichia leucophrys*	x			x					
White-throated sparrow	*Zanotrichia albicollis*	x	x		x	x				
Seaside sparrow	*Ammodramus caudacutus*									
Sharp-tailed sparrow	*Ammospiza maritimaus*		x							
Fox sparrow	*Passerella iliaca*				x					
Lincoln's sparrow	*Melospiza lincolnii*	x								
Swamp sparrow	*Melospiza georgiana*	x	x	x	x	x				
Song sparrow	*Melospiza melodia*	x	x	x	x	x				
Snow bunting	*Plectrophenax nivalis*				x	x				
House sparrow		x	x							
Number of species:		117	124	72	83	98	45	18	36	20

Table 3.07-1 (Page 6 of 6)

Wildlife Species Likely to Use the Newark Bay Area as Identified During Studies in the NY/NJ Harbor Area

		Upland, Marine and Adjacent Shoreline Sites					Marine and Adjacent Shoreline Sites			Marine and Open Water Sites
				Andrle and Carroll	Aquila and Alderson		Hudson River Waterfront LMS Unpublished			Pany/NJ Newark Bay
Common Name	Scientific Name	USCG 1995	Harbor Herons Report (1990) Individuals	(1988) Breeding Birds	(1994) Overwintering Birds	Liberty State Park TI (1976)	LMS (1984 a)	LMS (1984 b)	LMS (1984 c)	LMS (1996b)
Reptiles										
Northern brown snake	*Storeria dekayi*	x								
Eastern black racer	*Coluber constrictor*		x							
Common garter snake	*Thamnophis sirtalis*		x							
Snapping turtle	*Chelydra serpentina*	x	x							
Painted turtle	*Chrysemys picta*		x							
Diamondback terrapin	*Malaclemys terrapin*	x	x							
Eastern fence lizard	*Sceloporus undulatus*		x							
Number of species:		3	6	Not Applicable	Not Applicable					
Amphibians										
Red-backed salamander	*Plethodon cinereus*		x							
Green frog	*Rana clamitans*		x							
Bullfrog	*Rana catesbeiana*		x							
Eastern grey tree frog	*Hyla versicolor*		x							
Southern leopard frog	*Rana sphenocephala*		x							
Spring peeper	*Hyla crucifer*	x	x							
American toad	*Bufo americanus*		x							
Fowler's toad	*Bufo woodhousei fowleri*	x	x							
Woodland salamander	*Plethodon sp.*		x							
Four-toed salamander	*Hermidactylium scutatum*		x							
Number of species:		2	10	Not Applicable	Not Applicable					

Table 3.07-2

Confirmed, Probable, and Possible Wildlife Species Using The Newark Bay Shoal Areas

Common Name	Scientific Name	Status	Season	Habitat
Mammals				
Eastern pipistrelle	*Pipistrellus subflavus*	Possible	Spring to fall	Aerial - over land and water
Big brown bat	*Eptesicus fuscus*	Possible	Spring to fall	Aerial - over land and water
Red bat	*Lasiurus borealis*	Possible	Spring to fall	Aerial - over land and water
Hoary bat	*Lasiurus cinereus*	Possible	Spring to fall	Aerial - over land and water
Evening bat	*Nycticeius humeralis*	possible	Spring to fall	Aerial - over land and water
Silver-haired bat	*Lasionycteris noctivagens*	Possible	Spring to fall	Aerial - over land and water
Small-footed bat	*Myotis leibii*	Possible	Spring to fall	Aerial - over land and water
Little brown bat	*Myotis lucifugus*	Possible	Spring to fall	Aerial - over land and water
Northern long eared bat	*Myotis septentrionalis*	Possible	Spring to fall	Aerial - over land and water
Muskrat	*Ondatra zibethica*	Possible	Spring to fall	Marsh - wetland, riverine, small bays and creeks
Harbor seal	*Phoca vitulina*	Possible	All year	Marine bays, channels and coastal waters
Birds				
Common loon	*Gavia immer*	Possible	Lat - fall - early spring	Open water
Red-throated loon	*Gavia stellata*	Possible	Late fall - early spring	Open water
Pied-billed grebe	*Podilymbus podiceps*	Possible	Late fall - early spring	Open water
Great cormorant	*Phalacrocorax carbo*	Probable	Winter	Open water
Double-crested cormorant	*Phalacrocorax auritus*	Confirmed	All year	Open water
Great blue heron	*Ardea herodias*	Probable	All year	Marshes - shallow water
Green heron	*Butorides virescens*	Possible	All year	Marshes - shallow water
Great egret	*Ardea albus*	Probable	Summer	Marshes - shallow water
Snowy egret	*Egretta thula*	Possible	Summer	Marshes - shallow water
Black-crowned night heron	*Nycticorax nycticorax*	Possible	Summer	Marshes - shallow water
Yellow-crowned night heron	*Nycticorax violacea*	Possible	Summer	Marshes - shallow water
Glossy ibis	*Plegadis falcinellus*	Possible	Summer	Marshes - shallow water
Brant goose	*Branta bernicla*	Probable	Winter	Marshes - shallow water
Snow goose	*Chen caerulescens*	Possible	Winter	Marshes and adjacent open water
Canada goose	*Branta canadensis*	Confirmed	All year	Marshes and adjacent open water
Mallard	*Anas platyrhynchos*	Confirmed	All year	Marshes and adjacent open water
Black duck	*Anas rubripes*	Confirmed	All year	Marshes and adjacent open water
Gadwall	*Anas strepera*	Confirmed	All year	Marshes and adjacent open water
Northern pintail	*Anas acuta*	Possible	Fall and early winter	Open water
Ruddy duck	*Oxyura jamaicensis*	Probable	Fall and early winter	Open water
Canvasback	*Aythya valisineria*	Confirmed	Late fall - early winter	Open water
Lesser scaup	*Aythya affinis*	Probable	Late fall - early winter	Open water
Greater scaup	*Aythya marila*	Probable	Late fall - early winter	Open water
Common goldeneye	*Bucephala clangula*	Probable	Late fall - early winter	Open water
Green-winged teal	*Anas crecca*	Probable	Late fall - early spring	Marshes - open water
Blue-winged teal	*Anas discors*	Probable	All year	Marshes - open water
American wigeon	*Anas americana*	Confirmed	Late fall - early spring	Marshes - open water
Northern shoveler	*Anas clypeata*	Possible	Late fall - early spring	Marshes - open water
Redhead	*Aythe americana*	Possible	Late fall - early spring	Open water
Ring-necked duck	*Aythe collaris*	Posssible	Late fall - early spring	Marshes - open water
Bufflehead	*Bucephala albeola*	Confirmed	Late fall - early spring	Open water
White-winged scoter	*Melanitta deglandi*	Possible	Late fall - early spring	Open water
Oldsquaw	*Clangula hyemalis*	Possible	Late fall - early spring	Open water
Hooded merganser	*Lopyodytes mergus*	Probable	Late fall - early spring	Open water
Common merganser	*Mergus merganser*	Probable	Late fall - early spring	Open water
Red-breasted merganser	*Mergus serrator*	Confirmed	Late fall - early spring	Open water
Red-tailed hawk	*Buteo jamaicensis*	Possible	All year	Upland
Northern harrier	*Circus cyaneus*	Possible	All year	Marshes
Osprey	*Pandion haliaetus*	Possible	Summer	Over open water
Peregrine falcon	*Falco peregrinus*	Probable	All year	Over water and land
Merlin	*Falco columbarius*	Possible	Winter	Over water and land
American kestrel	*Falco sparverius*	Possible	All year	Over land
American coot	*Fulicia americana*	Possible	Summer	Marshes, tidal creeks and open water
Great black-backed gull	*Larus marinus*	Confirmed	All year	Open water
Herring gull	*Larus argentatus*	Confirmed	All year	Open water
Ring-billed gull	*Larus delawarensis*	Confirmed	All year	Open water
Laughing gull	*Larus atricilla*	Confirmed	Summer	Open water
Common tern	*Sterna hirundo*	Probable	Summer	Open water
Roseate tern	*Sterna dougallii*	Possible	Summer	Open water
Least tern	*Sterna albifrons*	Probable	Summer	Open water
Black skimmer	*Rynchops niger*	Possible	Summer	Open water, tidal creeks and rivers
Tree swallow	*Iridoprocne bicolor*	Probable	Summer	Over land and water
Barn swallow	*Hirundo rustica*	Probable	Summer	Over land and water
American crow	*Corvus brachyrynchos*	Confirmed	All year	Along shores and mudflats
Reptiles				
Loggerhead	*Caretta caretta*	Possible	Summer	Coastal waters
Kemp's ridley	*Lepidochelys kempii*	Possible	Summer	Coastal waters
Green sea turtle	*Chelonia mydas*	Possible	Summer	Coastal waters

areas in the Northeast and mid-Atlantic states where they overwinter (Bellrose 1980). The expected arrival in the Newark Bay area is dependent on species and winter conditions, which vary from year to year.

The northward migration from the NY/NJ estuary begins as early as February for some species, but for most occurs in March. Most canvasbacks, scaups, and buffleheads are found in large numbers in the New York/New Jersey estuary from late November through March (TI 1976).

3.07.1.2 Puddle Ducks. Puddle ducks breed and overwinter in the New York/New Jersey estuary. Mallards and black ducks are common nesters in this area, with occasional nesting by gadwall, green-winged teal, and blue-winged teal (Andrle and Carroll 1988). Overwintering species include gadwalls, black ducks, pintails, and mallards (TI 1976; LMS 1984a, 1984b, 1987).

Prior to the 1900s few mallards nested in the New York/New Jersey area. Increased numbers began to spread eastward across New York State at the same time reared mallards escaped and began breeding. Mallards took advantage of improved marshes created by NYSDEC (Cook 1957), accelerating their spread eastward and rapid habitation of new marshes. Mallards usually nest on the ground near ponds and wetlands where they feed. The nest is commonly found under bushes, in grassy weedy areas, in cattails, or in common reed (Bent 1923). The nests typically consist of a shallow depression well lined with vegetation and downy feathers (Bent 1923). The mallard now breeds commonly in the New York area (Andrle and Carroll 1988).

The American black duck was the most common duck breeding in New York (Eaton 1910). Numbers declined during the 1950s and 1960s; much of this decline was blamed on increasing populations of breeding mallards (Smith and Ryan 1978). The hybridization between mallards and black ducks is partially responsible for the decline (Andrle and Carroll 1988). Habitat loss, toxicants, excessive hunting, and acid rain have also been blamed for the decline (Andrle and Carroll 1988).

The black duck population using coastal saltmarsh habitat in the NY/NJ Harbor area has remained stable, while inland populations have declined (Bull 1974). The black duck breeds in a variety of habitats, from coastal saltmarshes and brackish tidal marshes to freshwater marshes, bogs, lakes, ponds, streams, and wetlands of inland hemlock and northern hardwood forests (Stewart 1958). Nests are found on the ground in dense vegetation, along the edges of wetlands, or along water (Andrle and Carroll 1988). The nest generally consists of a depression made by the hen and lined with vegetation and down (Andrle and Carroll 1988).

Both mallards and black ducks can be expected to use wetland habitat to the north of the project site in an area of dense emergents and shoreline debris; potential nesting habitat is found toward the northern end of the project site. At least one mallard was observed raising young in this area during 1995 (LMS 1996b).

The mallard nests and fledges young earlier than the black duck (Andrle and Carroll 1988). The mallard may raise two broods laying eggs between late March and early June, while the black duck lays one set of eggs from early April to mid- to late June. Unfledged young occur from late April through mid-August for the mallard and to mid-July for the black duck (Andrle and Carroll 1988). Young of both species fly at seven to eight weeks (Andrle and Carroll 1988).

At least three species of puddle ducks use Newark Bay and the New York/New Jersey estuary to overwinter: gadwalls, black ducks, and mallards, which were common species identified during the winter in the NY/NJ area (TI-1976; LMS 1984a, 1984b, 1987, 1996b). These species prefer marshes, bays, and estuaries for overwintering (Howe et al. 1978). As with diving ducks, their presence in the NBCDF area is dependent on availability of food and appropriate nesting and resting habitats (Howe et al. 1978).

3.07.1.3 Northern Diamondback Terrapin. The northern diamondback terrapin is reported in the Hackensack Meadowlands Complex of northern New Jersey (Wood 1995). No terrapins were collected in monthly bottom trawls conducted in Newark Bay from April 1995 to March 1996 (LMS 1996b). Terrapins prefer the shelter of sinuous creeks as opposed to the open water of sounds and bays (Wood 1995). Terrapins may occur in the project area as transients moving between the Hackensack Meadowlands Complex and marshes and tidal creeks to the south along the Arthur Kill.

Northern diamondback terrapins are year-round residents in marshes bordering estuaries and bays from Cape Cod, Massachusetts, to Cape Hatteras, North Carolina (NYSDEC 1993). Market hunting reduced their numbers during the early part of this century (Garber 1990). During the 1970s and 1980s, their numbers increased as a result of reduced market demand. A recent surge in market demand for terrapins may have an adverse impact upon populations (Garber 1990). Diamondbacks also appear to be a hardy species, tolerant of polluted waters (Wood 1995). Northern diamondback terrapin populations are considered stable in New York (NYSDEC 1993).

Terrapins are active from April through October and hibernate from November through March. Diamondback terrapins are sexually dimorphic; adult females are about 7.1 to 7.9 in. (18 to 20 cm) in length and adult males are about 4.3 to 5.1 in. (11 to 13 cm) (Wood 1995). They are highly aquatic and their cryptic behavior gives little indication of their presence. They are a diurnal turtle, preferring salt marshes, brackish water areas, and estuaries (NYSDEC 1993).

Terrapins are primarily carnivores, but will occasionally scavenge. Stomach analysis of individuals showed food items consisting of snails, crabs, marine annelids, mollusks, and other crustaceans (NYSDEC 1993). Some terrapins may take vegetable matter such as tender shoots and nuts of marsh plants (NYSDEC 1993).

Adult female terrapins are most visible during the nesting season, late may to early July (Wood 1995; NYSDEC 1993). Females search for nest sites above the high tide line

(Wood 1995). Nests are excavated in dunes, sandy hummocks, dike roads, and disturbed areas to a depth of 3.9 to 7.9 in. (10 to 20 cm). Nesting sites may be individual or colonial (NYSDEC 1993).

Eggs usually hatch in September after about 90 days of incubation (NYSDEC 1993). Hatchling carapace length is approximately 1.0 in. (25 mm) and the young resemble adults. Late hatchlings may enter hibernation immediately or shortly after emerging.

3.07.1.4 Shorebirds. A variety of shorebirds including plovers, woodcock, snipe, turnstones, sandpipers, yellowlegs, dunlin, and sanderling migrate through the Newark Bay/New York Harbor area. None of these shorebirds were observed using the CDF area during monthly surveys conducted between April 1995 and March 1996 (LMS 1996b). Most shorebirds prefer to feed in wet sand and mud (Clark and Gelvin-Innvaer 1995) in dewatered areas to areas having only a few inches of water. Water depth over the proposed NBCDF shoal areas seldom if ever reaches shallow depths suitable for shorebirds.

Shoreline areas adjacent to the NBCDF area include a mix of bulkheads, disturbed debris cluttered sandy intertidal and beach areas, and relatively undisturbed intertidal mud and mud shoreline. These areas provide marginal habitat for foraging and resting shorebirds. Any shorebirds using these areas for foraging would be 325 ft (100 m) or more outside the project area.

Some marginal nesting habitat for shorebirds, including spotted sandpiper, killdeer, and woodcock, might occur along the shorelines in the vicinity of the NBCDF project area. The most likely use of this area by shorebirds may be occasional rooftop nesting by a species such as killdeer. It is less likely that ground nesting would occur because of marginal habitat and potential predators such as rats, stray cats, and raccoon.

3.07.1.5 Gulls. Gulls forage and nest in Newark Bay and NY/NJ Harbor areas. Occasional nesting of herring gulls and black-backed gulls probably occurs near the NBCDF project area. These species are known to nest on Shooter's Island (Parsons 1994).

Several species of gulls, including herring, black-backed, ring-billed, laughing, and Bonaparte's, are known to rest and forage in Newark Bay (LMS 1996b; Parsons 1994). These species move about the area in search of food, including fish and invertebrates, many of which are dead or dying. Resting/roosting sites also include uplands, parking lots, and roofs of buildings. Foraging sites also include upland areas along shorelines and landfills containing discarded food.

3.07.1.6 Terns. Terns were not observed in the NBCDF or Newark Bay area during the April 1995 through March 1996 monthly surveys (LMS 1996b). The area provides suitable foraging habitat for terns including an abundance of forage species such as bay anchovy. Suitable nesting habitat is not present in the vicinity of the NBCDF project

area. The endangered least tern was reported nesting near the NBCDF project area during 1977 (Erwin and Korschgen 1979); it has not been recorded in Newark Bay since 1977 (see Section 3.11.1).

Other tern species, including common, least, gull-billed, roseate, and Forster's terns and an occasional black skimmer, have been confirmed as breeding on Long Island from 1980 to 1985, but none have been reported as possible breeding species on Staten Island just south of Newark Bay (Andrle and Carroll 1988).

3.07.1.7 Cormorants. Two species of cormorants, the double-crested and great, occur in the Newark Bay and New York Harbor area. Both cormorants forage on fish caught by diving from the surface of the water and swimming in pursuit (Terres 1980). The great cormorant is a winter resident, while the double-crested cormorant breeds locally and occurs in lower numbers during the winter (Bull 1974).

The double-crested cormorant is a colonial nester, preferring isolated undisturbed islands (Andrle and Carroll 1988). It has been confirmed nesting on Shooter's Island just south of the project area (Andrle and Carroll 1988). It is not expected to nest in areas nearer the project but has been observed foraging there (LMS 1996b).

The great cormorant is not a local nester and does not occur in the Newark Bay area during the breeding season; it is a winter resident (Bull 1974). Great cormorants may forage in the NBCDF area, but they were not observed during the 1995-1996 seasonal surveys (LMS 1996b).

3.07.1.8 Raptors. Two falcons, the American kestrel and the peregrine falcon nest near Newark Bay. Their occurrence in the project area would be related to foraging activity. The peregrine falcon is discussed in Section 3.11. The American kestrel is less likely to forage over water because it feeds mainly on small terrestrial vertebrates and invertebrates (Terres 1980).

Other raptors, including sharp-shinned, Cooper's, red-shouldered, and broad-winged hawks, are present during migratory periods, along with an occasional bald eagle and merlin. Osprey, northern harriers, and red-tailed hawks are more likely to forage in the Newark Bay area because they nest in the NY/NJ Estuary (Andrle and Carroll 1988). Osprey forage over water on fish, while northern harriers and red-tailed hawks forage in upland and wetlands, mostly on vertebrates (Terres 1980).

3.07.1.9 Rails and American Coot. Three species of rails (clapper, Virginia, and sora) and the American coot may breed in the general area of Newark Bay (Andrle and Carroll 1988). The rail species occur in marshes; while the American coot is the more aquatic member of the rail family (Terres 1980). Only the American coot might be found in the CDF project area. The rails remain in marshes and along creeks; they would not be expected to occur on the open water or shoreline near the project area.

3.07.1.10 Great Blue Heron and Green-Backed Heron. The green-backed heron may breed in the vicinity of Newark Bay (Parsons 1994; Andrle and Carroll 1988). The green-backed heron is usually a solitary nester but sometimes nests in small groups (Palmer 1962). At Shooter's Island the first breeding was recorded in 1982; since then breeding pairs have fluctuated between one and nine. Six pairs nested on Shooters Island in 1994 (Parsons 1994).

The great blue heron is considered a nonbreeding summer visitor to the coastal lowlands (Andrle and Carroll 1988). Only two possible nesting records for great blue heron were identified on Staten Island; none were identified on Long Island (Andrle and Carroll 1988). Great blue heron have not been recorded nesting on Shooter's Island since surveys began in 1974 (Parsons 1994).

Because of deep water, no wading bird species are expected to forage in the NBCDF project area. Of the two heron species, only the great blue heron can forage in deeper-water areas and sometimes uses open bays. The green-backed heron prefers tidal creeks and shorelines, where it can forage in more closed situations often using sticks or banks as forage platforms rather than standing in water (Palmer 1962).

3.07.1.11 Marine Turtles. Three of the seven species of marine turtles are known to inhabit the NY/NJ estuary on a regular basis: Kemp's ridley, loggerhead, and green (Schoelkopf and Stetzar 1995a; Durham, pers. commun., 1996). The three marine turtles migrate into the NY/NJ area in late May and remain until November, the loggerhead is the most common visitor followed by the Kemp's ridley and then the green, which is a more tropical species (Schoelkopf and Stetzar 1995a).

Although no nesting takes place as far north as New Jersey, juvenile marine turtles move inshore to bays, estuaries, and coastal areas, where they remain until reaching maturity generally after 10 years of age (Schoelkopf and Stetzar 1995a). Turtles forage on estuarine invertebrates and vegetation, crabs, in particular, attract foraging sea turtles to the estuary (Schoelkopf and Stetzar 1995a). Burke et al. (1990) found that over 75% of the diet of loggerhead turtles and Kemp's ridleys consisted of blue crabs, with the other 25% consisting of molluscs, algae, and natural debris.

In Chesapeake Bay, Keinath et al. (1987) found loggerheads and Kemp's ridleys partition the bay by water depth. Loggerheads tend to reside in deeper water and forage for their preferred prey, horseshoe crab, while Kemp's ridleys inhabitat the shallower areas in search of their preferred prey, blue crab. They found juvenile green turtles eat both invertebrates and aquatic vegetation and move into shallow water to feed during summer.

The possibility of any of these marine turtles entering Newark Bay is relatively remote. Juvenile sea turtles are late spring to fall visitors to Newark Bay (Schoelkopf, pers. commun., 1996). The loggerhead or Kemp's ridley could be attracted by the large number of blue crabs in Newark Bay; however, they would be considered uncommon visitors, and the green turtle as a rare visitor (Schoelkopf, pers. commun., 1996).

3.07.1.12 Marine Mammals. The possibility of cetaceans (whales, dolphins, porpoises) entering Newark Bay is relatively remote. However, some species of pinnipeds (seals), especially harbor seals, are possible any time of the year. Schoelkopf and Stetzar (1995b) report species commonly encountered in the Delaware Estuary include bottlenose dolphin, harbor porpoise, humpback whale, harbor seal, and gray seal. They report less commonly sighted species include pygmy sperm whale, long-finned pilot whale, fin whale, northern right whale, harp seal, hooded seal, and ringed seal.

It remains uncertain whether these species would enter the Kill Van Kull or Arthur Kill to obtain access to Newark Bay. Both the harbor seal and harbor porpoise are reported as uncommon visitors to Newark Bay (Schoelkopf, pers. commun., 1996).

3.08 BENTHOS

Benthos are defined as organisms attached to or resting on the bottom or living in the bottom sediments (Odum 1971). Benthic organisms are primarily filter-feeders and deposit feeders. Since the benthos are often sessile or relatively immobile, the benthic community reflects both habitat conditions and seasonal changes in space and time. Substrate type, such as soft sediments or hard surfaces (including pilings or rocks), is the habitat component that most affect species composition and distribution patterns. Other factors that affect the benthic community include physical factors (currents, wave action, and disturbance), chemical factors (DO, water temperature), and life history factors (primarily related to reproduction). The dependence of the benthic community on bottom sediments for food and shelter makes it extremely important in the evaluation of a project involving dredging and filling.

The benthic fauna of Newark Bay was surveyed during 1985, with samples collected at 30 stations, throughout the western and southern half of Newark Bay (the northern limit was Port Newark) and the Kill Van Kull in the vicinity of Shooters Island (USACE 1987a). Benthic sampling was conducted during the spring (Cerrato 1985) and summer (Chezik 1985) months, and included an equal number of sampling stations from shallow-water (7-18 ft, [2.1-5.5 m]) and deeper water (33-40 ft [10.1-12.2 m]) stations. A listing of benthic fauna by sampling month identified in the Newark Bay samples, along with the dominant species designated, is presented in Table 3.08-1. In general, greater numbers of species and higher abundances were recorded during the summer sampling month, with a significant difference ($\alpha = 0.5$) noted for the shallow-water-depth stations.

Overall benthic organism abundances in Newark Bay were classified as moderate. The Newark Bay benthic community was dominated by polychaete worms, which are habitat generalists and exhibit high tolerance to environmentally stressful conditions such as low DO levels. Two polychaete worms - *Streblospio benedicti, Sabellaria vulgaris,* and the soft clam *Mya arenaria* - were dominant during both the spring and summer periods. Three different polychaete worm species - *Scolecolepides viridis, Nereis succinea,* and *Polydora ligni* - were dominant in the spring, being replaced by *Spio setosa* (polychaete), *Balanus improvisus* (barnacle), and *Molgula manhattensis* (tunicate) during the summer. There was a high degree of variability in individual species abundance levels between the shallow- and deepwater stations; however, there was no significant difference detected in abundance or species representation between the two habitat types. Physical and chemical parameters measured during these studies included water temperature, salinity, and DO. All three parameters were similar at the shallow- and deepwater stations and it was concluded that none of the three was limiting to the development of the benthic community. Stations characterized by fine-grained sediments (silt and clay) exhibited lower species numbers and lower overall abundance. The moderate organism abundance and generally low species diversity in the benthos suggest that Newark Bay is a stressed environment that restricts the development of the benthic community.

TABLE 3.08-1 (Page 1 of 3)

NEWARK BAY/KILL VAN KULL BENTHOS SURVEY

1985

TAXONOMIC LISTING	MAY	AUGUST
CNIDARIA		
ANTHOZOA		
METRIDIIDAE		
Metridium senile	X	X
HYDROZOA		
HYDRACTINIIDAE		
Hydractinia sp.		X
TUBULARIIDAE		
Tubularia sp.		X
ASCHELMINTHES		
Nematoda sp.	X	X
RHYNCHOCOELA		
Nemertea sp.	X	
ANNELIDA		
OLIGOCHAETA		
Oligochaeta sp.		X
POLYCHAETA		
AMPHARETIDAE		
Asabellides oculata	X	
CAPITELLIDAE		
Capitella capitata		X
Capitellidae sp.	X	X
CIRRATULIDAE		
Tharyx acutus	X	X
CLYCERIDAE		
Glycera americana		X
Glycera capitata	X	
Glycera dibranchiata	X	X
Glycera sp.	X	X
MAGELONIDAE		
Magelona rioja	X	
MALDANIDAE		
Clymenella sp.	X	X
Maldanidae sp.	X	X
NEPHTYIDAE		
Nephtys incisa		X
Nephtys sp.		X
NEREIDAE		
*Nereis succinea**	X	X
Nereis sp.		X
PECTINARIIDAE		
Pectinaria gouldii	X	X
PHYLLODOCIDAE		
Eteone heteropoda	X	X
POLYNOIDAE		
Harmothoe extenuata	X	
Lepidonotus squamatus	X	X
Polynoidae sp.		X

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TABLE 3.08-1 (Page 2 of 3)

NEWARK BAY/KILL VAN KULL BENTHOS SURVEY

1985

TAXONOMIC LISTING	MAY	AUGUST
SABELLARIIDAE		
*Sabellaria vulgaris**	X	X
SABELLIDAE		
Fabricia sabella		X
SERPULIDAE		
Hydroides dianthus		X
SPIONIDAE		
*Polydora ligni**	X	X
Scolelepis squamata	X	
*Scolecolepides viridis**	X	X
*Spio setosa**		X
*Streblospio benedicti**	X	X
ARTHROPODA		
CRUSTACEA		
CIRRIPEDIA		
BALANIDAE		
*Balanus improvisus**		X
Balanus sp.	X	X
CAPRELLIDEA		
CAPRELLIDAE		
Caprella sp.		X
CUMACEA		
Oxyurostylis smithi	X	X
AMPHIPODA		
AORIDAE		
Lembos smithi	X	
Unciola irrorata	X	
CHOROPHIIDAE		
Corophium acherusicum	X	X
Corophium sp.		X
Erichthonius brasiliensis	X	
MELITIDAE		
Melita nitida	X	X
Melitidae sp.	X	X
ISOPODA		
ANTHURIDAE		
Cyathura polita	X	X
IDOTEIDAE		
Edotea montosa	X	X
MYSIDACEA		
MYSIDAE		
Neomysis americana		X
DECAPODA		
CRANGONIDAE		
Crangon septemspinosa		X
XANTHIDAE		
Rhithropanopeus harrisii	X	X
MOLLUSCA		

TABLE 3.08-1 (Page 3 of 3)

NEWARK BAY/KILL VAN KULL BENTHOS SURVEY

1985

TAXONOMIC LISTING	MAY	AUGUST
GASTROPODA		
CALYPTRAEIDAE		
Crepidula plana		X
NASSARIIDAE		
Ilyanassa obsoletata		X
Nassarius trivittata	X	
BIVALVIA		
MACTRIDAE		
Mulinia lateralis	X	X
Spisula solidissima		X
MYIDAE		
*Mya arenaria**	X	X
MYTILIDAE		
Mytilus edulis	X	X
OSTREIDAE		
Crassostrea virginica		X
SOLENIDAE		
Ensis directus		X
TELLINIDAE		
Tellina agilis	X	X
ECTOPROCTA		
GYMNOLAEMATA		
CHEILOSTOMATA		
CALLOPORIDAE		
Callopora sp.		X
ELECTRIDAE		
Electra sp.		X
MEMBRANIPORIDAE		
Conopeum reticulum	X	X
Membranipora tenuis		X
CTENOSTOMATA		
VESICULARIDAE		
Bowerbankia sp.		X
CHORDATA		
ASCIDIACEA		
PLEUROGONA		
MOLGULIDAE		
*Molgula manhattensis**	X	X

*Dominant species.
Source: USACE 1987b.

Twenty-five stations (18 channel stations and seven shallow-water stations) located in the northern and central sections of Newark Bay were sampled for benthic macroinvertebrates during 1993 and 1994 (NOAA 1994). Bottom sediments at the northern end of the Bay in the vicinity of the mouth of the Passaic River consisted primarily of soft, black, silty clay; north of the two bridges the bottom sediments were soft with varying amounts of gravel, shell, sand, silt, and clay. South of the bridges the bottom sediments in both the channel and shoal stations were light, soft, silt and clay, with some shell fragments. Channel stations located opposite Port Elizabeth usually contained lumps of thick, hard, red clay. Sample collection information, including designation of dominant species, is presented in Table 3.08-2. As noted for the benthic study conducted during 1985, the benthos at both shallow-water and channel stations were similar in species composition (dominated by polychaete worms) and exhibited similar seasonal abundance patterns. The Newark Bay benthic community was determined to have lower overall abundance and lower species diversity when compared to the benthos of Upper New York Harbor.

Lawler, Matusky & Skelly Engineers LLP (LMS) conducted a Newark Bay benthic sampling program for the Port Authority from April 1995 through March 1996. Seven stations were sampled: five of the stations were in Newark Bay and included stations in the immediate vicinity of the proposed NBCDF sites. Two of the stations were outside Newark Bay; one was near the Bayonne Bridge and the second was near the Goethals Bridge. All seven stations were sampled on a monthly schedule (Figure 3.08-1) (LMS 1996b). Benthic samples were collected using a 9.0 x 9.0-in. (23-cm x 23-cm) Ponar grab sampler at shallow water stations (maximum station depth = 4 ft [1.2 m]), with station conditions generally characteristic of recently undisturbed sediments. Total abundance by species for the five Newark Bay stations is presented in Table 3.08-3, and monthly abundance by species for all stations combined over the 12-month study period is presented in Table 3.08-4.

The Newark Bay benthos was dominated by polychaete worms. Six species of polychaete worms were among the ten most abundant species identified in Newark Bay sediment samples. The dominant species collected was the polychaete worm *Scolopios* sp., which accounted for 28.5% of the total. The five other polychaete worms ranked in the top 10 were *Streblospio benedicti* (ranked 2, 23.7% of the total), *Personidae* spp. (ranked 4, 7.0% of the total), *Phyllodocidae* spp. (ranked 8, 1.7% of the total), *Glycera* sp. (ranked 9, 1.7% of the total), and *Polydora ligni* (ranked 10, 1.6% of the total). The other species accounting for the top 10 by abundance included: two bivalves, *Mulinia lateralis* (ranked 3, 15.4% of the total), and *Mya arenaria* (ranked 6, 4.4% of the total); the estuarine isopod *Cyathura polita* (ranked 5, 5.8% of the total); and the cumacean *Oxyurostylis smithii* (ranked 7, 1.9% of the total). Species composition and abundance patterns were similar among the five Newark Bay stations. The greatest abundance and species representation was noted during the late winter-early spring period, and the lowest abundance and species representation was noted during the summer months.

Seasonal benthic sampling was conducted as part of an environmental assessment study related to the addition of a second bridge span across the Arthur Kill at several stations

Table 3.08-3

BENTHIC INVERTEBRATE TAXA COLLECTED FROM NEWARK BAY, ARTHUR KILL, KILL VAN KULL, AREAS 1995

NUMBER PER 0.05 SQUARE METER

Station Appx. Depth at MLW	NBSW (N) 1-2' TOTAL	NBSW (S) 1-2' TOTAL	NBNW 1-4' TOTAL	NBSE 1-3' TOTAL	NBNE 1-2' TOTAL	ALL NEWARK BAY STATIONS TOTAL	PERCENT COMP.
SPECIES COLLECTED							
RHYNCHOCOELA							
Nemertea	15	7	5	8	21	56	1.30
ANNELIDA							
Oligochaeta	6	1			3	10	0.23
Polychaeta							
Phyllodocidae	12	13	28	9	15	77	1.78
Phyllodoce mucosa							
Glyceridae							
Glycera sp.	24	11	9	20	9	73	1.69
Glycera dibranchiata	1	2	1		1	5	0.12
Goniadidae	3	1	1			5	0.12
Pectinariidae							
Pectinaria gouldii	2	2	5	9	8	26	0.60
Nereidae							
Nereis succinea	8	14	15	3	13	53	1.23
Opheliidae	12					12	0.28
Paraonidae	45	38	156	38	31	308	7.13
Spionidae							
Scolecolepidis viridis		1	1		1	3	0.07
Streblospio benedicti	105	268	442	161	73	1049	24.27
Polydora ligni	17	5	8	36	3	69	1.60
Spiophanes bombyx							
Orbiniidae							
Scoloplos sp.	297	464	196	157	147	1261	29.18
Sabellariidae							
Sabellaria vulgaris							
Onuphidae							
Diopatra cuprea							
Eunicidae							
Eunice norvegica							
Nephtydae							
Nephtys sp.							
Capitellidae						1	0.02
Capitella capitata	1			2		2	0.05
Ampharetidae							
Hypaniola grayi							
Sabellidae					1	1	0.02
Sabella sp.							
Sabella micropthalma					2	2	0.05
Cirratulidae							
Hesionidae							
Podarke sp.							
Polynoidae							
Lepidonotus squamatus							
MOLLUSCA							
Bivalvia							
Mercenaria mercenaria							
Mya arenaria	55	66	63	4	8	196	4.53
Mulinia lateralis	7	8	50	85	531	681	15.76
Tellina sp.	6	21	4	10	10	51	1.18
Lyonsia hyalina		1				1	0.02
Mytilus edulis							
Macoma sp.							
Gastropoda							
Crepidula fornicata							
Crepidula plana							
Retusa sp.				1		1	0.02
Haminoea solitaria		2	10	1	1	14	0.32
Epitonium sp.							
ARTHROPODA							
Isopoda							
Cyathura polita	45	73	30	50	56	254	5.88
Edotea triloba			2		2	4	0.09
Limnoria lignorum							
Cumacea							
Leucon americanus	13		24	10	1	48	1.11
Oxyurostylis smithii							
Amphipoda	1				3	4	0.09
Ampeliscidae							
Ampelisca sp.	2		1	2		5	0.12
Ampelisca abdita	2	4		15	1	22	0.51
Corophidae							
Corophium Sp.							
Gammaridae							
Gammarus sp.	1	1	2	4		8	0.19
Gammarus mucronatus				2		2	0.05
Aoridae							
Unciola dissimilis					1	1	0.02
Melitidae							
Melita sp.							
Melita nitida							
Thoracica							
Balanus sp.					2	2	0.05
Caridea							
Crangon septemspinosus		2			1	3	0.07
Brachyura							
Portunidae							
Callinectes sapidus			2			2	0.05
Xanthidae							
Rhithropanopeus harrisii					3	3	0.07
Neopanope texana sayi							
Europanopeus depressus							
CHORDATA							
Molgula manhattensis			5	1	1	7	0.16
Total	680	1005	1060	628	949	4322	100.00

Table 3.08-4

BENTHIC INVERTEBRATE TAXA COLLECTED FROM NEWARK BAY, ARTHUR KILL, KILL VAN KULL, AREAS 1995

NUMBER/ 0.56 SQUARE FEET

Station Date	TOTAL ALL STATIONS (5 Newark Bay; 2-Channel Site) APR 1995	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN 1996	FEB	MAR	TOTAL	PERCENT COMP.
SPECIES COLLECTED														
RHYNCHOCOELA														
Nemertea	4	33	6	1		3	1	3		2	1	6	60	0.35
ANNELIDA														
Oligochaeta	18	31		32			2	14	6		25	49	177	1.04
Polychaeta														
Phyllodocidae	161	164	2	3		9	3	8	13	5	13	59	440	2.59
Phyllodoce mucosa	1												1	0.01
Glyceridae												5	5	0.03
Glycera sp.		16	18	8		13	25	21	19	13			133	0.78
Glycera dibranchiata	2				3								5	0.03
Goniadidae	12	2			2	9	1						26	0.15
Pectinariidae														
Pectinaria gouldii	1				1	16	6	2	9	1	5	10	51	0.30
Nereidae														
Nereis succinea	15	31	13	1		15	4		9	4	4	35	131	0.77
Opheliidae		17		12									29	0.17
Paraonidae	88	141	61	91	4	55	37	17	37	12	133	153	829	4.88
Spionidae		1											1	0.01
Scolecolepidis viridis	5	35	3			1					1		45	0.26
Streblospio benedicti	2298	3614	88	102		46	77	186	476	168	648	1104	8807	51.83
Polydora ligni	20	36	9	4		34	5	2	19	12	8	13	162	0.95
Spiophanes bombyx	1												1	0.01
Orbiniidae														
Scoloplos sp.	244	336	174	206	31	97	50	46	88	119	93	92	1576	9.28
Sabellariidae														
Sabellaria vulgaris						417	18			44	26	1721	2226	13.10
Onuphidae														
Diopatra cuprea									10	9	1	3	23	0.14
Eunicidae														
Eunice norvegica					2	10	6		1				19	0.11
Nephtydae														
Nephtys sp.								1					1	0.01
Capitellidae														
Capitella capitata						7							7	0.04
Ampharetidae						2						12	14	0.08
Hypaniola grayi									1				1	0.01
Sabellidae														
Sabella sp.						7			1				8	0.05
Sabella micropthalma												3	3	0.02
Cirratulidae									2				2	0.01
Hesionidae														
Podarke sp.						2							2	0.01
Polynoidae														
Lepidonotus squamatus							1				1		2	0.01
MOLLUSCA														
Bivalvia													1	0.01
Mercenaria mercenaria		1												
Mya arenaria	91	180	55	6	6	2	1		3	3	13	69	429	2.52
Mulinia lateralis	10	14	1	1	39	137	96	51	122	152	151	87	861	5.07
Tellina sp.	7	17	18	11			1	11				3	68	0.40
Lyonsia hyalina	1												1	0.01
Mytilus edulis	1	1											2	0.01
Macoma sp.												2	2	0.01
Gastropoda														
Crepidula fornicata						2	1				1		4	0.02
Crepidula plana						9	1			1	1		12	0.07
Retusa sp.		1											1	0.01
Haminoea solitaria		1	1			4	1	3	5				15	0.09
Epitonium sp.											1		1	0.01
ARTHROPODA														
Isopoda														
Cyathura polita	51	83	25	25	11	8	18	7	9	8	11	7	263	1.55
Edotea triloba	22	16				2	4	3	12	1	4	4	68	0.40
Limnoria lignorum						1					1	1	3	0.02
Cumacea														
Leucon americanus	48	18	1				1	6	2		20	7	103	0.61
Oxyurostylis smithii	2	2											4	0.02
Amphipoda	6	47											53	0.31
Ampeliscidae												3	3	0.02
Ampelisca sp.								3	2				5	0.03
Ampelisca abdita	13	7	1					1		6	9	1	38	0.22
Corophiidae				6									6	0.04
Corophium Sp.		1							17	1	4		23	0.14
Gammaridae		3										40	43	0.25
Gammarus sp.		1	5		1					1	3		11	0.06
Gammarus mucronatus	2												2	0.01
Aoridae	0	107											107	0.63
Unciola dissimilis	1												1	0.01
Melitidae														
Melita sp.							4						4	0.02
Melita nitida						10	2		3				15	0.09
Thoracica														
Balanus sp.									2		9		11	0.06
Caridea														
Crangon septemspinosus		2						2		1	2		7	0.04
Brachyura														
Portunidae														
Callinectes sapidus									1			2	3	0.02
Xanthidae												4	4	0.02
Rhithropanopeus harrisii		2				1			1			1	5	0.03
Neopanope texana sayi												1	1	0.01
Europanopeus depressus											1		1	0.01
CHORDATA														
Molgula manhattensis	15				1	3			1		1	2	23	0.14
Total	3140	4961	481	509	101	922	366	387	871	563	1191	3499	16991	100.00

Table 3.09-1 (Page 1 of 2)

Summary of sediment criteria

Parameter	ERL[a]	ERM[b]	Acute Toxicity (ug/gOC)[c]	Chronic Toxicity (ug/gOC)[d]	LEL (ug/g)[e]	SEL (ug/g)[f]
Trace Elements (ppm)						
Antimony	2	25			2.0	25.0
Arsenic	33	85			6.0	33.0
Cadmium	5	9			0.6	9.0
Chromium	80	145			26.0	110.0
Copper	70	390			16.0	110.0
Iron (%)					2.0%	4.0%
Lead	35	110			31.0	110.0
Managanese					460.0	1100.0
Mercury	0.15	1.3			0.15	1.3
Nickel	30	50			16.0	50.0
Silver	1	2.2			1.0	2.2
Tin	NA	NA				
Zinc	120	270			120.0	270.0
Polychlorinated Biphenyls (ppb)						
Total PCBs	50	400	13803.8	41.4		
DDT and Metabolites (ppb)						
DDT	1	7	130	1.0		
DDD	2	20				
DDE	2	15				
Total DDT	3	350				
Other Pesticides (ppb)						
Lindane	NA	NA				
Chlordane	0.5	6	0.05	0.002		
Heptachlor	NA	NA	1.3	0.09		
Endosulfan			0.12	0.004		
Dieldrin	0.02	8		17.0		
Aldrin	NA	NA				
Endrin	0.02	45		0.73		
Mirex	NA	NA		0.7		
Malathion				0.02		
Methoxychlor				0.6		

Table 3.09-1 (Page 2 of 2)

Summary of sediment criteria

Parameter	ERL[a]	ERM[b]	Acute Toxicity (ug/gOC)[c]	Chronic Toxicity (ug/gOC)[d]	LEL (ug/g)[e]	SEL (ug/g)[f]
PAHs (ppb)						
Acenapthene	150	650		240		
Anthracene	85	960				
Azinphosmethyl				0.003		
Benzo(a)anthracene	230	1600				
Benzo(a)pyrene	400	2500				
Benzo(e)pyrene	NA	NA				
Benzidine			0.003	0.003		
Biphenyl	NA	NA				
Chrysene	400	2800				
Dibenz(a,h)anthracene	60	260				
Dichlorobenzenes			120.0	12.0		
2,6-dimethylinaphthylene	NA	NA				
Fluoranthene	600	3600		1340		
Fluorene	35	640				
Hexachlorobutadiene			16.4	1.6		
Hexachlorocyclohexanes			1.0	0.03		
Hexachlorocyclopentadiene			6.8	0.7		
1-methylnaphthalene	NA	NA				
2-methylnaphthalene	65	670				
1-methylphenanthrene	NA	NA				
Naphthalene	340	2100				
Perylene	NA	NA				
Phenanthrene	225	1380		160		
Pyrene	350	2200				
2,3,5,-trimethylnaphthalene	NA	NA				
Toxaphene			0.14	0.01		
Trichlorobenzenes			910	91		
Total PAH	4000	35000				

[a]Long and Morgan (1990). ERL - Effects range low. Sediment criteria units located in first column unless otherwise noted.
[b]Long and Morgan (1990). ERM - Effects range medium. Sediment criteria units located in first column unless otherwise noted.
[c]NYSDEC (1993). Marine sediment criteria for benthic aquatic life.
[d]NYSDEC (1993). Marine sediment criteria for benthic aquatic life.
[e]NYSDEC (1993). LEL - Lowest effect level.
[f]NYSDEC (1993). SEL - Severe effect level.

More recently, Bonnevie et al. (1993) and Huntley et al. (1993) identified a number of contaminants that exceeded the ERL and ERM concentrations in sediment samples from the lower Passaic River, lower Hackensack River, and Newark Bay. Contaminants in exceedance included total PAHs, mercury, lead, and zinc.

Long et al. (1995) also reported relatively high toxicity levels in Newark Bay and the Arthur Kill in comparison to the surrounding estuary. In a 1995 Technical Memorandum (National Status and Trends Program), NOAA reported that 48 of 57 samples collected from Newark Bay and vicinity were significantly toxic to amphipods in flow-through bioassay tests. Amphipod survival was very low in most samples from the lower Passaic River, much of Newark Bay, and most samples from the northern reaches of the Arthur Kill. Toxicity to amphipods was correlated with concentrations of PCBs, dioxins, and pesticides measured in sediment samples from the lower Passaic River, Newark Bay and vicinity. These concentrations often exceeded effects-based guidelines or toxicity thresholds (Long et al. 1995).

While high sediment concentrations of contaminants can pose a hazard to benthic organisms and other aquatic resources by virtue of bioaccumulation and foodchain transport, Squibb et al. (1991) also noted that larval and juvenile stages of fish and shellfish are particularly sensitive to water column concentrations of metals.

Aquatic resources may become exposed to toxic contaminants in sediments and the water column in a variety of ways, including bioconcentration, ingestion, diffusion, and trophic transfer. The uptake of toxic contaminants may occur from fine-grained sediment particles to bivalve molluscs, polychaete worms, amphipods, crabs, and finfish. Zongwei et al. (1994) examined the uptake of dioxin by blue crabs from sediments in Newark Bay and hypothesized that food chains and food organisms may be more important than sediments as immediate sources of dioxin found in blue crabs tissues. Zongwei et al. (1994) noted that prey items, such as the bivalve mollusc *Mya arenaria*, have been shown to concentrate dioxins in their body tissue.

Benthic invertebrates are the primary food source of many fishes, particularly juveniles and species that are small as adults. Piscivorous fishes have an abundance of prey in the juveniles of many fish species and forage species such as killifish, silversides, bay anchovy, and menhaden. These prey species rely on planktonic forms and small invertebrates for food, which in turn have a food source originating with organic detritus or particulate matter.

Existing elevated contaminant concentrations and toxicity may pose adverse biological effects to the aquatic resources of Newark Bay and the study area in a variety of ways. Major categories of toxicant-associated biological effects reported for the estuary include:

- Changes in resident microbial communities
- Alterations and shifts in phytoplankton community structures

- Reduced densities and species diversity of benthic communities
- Increased occurrence of fin erosion and other diseases in bottom-dwelling fish
- Increased occurrence of tumors and other histopathological disorders of bottom-dwelling fish
- Increased occurrence of a variety of diseases in crabs, lobsters, and shrimp
- Tissue contamination of fish and shellfish
- Increased resistance of resident killifish and soft-shelled clams to the effects of subsequent doses of toxicants

Additional effects that are believed to be caused by toxic contamination include reproductive impairment in fish-eating birds, behavioral impairments, and altered life histories.

Elevated concentrations of contaminants, particularly PCBs and certain pesticides, in finfish from the estuary have resulted in NJDEP issuing commercial fishing bans and recreational fishing advisories for Newark Bay and the surrounding waterways. Recommendations to limit consumption are in effect for striped bass, bluefish, white perch, white catfish, American eel, and blue crab for the entire Newark Bay complex. Commercial sale of striped bass, American eel, and blue crab taken from Newark Bay is prohibited.

The advisories range from no consumption (striped bass and blue crab) to consumption rates of no more than one meal per week (American eel, bluefish, white perch, and white catfish). The most restrictive consumption advisories apply to those segments of the population most at risk, including pregnant women, nursing mothers, infants, children under 15, and women of childbearing age.

Additional information on aquatic resource contamination can be found in Section 3.16, Human Health.

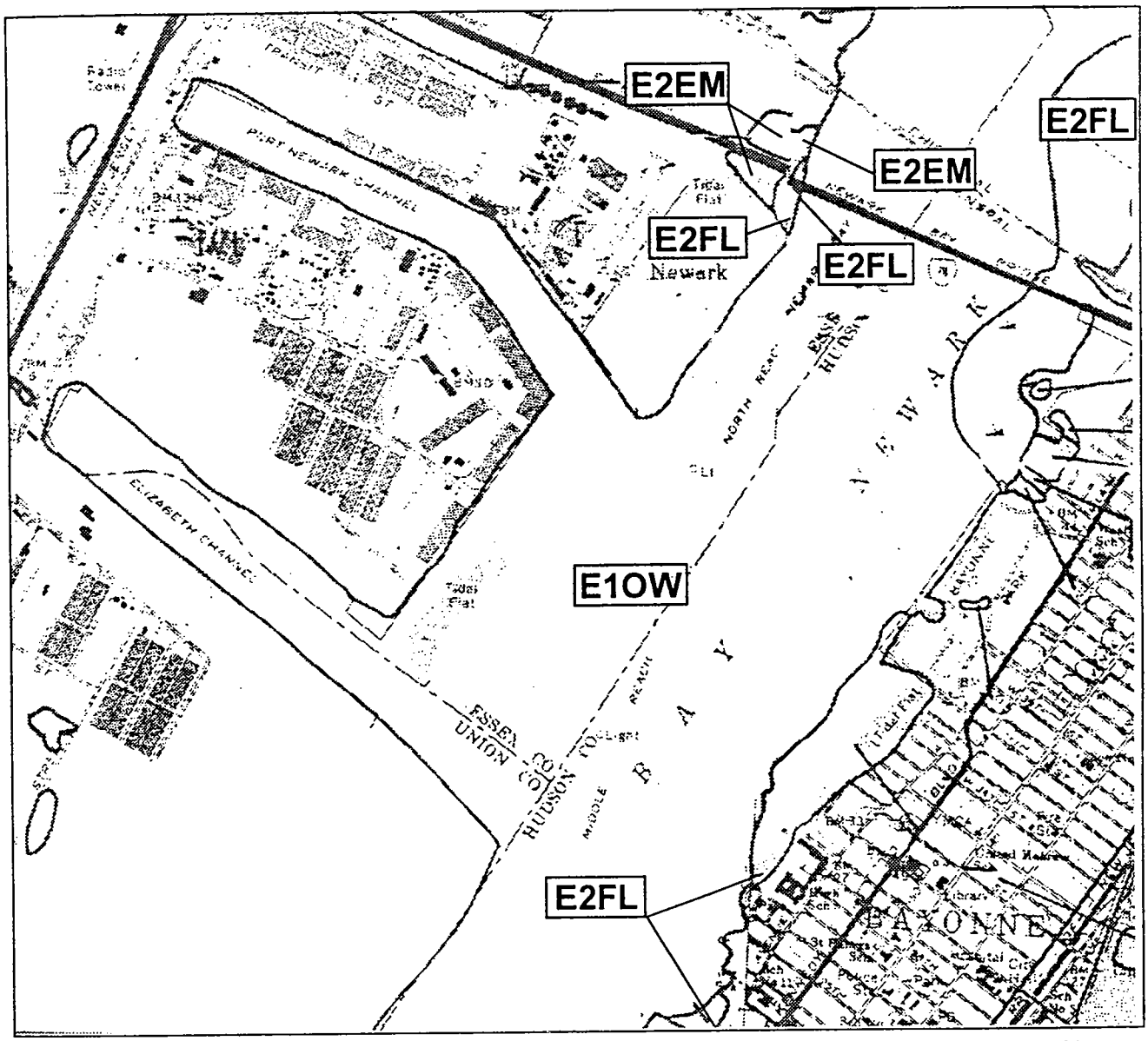
3.10 WETLANDS

No vegetated or emergent wetlands are present within Areas 1 and 2, the areas of Newark Bay proposed for development of the NBCDF. A small area, approximately 6 acres in size located adjacent to the west side of the Newark Bay Bridge (Figure 3.10-1) and north of the northern portion of proposed NBCDF Area 2, has been mapped as emergent, intertidal, vegetated wetland. The evaluation of Newark Bay wetlands consisted of review of the regional National Wetlands Inventory (NWI) maps (Elizabeth and Jersey City, New Jersey, quadrangles), review of the regional NOAA navigation charts (Nos. 12333 and 12337), review of the threatened and endangered species area listing, and interviews with regional agency staff responsible for wetlands identification and protection.

Virtually the entire study area of Newark Bay is mapped by NWI as estuarine, subtidal, open water, unknown substrate wetlands (E1OW). This designation is used for areas that are not exposed by tidal action and are generally unvegetated. Navigation charts were reviewed for information on substrate types; the charts indicated either a "hard" (fine gravel and/or sand) or "sticky" (clay and/or organic substrate) bottom material. In general, areas subject to tidal currents (channel areas) feature sand or clay substrates, while shallows or backwaters where current velocities are minimal generally feature soft mud or organic substrates.

One discrepancy was noted on the Elizabeth, New Jersey, NWI map with regard to wetland designation. An area north of the Elizabeth Channel entrance is noted as "tidal flat" on the map but is not mapped as an intertidal wetland. Conversations with agency personnel (Dr. Marc Helman, USACE, and Larry Baier, NJDEP Essex County) indicated the area in question is only exposed under unusual conditions (e.g., north wind coupled with a spring low tide or full moon low tide) and thus, is not mapped as an intertidal wetland. A review of the bathymetric map indicates that the bottom over this area is from 5 to 7 ft (1.5 to 2.1 m) below MLW. It is probable that seasonally abundant (migratory) waterfowl may feed in this area. Typical species that might be present include the canvasback, greater and lesser scaup, and bufflehead. All four species are diving ducks that feed on marine invertebrates, such as amphipods, clams, snails, and worms. The area may be used by some species of shallow-water forage fish, such as mummichogs, killifish, or silversides. The area's attractiveness to these species may be diminished by its isolation by deep (32 to 40 ft [9.8 to 12.2 m] at MLW) water on all sides, which may discourage movement by these species to the shallow zone.

A large expanse of "estuarine, intertidal flat" (E2FL) is mapped by NWI on the east side of Newark Bay east of the proposed NBCDF sites and the Federal navigation channel. These flats are located along the Bayonne waterfront and north and south of the Newark Bay Bridge. A review of the NOAA navigation chart indicates a tidally exposed area south of Hudson County Park, with MLW depths of 1 ft (0.3 m) or less. These mapped flats are exposed by daily tidal cycles. Several wrecks and "numerous snags and



Sources: National Wetland Inventory Maps:
Jersey City and Elizabeth, NJ, Quads, 1976.

LEGEND	
E2EM	Estuarine, intertidal, emergent vegetation
E2FL	Estuarine, intertidal, flat
E1OW	Estuarine, subtidal, open water

Figure 3.10-1

U.S. Army Corps of Engineers
Newark Bay Confined Disposal Facility

National Wetland Inventory-Mapped Wetlands in the Project Vicinity

obstructions" are also cited in the area between Hudson County Park and the Newark Bay Bridge.

Estuarine flats are tidally exposed, unvegetated expanses of mud, fine sand or clay; typical man-made components often observed include glass and/or brick fragments. Pilings, logs, and pieces of metal are typically scattered on the mudflats; these objects provide cover for benthic organisms such as mud crabs and polychaete worms and habitat for sessile organisms such as barnacles and mussels. Estuarine mudflats are important feeding areas for shorebirds such as herons, egrets, and sandpipers. The presence of heron and egret roosting and rookery areas (Shooters Island, Pralls Island) south of the study area in the Arthur Kill corridor was documented in LMS correspondence with the New Jersey Natural Heritage Program for Hudson County as part of the endangered/ threatened species file search. It is possible that human disturbance, wakes caused by boat traffic, and water depth may limit use of the mudflats as a feeding area by herons and egrets.

An area north of proposed NBCDF site 2N, on the west side of Newark Bay (adjacent to the west side of the Newark Bay Bridge), is mapped by NWI as "estuarine, intertidal, emergent vegetation wetland" (E2EM). The type of vegetation present in the area is not discernable from available aerial photographs. Based on prior LMS studies in the vicinity, the vegetation is either common reed or saltmarsh cordgrass. Typically, the saltmarsh cordgrass occupies the more frequently inundated, lower-elevation portions of the vegetated marsh, while the reed grass occupies the less frequently inundated areas. Reed grass is viewed as an invasive species with less value to wildlife than saltmarsh cordgrass. Contact with NJDEP personnel (Mr. Lou Cattuna, pers. commun.) indicated that their office had no site-specific information on this wetland.

3.11 ENDANGERED AND THREATENED SPECIES

The following Federal and state agencies were contacted regarding the potential presence of any species of special status known to occur within the immediate vicinity of the proposed NBCDF: U.S. Fish and Wildlife Service (USFWS), National Marine Fisheries Service (NMFS), New Jersey Natural Heritage Program (NJNHP), and the NJDEP Division of Fish, Game and Wildlife.

Newark Bay is located within the borders of Essex, Hudson, and Union counties, New Jersey. Rare species information for the three counties encompassing Newark Bay was provided by NJDEP's Natural Heritage Program (Breden, pers. commun., 1995). Vertebrate, invertebrate, and plant species and their status are listed on Table 3.11-1. An explanation of the Federal and state status code are presented at the end of the table. None of these species have been documented or observed in the NBCDF area.

The USFWS indicates that the proposed NBCDF is within 5 miles (8 km) of three peregrine falcon (*Falco peregrinus*) nesting sites (Staples, pers. commun., 1995). The nest sites are located on the Goethals Bridge, Bayonne Bridge, and adjacent to the General Pulaski Skyway in Kearny. Except for the peregrine falcon and an occasional transient bald eagle (*Haliaeetus leucocephalus*), no other Federally listed or proposed threatened or endangered flora or fauna under USFWS jurisdiction are known to occur in the vicinity of the NBCDF.

NJNHP lists 14 vertebrate species (two amphibians, 10 birds, and two reptiles) as threatened and/or endangered in Essex, Union, and Hudson counties. One invertebrate species, the American burying beetle, is listed, with the listing limited to Essex County. Eighteen vascular plants are listed in the vicinity of Newark Bay, with all of the listed species determined to be endangered. No Federally listed species are indicated by NJNHP to be present in the three New Jersey counties bordering Newark Bay.

The NMFS suggests that the species found in Newark Bay are typical of those species found throughout the Hudson-Raritan Estuary, with no indication of any Federally listed threatened or endangered species recorded from the Bay (Gorski, pers. commun., 1995). As Newark Bay is part of the New York/New Jersey Harbor Complex with direct connections to the Atlantic Ocean, several marine species of special concern could possibly be present in Newark Bay. The list presented by NMFS of marine species that could be present in Newark Bay as a result of their presence in the Atlantic Ocean off the New York/New Jersey coast is presented below:

Table 3.11-1 (Page 1 of 2)

Species of Special Status Documented in Essex, Hudson, and Union Counties, New Jersey

Common Name	Scientific Name	Status Code	
		Federal	New Jersey
Vertebrates			
Blue-spotted salamander	*Ambystoma laterale*		E
Longtail salamander	*Eirucea longicauda longicauda*		T
Barred owl	*Strix varia*		T/T
Bobolink	*Dolichonyz oryzivorus*		T/T
Cooper's hawk	*Accipiter cooperii*		E
Grasshopper sparrow	*Ammodramus savannarum*		T/T
Least tern	*Sterna antillarum*		E
Pied-billed grebe	*Podilymbus podiceps*		E/S
Red-shouldered hawk	*Buteo lineatus*		E/T
Savannah sparrow	*Passerculus sandwichensis*		T/T
Sedge wren	*Cistothorus platensis*		E
Upland sandpiper	*Bartramia longicauda*		E
Bog turtle	*Clemmys muhlenbergii*	C2	E
Wood turtle	*Clemmys insculpta*		T
Invertebrates			
American burying beetle	*Nicrophorus americanus*	LE	E
[Moth]	*Papaipema aerata*	C2	
Vascular Plants			
Basil bee-balm	*Monarda clinopodia*		E
Canada hawkweed	*Hieracium kalmii*		E
Canada violet	*Viola canadensis*		E
Cyrerus-like sedge	*Carex pseudocyperus*		E
Downy phlox	*Phlox pilosa*		E
Erect bindweed	*Calystegia spithamaea*		E
Featherfoil	*Hottonia inflata*		E
Larger canadian St. John's-wort	*Hypericum majus*		E
Large-water plantain	*Alisma triviale*		E
Long-awned smoke grass	*Muhlenbergia capillaris*		E
Northern blazing star	*Liatris scariosa var*	C2	E

Table 3.11-1 (Page 2 of 2)

Species of Special Status Documented in Essex, Hudson, and Union Counties, New Jersey

Common Name	Scientific Name	Status Code	
		Federal	New Jersey
Pale duckweed	*Lemna valdiviana*		E
Sea-side arrow grass	*Triglochin maritimum*		E
Smooth beard tongue	*Penstemon laevigatus*		E
Smooth rattlesnake root	*Prenanthes racemosa*		E
Torrey's mountain mint	*Pycnanthemum torrei*		E
Variable sedge	*Carex polymorpha*	C2	E
Virginia false-gromwell	*Onosmodium virginianum*		E

A slash (/) separating status codes indicates a dual status. The first status code refers to the state breeding population, and the second status code refers to the migratory or winter population. In addition, two Federal status codes are listed on Table 3.11-1; code explanations of the code are presented below:

E - **Endangered species.** An endangered species is one whose prospects for survival within New Jersey are in immediate danger due to one or many factors: a loss of habitat, overexploitation, predation, competition, disease. An endangered species requires immediate assistance or extinction will probably follow.

T - **Threatened species.** A species that may become endangered if conditions surrounding the species begin to or continue to deteriorate.

S - **Stable species.** A species whose population is not undergoing any long-term increase/decrease within its natural cycle.

LE - Taxa formally listed as endangered.

C2 - Taxa for which information now in possession of the Service indicates that proposing to list them as endangered or threatened species is possibly appropriate, but for which substantial data on biological vulnerability and threat(s) are not currently known or on file to support the immediate preparation of rules.

Common Name	Scientific Name
Loggerhead turtle (T)	*Caretta caretta*
Kemp's ridley turtle (T)	*Lepidochelys kempii*
Green turtle (T)	*Chelonia mydas*
Leatherback turtle (E)	*Dermochelys coriacea*
Shortnose sturgeon (E)	*Acipenser brevirostrum*
Right whale (E)	*Eubalaena glacialis*
Humpback whale (E)	*Megaptera novaeangliae*
Finback whale (E)	*Balaenoptera physalus*
Harbor porpoise (E)	*Phocoena phocoena*

Federal and state-listed threatened or endangered species are a primary concern because these species are important on a regional basis and they may be especially vulnerable to disturbance and habitat loss. The resource agency contacts confirmed the presence of only one species, the least tern (state listed as threatened), in the immediate vicinity of the project site. Another species, the peregrine falcon (Federally and state listed as endangered), was found to have three nest sites within 5 miles of the proposed NBCDF. Life history information on the two listed species known to be present in the Newark Bay vicinity is presented and discussed in the following sections.

Least tern (*Sterna antillarum*). The least tern, listed as endangered in New Jersey and New York, is the smallest tern found in the New York/New Jersey estuary (Andrle and Carroll 1988). The occurrence record for Newark Bay reports only one sighting in 1977, leaving questions regarding whether it was observed during breeding season or migration periods. The question remains open as to the continued use of the project area by the least tern.

USFWS reported the occurrence of 10 nesting pairs of least terns in the Port Newark area during a 1977 survey of coastal waterbird colonies (Erwin and Korschgen 1979). This may be the source of the above NJDEP Natural Heritage Report of a least tern in Port Newark. The current status of this nesting colony is unknown.

The least tern is locally common in coastal areas, where it nests on beaches, dredged material disposal areas, and other open shoreline sites (Peterson 1988). Other areas used for nesting include parking lots, rooftops, airports, and road shoulders (Downing 1973; Fisk 1975; Jackson and Jackson 1985; Atwood et al. 1979; Anderson 1972). Least terns usually nest in colonies of less than 25 breeding pairs (Peterson 1988). Tern colonies can range in size from a few to several hundred nesting pairs (Massey 1974).

Nest sites are often close to water (Carreker 1985). Coastal least terns commonly breed near shallow waters of estuaries and bays (Massey 1971; Dorr 1976; Erwin 1978; Thompson 1982). In North Carolina, of 61 observed colonies, all were within 250 m of a large expanse of shallow water (Jernigan et al. 1978).

Craig (1971) found least tern colonies need to be located close to feeding areas. Ideal nesting substrate does not attract or support breeding pairs if suitable feeding areas are not present within a reasonable distance. Interior least terns in Nebraska generally foraged within 325 ft (100 m) of nest sites (Faanes 1983). In Kansas interior least terns occasionally flew 2.0 to 3.0 miles (3.2 to 4.8 km) from nest sites to feed; however, birds usually foraged within 1.0 miles (1.6 km) of the nesting area (Schulenberg, cited in Carreker 1985). In California, Atwood and Minsky (1983) found that most foraging occurred within 2.5 miles (3.2 km) of nesting sites. In Mississippi least terns foraged in deeper water 3.0 to 5.0 miles (4.8 to 8.0 km) from shore (Hays 1980).

Least terns forage over shallow-water areas such as nearshore ocean (Collins et al. 1979; Atwood and Minsky 1983), estuaries, lagoons (Wilbur 1974), rivers, streams, lakes, ponds (Hardy 1957), channels (Collins et al. 1979; Atwood and Minsky 1983), and canals (Fisk 1975). As least terns forage where prey occurs, the movements of prey species make it difficult to delineate foraging localities (Atwood and Minsky 1983).

Least terns are opportunistic foragers, exploiting most species of fish that are found near the surface within a certain size range (Moseley 1976; Tomkins 1959). McAtee and Beal (1912) found that anchovies were taken as prey 43% of the time, followed by menhaden (7%), mummichogs (6%), crustaceans (5%), silversides (1%), and 38% unidentified material in 49 least terns from New Jersey, Florida, and Louisiana. Burroughs (1966) found sand launce, herring, and hake used as prey by least terns in Massachusetts.

Least terns are not presently known to nest near Newark Bay. Suitability of available habitat for nesting is poor in the area. Any individuals observed are probably nonbreeding adults, postbreeding wanderers, or migrating individuals that forage in the New York/New Jersey Estuary, including Newark Bay (Bull 1974). Least terns occasionally can be found foraging in the New York area from late April through early September (Bull 1974). Nesting occurs as early as May, and fledging occurs as late as August (Andrle and Carroll 1988).

No least terns were observed during the monthly fish surveys conducted in Newark Bay (LMS 1996b). Monthly fish surveys in the Newark Bay shallows found the bay anchovy (a primary prey species of least terns) to be the most common fish collected from June to September 1994, and anchovies were present in Newark Bay from May through November 1994. The occurrence of larger numbers of bay anchovy coincides with the period during which adults feed their young, during fledging, and the beginning of the migration period (Andrle and Carroll 1988; LMS 1996b). This potential forage base is available but may be largely unused by least terns.

Peregrine falcon (*Falco peregrinus*): The peregrine falcon is a Federal and New Jersey State-listed endangered species because of population declines resulting from reproductive failures caused by DDT (Andrle and Carroll 1988). Section 7 consultation with USFWS is a Federal permit requirement. Section 7 issues are best resolved during the permit process.

Peregrine falcons declined greatly from the 1940s to the 1960s, to the point where they were considered extirpated from the eastern United States. Reintroduction began in 1974 and peregrine falcons are now nesting successfully in portions of the NY/NJ Harbor area on bridges and buildings. In the NY/NJ Harbor area, bridge-nesting peregrines use the superstructures above and below bridge roadways, either directly on the structure or in nesting boxes. Nesting success increases greatly when nest boxes are used (C. Nadareski, pers. commun., 1996). Peregrine falcons in the NY/NJ area are generally permanent residents. Young fledged from this area are recruited into the eastern population and may eventually establish breeding territories in the eastern U.S. and Canada.

Peregrine falcons have nested on and fledged young from the Goethals Bridge since 1988 (C. Nadareski, pers. commun.). Peregrines hunt from perches offering good views of foraging areas, taking prey from over land and water. Their prey includes a variety of birds, especially passerines, as well as waterfowl, shorebirds, and others; favorite prey are pigeons (C. Nadareski, pers. commun. 1996; Terres 1980).

3.12 CRITICAL HABITATS AND MARINE SANCTUARIES

USFWS is in the process of identifying Significant Coastal Habitats throughout the North Atlantic coastal region. This identification process has been completed for areas north of New York Harbor. Based on a review of available information and discussions with Federal, state, and local resource agencies, there are no critical habitats or marine sanctuaries in Newark Bay or along its shoreline.

South of Newark Bay, the Harbor Herons Complex (which includes the Isle of Meadows, Prall's Island, and Shooters Island) has been designated by the State of New York as a Significant Coastal Fish and Wildlife Habitat. The Harbor Herons Complex supports the largest harbor heron rookery in the northeast United States. Expanding populations will require foraging areas and a continued supply of forage, including fish and invertebrates. Some marginal foraging areas occur along the west shore of Newark Bay near the NBCDF area. Flight lines of wading birds departing Shooters Island for forage areas indicate that nearly half head north over Newark Bay (Maccarone and Parsons 1988).

Shooters Island (the rookery complex island nearest the NBCDF project area) is about 3 miles (5 km) south of the project area and hosts about 25% of the breeding pairs (Table 3.12-1). A total of 85 great egret, three snowy egret, 215 black-crowned night heron, and 22 glossy ibis nests were counted on Shooters Island during 1994 (Parsons 1994). The species composition and number of nests at these rookeries change frequently. During 1990, 26 great egret, 62 snowy egret, 93 black-crowned night heron, and 35 glossy ibis nests were counted on Shooters Island (Parsons 1994). These shifts in numbers of active nests at one rookery were observed to correspond to opposite shifts at other rookeries. The overall numbers of nests at the three rookeries was 1156 during 1990 and 1125 during 1994, indicating rather stable but dynamic populations.

Eight species of wading birds (black-crowned night heron [*Nycticorax nycticorax*], yellow-crowned night heron [*N. violaceus*], great egret [*Casmerodius albus*], snowy egret [*Egretta thula*], little blue heron [*E. caerulea*], cattle egret [*Bubulcus ibis*], green-backed heron [*Butorides striatus*], and glossy ibis [*Plegadis falcinellus*]) nest on these island rookeries. The most common nesting species during 1994 were black-crowned night heron (35% of nesting pairs), glossy ibis (22%), cattle egret (12%), great egret (11%), and snowy egret (8%) at all three rookeries (Figure 3.12-1). The least common species were little blue heron (0.5%), green-backed heron (0.8%), and yellow-crowned night heron (1.8%). The yellow-crowned night heron and little blue heron are listed by New Jersey as threatened species.

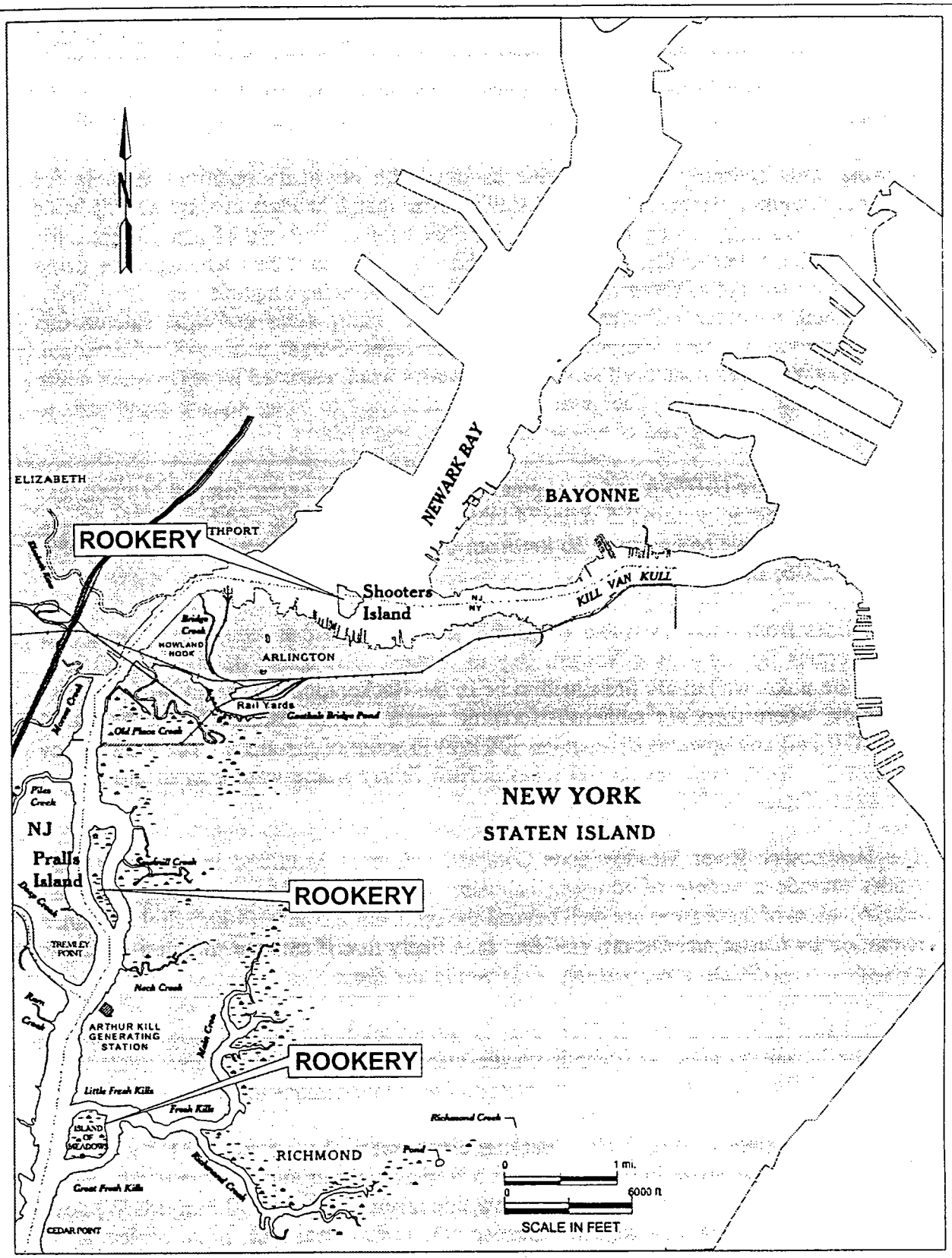
The foraging habitats of these wading bird species are generally similar, with some differences related to prey selected, prey size, feeding habits, and physical/biological conditions in foraging areas (Berger et al. 1982). The snowy egret, great egret, black-crowned night heron, little blue heron, green-backed heron, and glossy ibis are treated as a group rather than individually. The yellow-crowned night heron and cattle egret are

Table 3.12-1

Abundance of Nesting Wading Birds on Shooters Island, New York Harbor 1974-1994[a]

Year	Black-Crowned Night Heron	Great Egret	Snowy Egret	Cattle Egret	Glossy Ibis	Yellow-Crowned Night Heron	Little Blue Heron	Green-Backed Heron	Unknown	Total
1974	20	0		15	0	0	0	0	0	50
1975	50	0		0	0	0	0	0	0	50
1976	60	2	30	50	0	0	0	0	0	142
1977	50	7	30	70	21	0	0	0	0	178
1982	70	1	35	5	0	0	0	9	0	130
1985	90	7	58	82	1	0	0	1	0	239
1986	70	16	72	27	7	1	2	2	47	244
1987	92	25	55	2	13	2	0	5	11	205
1988	120	27	45	10	13	4	1	8	6	234
1989	81	25	64	13	14	4	1	2	5	209
1990	93	26	62	36	35	2	1	6	32	293
1991	265	81	156	54	104	5	1	4	35	705
1992	200	78	143	73	15	6	4	2	36	557
1993	286	89	73	18	51	6	4	3	36	566
1994	215	85	3	3	22	11	0	6	24	369

[a]Parsons 1994.



Source: Maccarone and Parsons, 1988.

Map source:

USGS 7.5 minute quadrangle maps Arthur Kill, NY-NJ, 1966, photorevised 1981, Elizabeth NJ-NY, 1967, photorevised 1981, and Jersey City, NJ-NY, 1967.

Figure 3.12-1

U.S. Army Corps of Engineers
Newark Bay Confined Disposal Facility

Harbor Herons Complex

discussed separately because their prey selection and habitat are more specialized than the others.

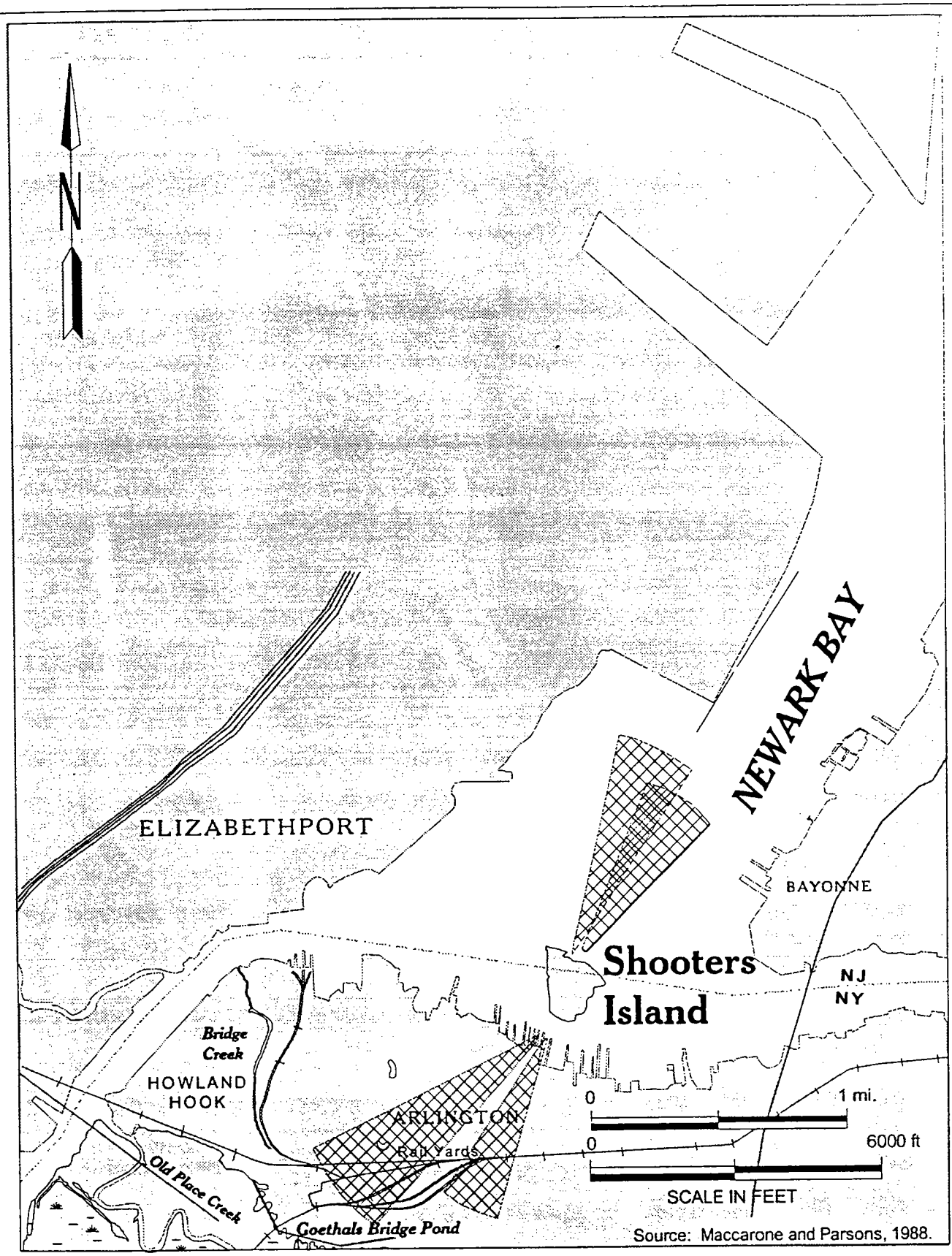
Wading birds generally select foraging habitats with physical conditions suitable for efficient foraging. Berger et al. (1982) studied three marsh habitats used by wading birds and concluded that wading birds chose nontidal habitats because of a preference for nonfluctuating water levels. Custer and Osborn (1978) found few wading birds using open waters of bays as foraging habitats unless they contained aquatic vegetation beds. Water depth prevents individuals from foraging in many areas and tidal fluctuations prevent individuals from foraging at certain tidal stages (Berger et al. 1982; Custer and Osborn 1978). They concluded short-legged waders were restricted more by water depth than long-legged waders. The great egret was restricted to using aquatic weed beds to between 1.5 hrs before and after low tide (Custer and Osborn 1978).

Custer and Osborn (1978) found most great egrets and snowy egrets foraged in areas near the breeding colony (within 2.5 miles [4 km]). However, egrets and herons are known to forage in suitable habitat over 20 km from their rookeries (Custer and Osborn 1978; Kushlan 1976; Bateman 1970).

Flight lines from Shooters Island (Figure 3.12-2) indicate that many great egrets and snowy egrets fly north over Newark Bay to forage. The actual destinations of these flights are unknown but are presumed to be in the Hackensack River and Meadowlands Complex, where there are numerous foraging areas. Flight distance is greater than 6 miles (10 km) and upwards of 12 miles (20 km) to some of the areas. The New Jersey Greenways report identifies several areas in New Jersey where wading birds are known to forage (Figure 3.12-3).

The Hackensack River Meadowlands Complex and areas identified in the Greenways report provide a variety of foraging habitats, including marshes, mudflats, and tidal creeks. Most of these areas are well beyond the optimum 2.5-mile (4-km) flight distance identified by Custer and Osborn (1978). It is likely that if suitable foraging locations existed in the NBCDF area, wading birds would use them.

The existing habitat in the NBCDF area is within approximately 3 miles (5 km) of Shooters Island but does not contain aquatic weed beds. Most of the area is too deep (>1 ft [<0.3 m]) at MLW for wading birds to use. Observations made during the 1995-1996 Newark Bay ecological survey were made around high tide to allow boat access over the shoal areas (LMS 1996b). Because depths were about 6 to 8 ft (1.8 to 2.4 m) and the normal tide range in Newark Bay is 3 ft, the depths at low water would be about 3 to 5 ft (0.9 to 1.5 m). Only at extreme low tide levels (1 ft below [0.3 m] MLW) does water depth allow some long-legged waders to use the shallower areas of the project area. No surveys were conducted during these times to determine whether any waders were using the shoal areas



Map source: USGS 7.5 minute quadrangle maps Arthur Kill, NY-NJ, 1966, photorevised 1981, Elizabeth NJ-NY, 1967, photorevised 1981, and Jersey City, NJ-NY, 1967.

Figure 3.12-2

U.S. Army Corps of Engineers
Newark Bay Confined Disposal Facility

Flightlines From Shooter's Island Rookery

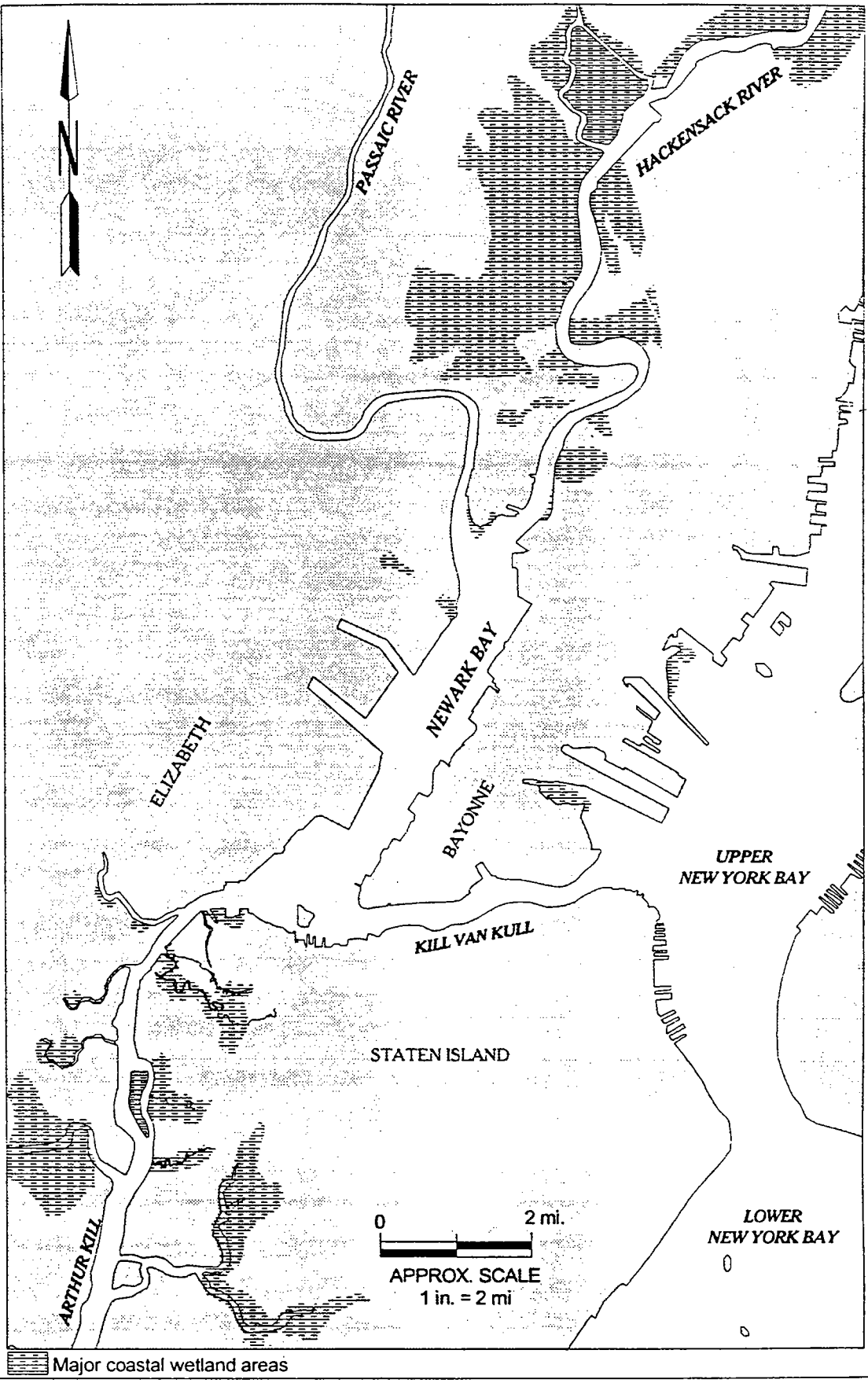


Figure 3.12-3

U.S. Army Corps of Engineers
Newark Bay Confined Disposal Facility

Major Coastal Wetland Areas - Approximate Locations in Newark Bay Area

of Newark Bay (LMS 1996b). However, it is doubtful that this area is used by waders except along the shoreline outside the CDF area.

The Newark Bay shoal area provides shallow water habitat for a variety of fish species. The following species may utilize these shoals for a variety of life functions as indicated below:

Species	Migration Corridor	Spawning	Nursery	Feeding	Season of Use
Atlantic silverside	✓			✓	September to November
Striped bass	✓		✓	✓	April to October
Bluefish	✓			✓	August to October
Winter flounder	✓	✓	✓	✓	February to November
Summer flounder	✓			✓	May to September
Weakfish	✓			✓	May to September
Bay anchovy	✓	✓	✓	✓	June to October
Atlantic tomcod	✓		✓	✓	May

Newark Bay shoal areas provide habitat for a variety of benthic and epibenthic invertebrates. These species provide a food source for fish, waterfowl, and other vertebrates, including humans. Blue crabs are the major shellfish species using the area from April through November; other less mobile species are resident throughout the year, or move with the tidal currents on a seasonal basis. The shoals provide an important habitat for the production of benthic and epibenthic organisms used as a food source by many of the vertebrate species found in the NY/NJ Harbor area.

3.13 AESTHETICS

Existing visual resources within the project study area were identified along both the western and eastern shoreline areas of Newark Bay. Visual resources are important views, vistas, and natural and man-made features that contribute to the visual character of an area. The availability of views of the project site is influenced largely by existing land uses.

Visual resources within the study area and the immediate vicinity of the proposed project are limited largely to the industrial and commercial facilities dominating the western shoreline. Additional visual resources identified include the Newark Bay Bridge and approach spans of the New Jersey Turnpike Extension, the Newark Bay Rail Road Lift Bridge, the community/park facilities along the eastern shoreline of Newark Bay, and the mid- to high-rise apartments located in the northwest section of Bayonne.

Existing views from the primary potential viewshed areas for both shorelines and the area in the immediate vicinity of the proposed project are described below.

Port Newark/Elizabeth Marine Terminals

The marine terminals at Port Elizabeth and Port Newark provide the closest viewshed of the immediate project study area. Located just south of the proposed NBCDF sites, the Port Elizabeth marine terminal is a large expanse of containers, storage facilities, and cargo/container cranes. Looking east from the pierhead line and marine terminal areas, the Bayonne shoreline is visible across Newark Bay. Residential and community facilities, including Bayonne High School and administrative buildings, are visible directly east of the proposed project area; mid- to high-rise apartment buildings can be seen to the northeast. The Newark Bay Bridge and approach spans dominate the view to the north. Views of Newark Bay and the project area from the terminal are often obstructed by container handling/storage operations and berthed steamships. The viewshed from the Port Newark terminal is also restricted by industrial activities, automobile processing, and warehousing facilities. Scrap metal processing and scrap metal piles block or impede the views from most of the Port Newark pierhead. Viewers in this area would include longshoremen, steamship crews, and other marine terminal employees.

Newark Bay Bridge and Approach Spans

Newark Bay and the surrounding area are visible to motorists traveling along the New Jersey Turnpike Extension, crossing Newark Bay between Newark and Bayonne. The Newark Bay Bridge is the highest viewing point in the study area and affords expansive views to the south of the Port Newark/Elizabeth marine terminals, Newark Bay, the Bayonne waterfront, and northern Staten Island. Views from the bridge can be partially obstructed due to bridge barriers and bridge superstructure. Motorists crossing Newark Bay westbound, from Bayonne to Newark, have restricted views of the project area due to guardrail, barriers, and oncoming (eastbound) traffic. Eastbound motorists are

provided slightly less restricted views of the project area. Looking southwest from the bridge, the marine terminals of Port Newark and Elizabeth are visible along the western shoreline of Newark Bay. The Port Newark automobile import/export center, clearly visible in the foreground, is the primary visual element seen by motorists traveling eastbound. The automobile import/export center provides space for automobile processing and distribution. Vast parking lots and warehouse facilities dominate this flat expanse of land. The container terminals and the solid bulk and break-bulk facilities of Port Elizabeth and Port Newark constitute the remaining views to the southwest. Steamships and container cranes dominate this landscape. Views to the southeast include Bayonne High School, the waterfront walkway of Bayonne Park, and mid- to high-rise apartment buildings in the northwest section of Bayonne.

Bayonne Waterfront

The Bayonne waterfront and shoreline areas provide the primary viewshed of Newark Bay and the proposed project study area. The low elevation and public access to the Bayonne waterfront provide expansive views of Newark Bay and the surrounding area. Dominant features to the west are the Ports of Newark and Elizabeth, consisting of docking facilities, warehouse and container storage areas, and ship cargo handling cranes/derricks. Visible from all three waterfront park facilities are the Port Elizabeth and Port Newark marine terminals, cargo cranes, and commercial shipping traffic which occupy most of the viewshed to the west of Bayonne. Distances between the Bayonne waterfront (viewing area) and the marine terminals vary from approximately 3000 ft (925 m) between City Park and the Port Elizabeth pierhead to approximately 6000 ft (1830 m) between Bayonne Park and Port Newark pierhead. Airline traffic, using Newark International airport, and the Newark skyline are just visible in the remote background. Looking north from the Bayonne waterfront, the Newark Bay Bridge and approach spans are visible across the bay waters. The Newark Bay Rail Road Lift Bridge is also visible in the background. The superstructures for both bridges are approximately 160 ft (50 m) above the water surface and are the dominant visual landmarks in the study area. The waterfront and park areas are heavily used for recreation. Recreational users of the parks and the waterfront areas are the primary viewers in this area.

3.14 CULTURAL RESOURCES

Known Cultural Resources

According to research conducted at the New Jersey Historic Preservation Office (NJHPO), the New Jersey State Museum, and the New Jersey State Archives, there are no previously reported archaeological sites, shipwrecks, or historic properties within the proposed NBCDF area. Examination of historic maps indicates that, at least from the mid-19th century to the present, the proposed NBCDF location has been submerged. No development has occurred within the immediate area, although development has occurred to the west. According to the research conducted at NJHPO, there are no historic properties within 0.25 mile (0.4 km) of the proposed NBCDF. There are no known archaeological resources located within the boundaries or within 1 mile (1.5 km) of the NBCDF in the site files of the New Jersey State Museum Archaeology/Ethnology Bureau. No shipwrecks are shown on any topographic or coast and geodetic maps examined for this report. An examination of the files of NJHPO, USACE, and PA did not reveal any cultural resource surveys previously conducted within the NBCDF area.

Historic Development of the Area

Currently, the 2100-acre (8.5 km^2) Port Newark/Elizabeth Marine Terminal is the largest complex in the Port of New York and New Jersey. Port Newark was created during the first quarter of the 20th century. Dredging for the Elizabeth Channel and construction of the Elizabeth Marine Terminal began in 1958, with the final phase of construction completed in 1974. It was created by dredging a channel from the Bound Creek and in-filling privately owned tideland. The current shoreline configuration of the Port Newark and Port Elizabeth area was completed during the 1970s.

Several nineteenth century landowner maps of the City of Newark and nineteenth and twentieth century topographic maps showing the area were examined at the New Jersey State Archives. Maps examined for this report are listed in the attached bibliography; however, not all are presented in this report.

The mid- to late nineteenth century atlas maps examined include the Hopkins (1873), Pidgeon (1881), Robinson and Tenney (1901), Lathrop and Odgen (1912) and Robinson (1927) atlases of Essex County and/or the City of Newark. The 1873 and 1881 maps appear to show proposed (paper) roads along the then eastern part of the city limits. The 1901 and 1912 maps also show streets and lots with owners' names in this area. Just north of Bound Creek, in the vicinity of present day Port Elizabeth, is what appears to be a dock associated with the name P. Sanford Ross. To the north of this is land owned by the Lister Agricultural Chemical Works. The 1927 map is similar but shows Port Newark and the City (now Port Newark) Channel. By this time, development of the Port Newark area extended only as far east as about 1600 ft (490 m) west of Areas 2S and 2N. It is not clear whether the docks associated with Ross were ever constructed as

information provided by PA, in the form of magazine articles, states that this area was undeveloped marshland in the 1950s.

The proposed NBCDF areas have been superimposed on several historic coast line maps. The earliest of these is a mid-nineteenth century survey of a portion of the United States Coast (Figure 3.14-1). The general vicinity of the proposed NBCDF area are indicated. The project area lies within the middle of the Bay.

Several New Jersey Geological Survey (NJGS) maps are presented as Figures 3.14-2 through 3.14-5. The earliest map dates to 1896 (Figure 3.14-2). The proposed NBCDF is located in the approximate center of Newark Bay. Water depths (in feet at MLW) in the vicinity of the NBCDF area range from 5 ft (1.5 m) on the western edges to about 10 ft (3.0 m) on the eastern edges. The land to the west was tidal marsh. Development in the area included what are now the Lehigh Central and Conrail railroads. Bound Creek forms the boundary between Essex and Union Counties. Between Maple Island Creek and the Lehigh Central Railroad, in the vicinity of the present Port Newark Terminal, was what appears to be a man-made channel or canal leading from the Conrail tracks to Newark Bay. The 1908 (Figure 3.14-3) edition of the NJGS does not differ greatly from the earlier map but identifies the canal as the Peddie Street Canal. Depths near the proposed NBCDF are about 2 to 5 ft (0.6 to 1.5 m) along the western edges to 9 to 11 ft (2.7 to 3.4 m) along the eastern edges.

By 1942 (Figure 3.14-4) the Port Newark Terminal had been established. It appears that the Peddie Street Canal was incorporated into the channel. Extensive railroad development and piers are shown within the terminal. The proposed NBCDFs are still in the middle of the Bay as shoreline filling has not yet extended to its present configuration. Depths range from 2 to 3 ft (0.6 to 1.0 m) on the western sides of the pits to 22 to 23 ft (6.7 to 7.0 m) along the eastern sides. The area of present Port Elizabeth consisted of Bound Creek surrounded by tidal marsh. The 1955 (Figure 3.14-5) edition shows no apparent changes in the immediate vicinity of the proposed NBCDFs but a slight increase in development within the Port Newark Terminal.

Newark Bay Shoreline Changes

Over the past thousands of years, natural fluctuations in seal level have at times dramatically altered water levels in streams, rivers, and lakes, thus changing shoreline locations. Areas that are currently wetlands or that are submerged in water may have been drier in historic and prehistoric times. Previous research and a review of historic maps suggest that water levels in Newark Bay (Kardas and Larrabee 1976) and other similar environments (Emery and Edwards 1966) have changed somewhat over the past few hundred years, and the prehistoric changes in sea level created much different shorelines than what currently exist.

The changes in water surface elevation in Newark Bay in historic times were modest, based on recent information. Sea level at the Battery has increased approximately 12 in.

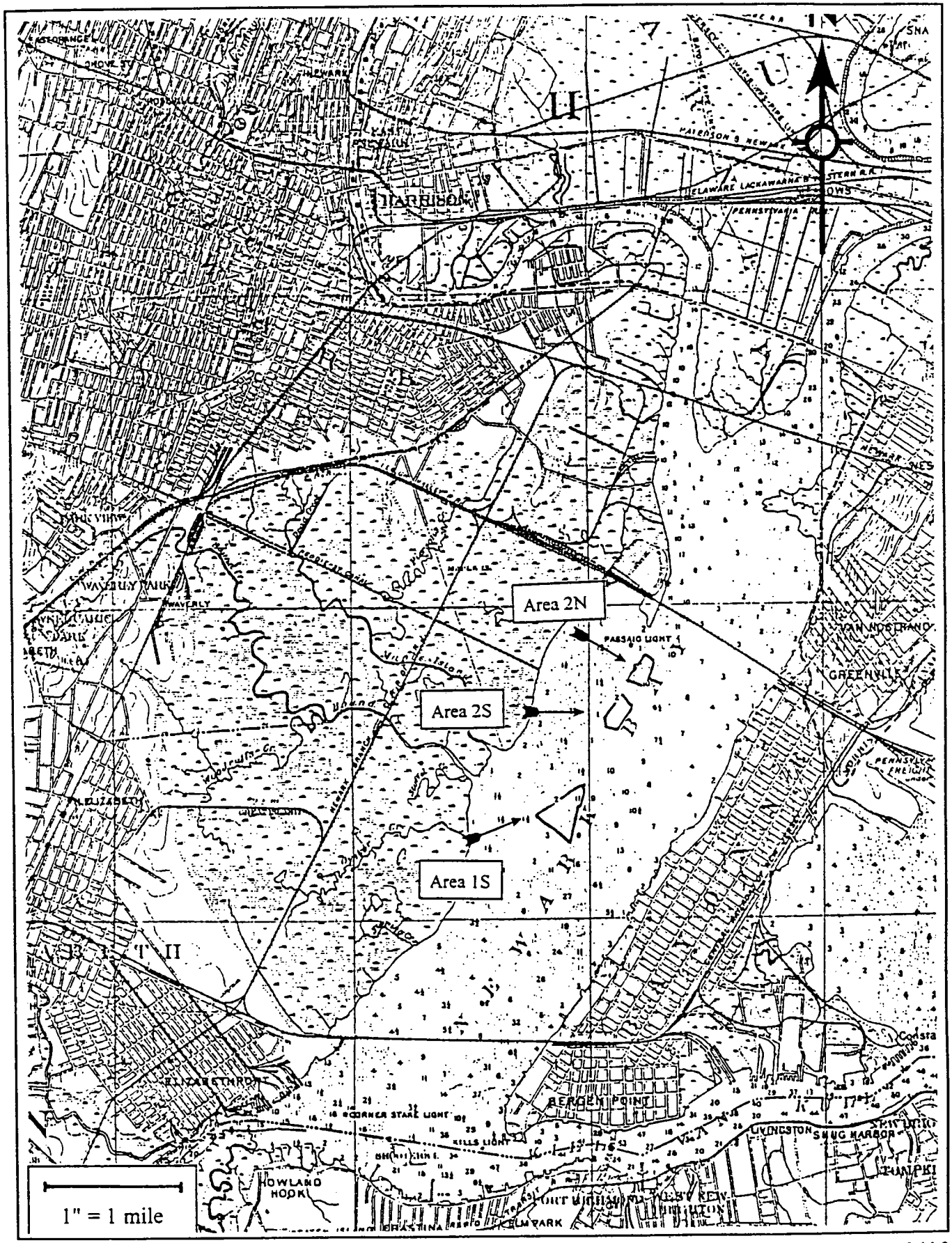


Figure 3.14-3

U.S. Army Corps of Engineers
Newark Bay Confined Disposal Facility

NBCDF Project Locations, 1908

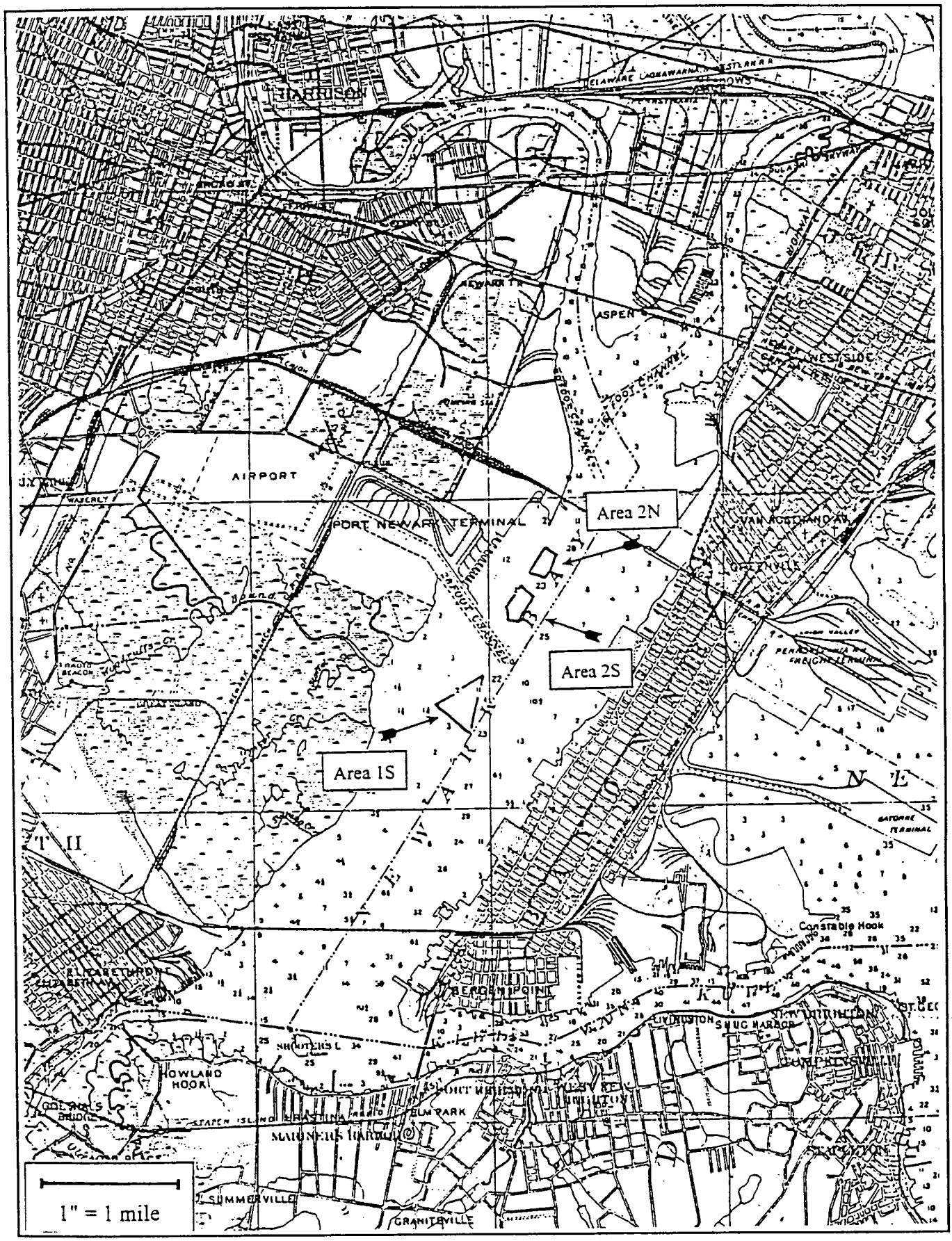


Figure 3.14-4

U.S. Army Corps of Engineers
Newark Bay Confined Disposal Facility

NBCDF Project Locations, 1942

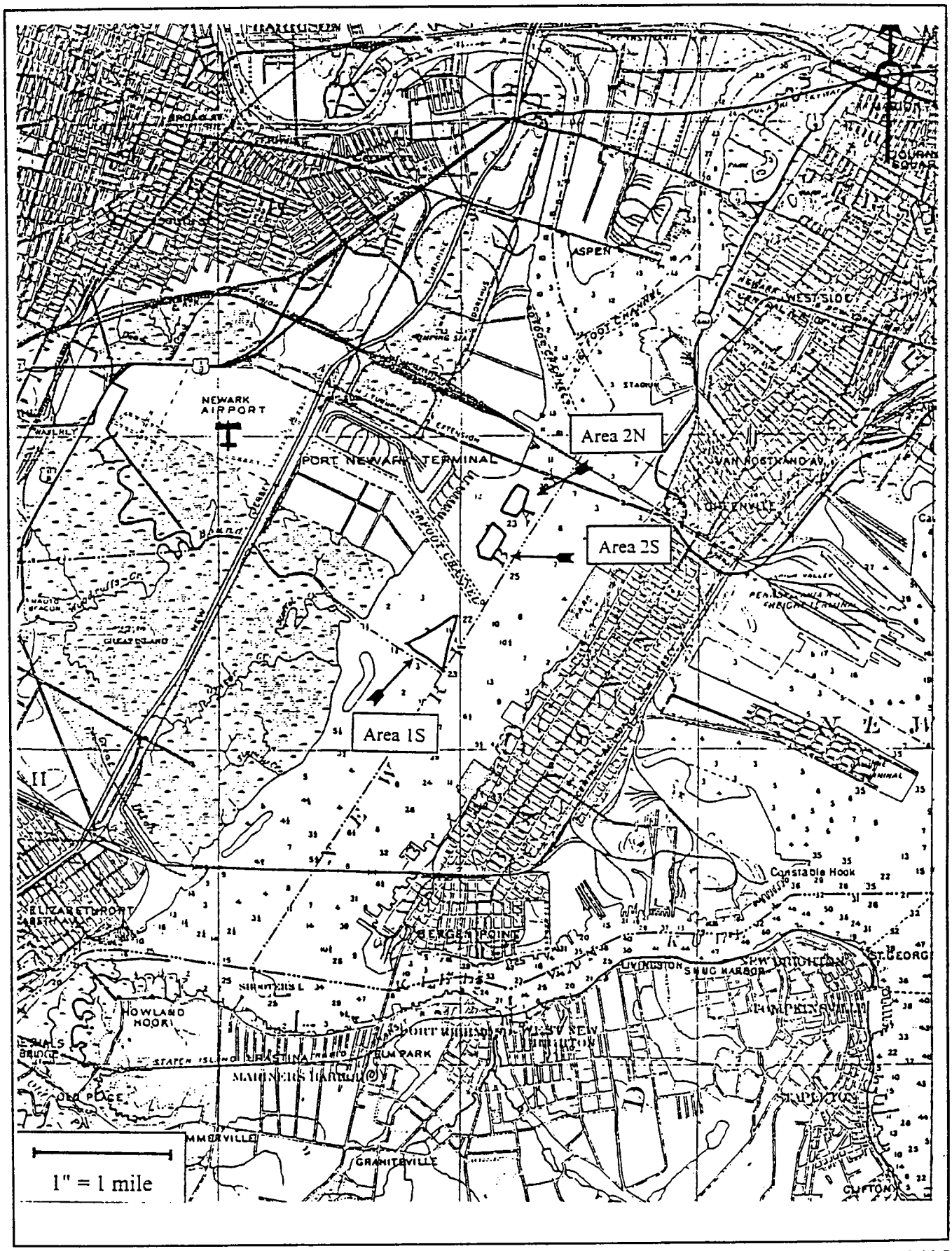


Figure 3.14-5

U.S. Army Corps of Engineers
Newark Bay Confined Disposal Facility

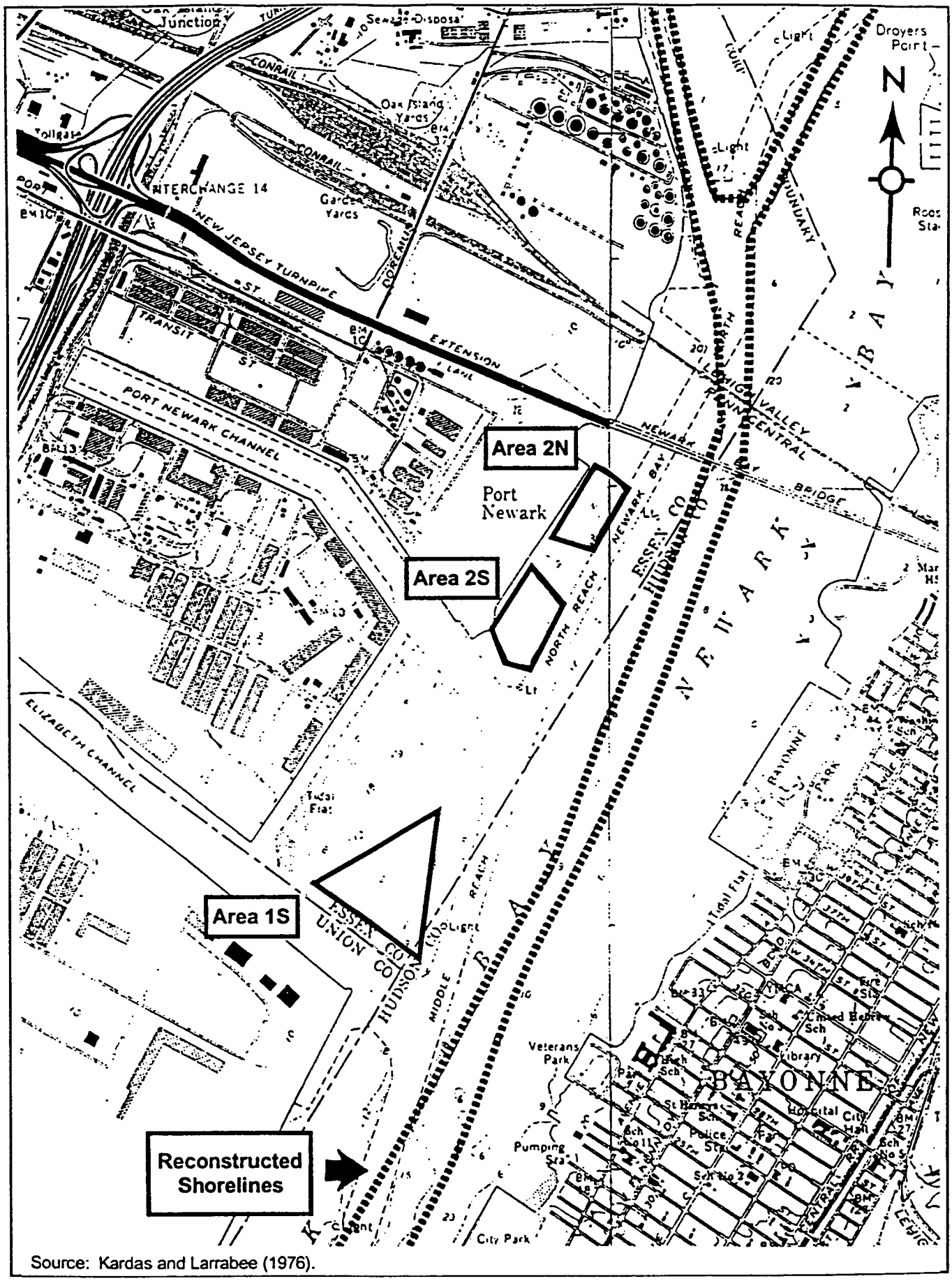
NBCDF Project Locations, 1955

(30.5 cm) since 1890, with a yearly change averaging 0.12 in./year (3 mm/year) (Swanson 1976). Extensive wetlands bordered the western side of the Bay prior to commercial development in this century. Recent NBCDF area sediment testing (Section 1.02.2) shows that chemicals discharged in this century extend to depths of 10 ft (3.0 m) in the area of the proposed CDFs and up to 25 ft (7.6 m) deep in nearby areas. This depth of contamination suggests that sediment disturbance to these depths took place recently in relation to the historic record. In addition, as discussed later, USACE records document previous dredging in the NBCDF area. Because the areas selected for NBCDF development were under water in historic times and the bottom sediments have recently been disturbed, it is likely that historic resources would be found in these areas.

While such changes in historic times do not appear to have altered shorelines located along Newark Bay significantly, earlier and more dramatic changes in sea level would have caused more significant alterations. Kardas and Larrabee (1976:16) argue that "the further one goes back into the prehistoric period, the more radically different the sea level and hence the shore line would have been." Because sea level changes ultimately affect the course of rivers and the shapes of bays, Kardas and Larrabee are able to generalize that the width of Newark Bay was much more constricted prehistorically. Figure 3.14-6 illustrates their estimated reconstruction of prehistoric shorelines in this region at approximately 3000 B.C. Based on estimated rates of sea level rises, they suggest that sea level would have been approximately -25 or -30 ft (-7.6 or -9.1 m) at that time, and would have altered the shape of Newark Bay considerably (Kardas and Larrabee 1976:10-15). Kardas and Larrabee also provide a more detailed discussion of changes in the form of Newark Bay through 600 B.C.

The results of Kardas and Larrabee's research imply that the NBCDF project area is located in a region that would have been relatively dry or at least not completely submerged during prehistoric times. The type of environment that likely existed within the project area prehistorically would have been favorable for human occupation.

Previous archaeological research of the New York and New Jersey area surrounding the proposed NBCDF has resulted in the documentation of prehistoric human activity, some of which occurred along shoreline areas, even those which are now under water. By at least 12,300 B.P. this region's climate was similar to that of the present, and populations could and did inhabit the area, as evidenced by a number of sites in the region. For example, the Port Mobil site, located on Staten Island overlooking the Arthur Kill, yielded an extensive collection of Paleo-Indian stone tools. According to Kraft (1977), occupation sites located in the area, "as well as others now submerged, may have been visited and occupied regularly by the people crossing the exposed and fairly level (except for occasional river trenches) continental shelf." In addition, "the fossil fauna that has from time to time been dredged off the continental shelf, and other evidence of . . . animals discovered on the Coastal Plain province of New Jersey" indicate that large mammals and riverine species were available prehistorically, making it an attractive area for human settlement.



Source: Kardas and Larrabee (1976).

Figure 3.14-6

U.S. Army Corps of Engineers
Newark Bay Confined Dredge Disposal Facility Project

Reconstruction of Prehistoric Shorelines, Circa 3000 BC

Emery and Edwards (1966) report that "presently submerged habitations and structures built by early man in North America are known, but all are close to the present shoreline and are of relatively recent date." For example, marine shell middens, resulting from human activity, have been located in shoreline areas on the Atlantic coast. Few midden older than about 4000 years have been located along the Atlantic coast, but middens older than that would now be covered with at least several meters of water (Emery and Edwards 1966). Emery and Edwards (1966) and former New York State archaeologist Dr. Robert Funk (personal communication) argue for the relatively high probability of locating evidence of prehistoric use of such areas, in the form of preserved resources that may be located within underwater deposits. According to Shepard (1964), there probably are many other sites in shallow waters of the coast which may be accessible to divers.

In conclusion, the evidence presented above indicates a high potential for the presence of buried prehistoric cultural deposits within Newark Bay sediments. Although there is no documentation to date of deeply buried cultural resources in Newark Bay, the potential for the presence of such resources in the NBCDF project area does exist.

Soil Borings

Soil borings were conducted in the proposed NBCDF areas as part of the environmental studies and ocean disposal testing. Information gained from these studies can be useful in cultural resources evaluations. Soil borings assist in identifying the composition of deeply buried strata which may reveal information regarding prehistoric geological deposits and buried cultural resources. The first phase of the sampling program collected 22 core samples: 10 from Area 1S, seven from Area 2S, and five from Area 2N (LMS 1996a). "Sediment conditions in each area indicate the presence of an upper layer of black organic silty clay which extends to a depth of approximately 20-25 ft (6.1-7.6 m) where it is underlain by a layer of gray sand" (LMS 1996a). One location within each proposed pit was selected for deep boring sampling. All three borings were 70 ft (21 m) deep. In addition, numerous borings were conducted by the PA to obtain geotechnical information on the area sediments (PA 1996b). Portions of the results of the borings from the engineer's report are presented below:

Area 1S - The upper sediment layer consisted of black, very loose silty clay with an occasional shell layer or small sand and silt lens. At about 15 ft (4.6 m), the clay graded quickly to sand, consisting of gray, fine-medium sand about 10 ft (3.1 m) thick. The sand layer abruptly changed to clay. Silt in fine layers may be incorporated into the clay, and it may be mixed with fine, medium, and coarse sand with depth.

Area 2S - The upper layer sediments were about 16 ft (4.9 m) thick and consisted of black silty clay, with an occasional mollusc or bivalve shell. The clay was mixed with small silt and fine sand layers and contained a small quantity of organic material. The sand layer was about 10 ft (3.1 m) thick and consisted of fine to medium gray, well-sorted sand. This graded medium to coarse sand was at the base of the layer. There was

an abrupt change to red- brown, silty clay at 28 ft (8.5 m). There were occasional fine sand and silt lenses throughout the soil column.

Area 2N - The top 10 ft (3.1 m) of sediment consisted of soft, silty clay with a trace of organic material, including a fine sand and silt layer at about 6-8 ft (1.8-2.4 m). A swamp-like marsh odor was also noted. Traces of peat and shells with a less distinct marsh gas odor were noted after 10 ft (3.1 m). The black organic clay and peat graded into a fine and medium gray sand at 14 ft (4.3 m). The sand layer extended to 26 ft (7.9 m), with a coarse basal layer between 22-26 ft (6.7-7.9 m) consisting of coarse sand with a trace of fine gravel. Red-brown dense and elastic silty clay extended below the sand to 70 ft (21 m).

These observations are consistent with findings in other sections of the FEIS, specifically Sections 3.01 and 3.04, and Appendix 3.04. The stratigraphy of Newark Bay consists of three units that overlie Mesozoic bedrock. The lowermost unit consists of Pleistocene red to red-brown clays. These are overlain by gray sands, gravelly sands, or sandy gravels, also of Pleistocene age. The uppermost unit consists of Holocene black organic muds, black sandy muds, and black muddy sands.

The lowermost unit represents deposition in a glaciolacustrine environment. This depositional environment was entirely subaqueous. Thin silt bands and local silt grains noted were most likely the product of aeolian deposition. The absence of sand or observable layering, the high oxidized nature of the sediment as indicated by the reddish color, and fine-grained nature of the sediment indicates that deposition occurred in a quiescent environment, possibly in the deeper portions of a prolglacial lake. By contrast, the intermediate unit, consisting of much coarser, more poorly sorted material, probably represents deposition in a highly energetic environment. The coarser grain size, lack of bedding, and poorer sorting suggest deposition by highly energetic, proglacial streams. In either case, the probability of finding cultural deposits is negligible. In both instances the depositional environment would have been subaqueous, hence, not a site for habitation. In the second case, the energy of the environment could have provided a high potential for erosion of any artifacts.

The uppermost unit is representative of geologically younger sedimentation in estuarine environments associated with postglacial sea level rise. The nature of the sedimentary succession gives no indication of the depositional environment, other than being low energy and, in the top part, estuarine. Examination of core logs and photos of cores from the NBCDF area did not indicate the presence of any anthropomorphic material. Examination of these materials constitutes an investigation of the permit area pursuant to the requirements of 33 CFR, Part 325, Appendix C, Paragraph 5.

Previous Dredging Activities

Examination of USACE New York District Office records of previous dredging indicated that limited dredging activity occurred in the proposed NBCDF areas. Previous dredging

activities in the proposed NBCDF area include: clay recovery activities in Area 1 and a shipways access channel constructed through Area 2. Dredging has occurred immediately adjacent to all the proposed NBCDF areas, mainly as maintenance dredging for the Federal Navigation Channel, Port Newark and Elizabeth channels, and associated berths.

Previous dredging activities to culturally sterile soils in these areas would have disturbed any previously existing cultural resources, and thus there is a low potential for locating undisturbed cultural resource deposits in these specific areas.

3.15 AIR QUALITY

Six air pollutants (priorty pollutants) have been identified by EPA as being of nationwide concern: carbon monoxide, nitrogen oxides, ozone, particulates, sulfur oxides, and lead (EPA 1980). The sources of these pollutants, their effects on human health and the nation's welfare, and their distribution in the atmosphere are quite variable. In the New York metropolitan area, ambient concentrations of carbon monoxide, ozone, and lead are predominantly influenced by motor vehicles. Nitrogen oxides and particulates are emitted from both mobile and stationary (e.g., power generation facilities, industry) sources, and emissions of sulfur dioxide and sulfates are mainly from stationary sources.

Representative ambient air quality data for the study area are presented in Table 3.15-1. These data were compiled by NJDEP for the years 1991 through 1993 (NJDEP 1994). The annual values are the highest pollutant levels recorded during any year of the three-year period; short-term (24 $\pm$ 3 hrs) values are the second-highest values recorded any year of the three-year period. None of the values in Table 3.15-1 are in contravention of the applicable time-weighted standards promulgated by the EPA (40 CFR 50) as ambient air quality standards. However, exceedences of the 8-hr carbon monoxide standard have been recorded at monitors in North Bergen, Elizabeth, and East Orange in 1994. The predominant sources of air pollutants in the study area are believed to be automobile exhaust and industrial discharges. Odors associated with industry and/or landfills in the study area are more of an aesthetic problem than a health concern. No sensitive receptors (schools, churches, etc.) were identified on the west side of Newark Bay adjacent to the project site. The potential receptors of concern are those downwind (east shore of Newark Bay - Bayonne) of the proposed work area. The closest identified receptors on the east side of Newark Bay are Hudson County Park, Bayonne Veterans Park, Bayonne City Park, and Bayonne High School located along the east shore of the Bay between 1.0 and 1.5 miles (1.5-2.5 km) east and southeast of the proposed NBCDF development areas.

NYSDEC maintains and operates the New York State Ambient Air Monitoring System. Utilizing data from the state system, as well as private networks, the monitoring system analyzes and reports on most of the air pollutants for which Ambient Air Quality Standards have been set. A statewide network of monitoring stations collect these data. A brief summary of the above-mentioned pollutants as reported in the 1991 annual report follows:

- Carbon monoxide levels have declined in recent years due to emission controls on automobiles. Portions of the New York/New Jersey metropolitan area remain in nonattainment of the National Air Quality Standards.

- Sulfur dioxide and sulfate levels have declined in the New York metropolitan area for the past 21 years; all NYSDEC sulfur dioxide

Table 3.15-1

Representative Air Pollutant Data - New Jersey Portion of Study Area

(1991-1993)

Location	Pollutant	Averaging Time	Value
Bayonne	SO_2	Annual	26 $\mu g/m^3$
		24 hour	76 $\mu g/m^3$
		3 hour	128 $\mu g/m^3$
Elizabeth Laboratory		Annual	34 $\mu g/m^3$
		24 hour	136 $\mu g/m^3$
		3 hour	453 $\mu g/m^3$
Newark		Annual	29 $\mu g/m^3$
		24 hour	97 $\mu g/m^3$
		3 hour	147 $\mu g/m^3$
Bayonne	PM_{10}	Annual	30 $\mu g/m^3$
		24 hour	61 $\mu g/m^3$
Elizabeth Laboratory		Annual	34 $\mu g/m^3$
		24 hour	73 $\mu g/m^3$
Carteret		Annual	28 $\mu g/m^3$
		24 hour	60 $\mu g/m^3$
Linden		Annual	31 $\mu g/m^3$
		24 hour	59 $\mu g/m^3$
Bayonne	NO_x	Annual	53 $\mu g/m^3$
Elizabeth Laboratory		Annual	64 $\mu g/m^3$
Newark		Annual	62 $\mu g/m^3$
Elizabeth Laboratory	CO	8 hour	6.9 ppm
		1 hour	9.1 ppm
Elizabeth		8 hour	6.0 ppm
		1 hour	9.2 ppm
Newark		8 hour	5.9 ppm
		1 hour	9.1 ppm
Perth Amboy		8 hour	4.2 ppm
		1 hour	8.5 ppm

monitoring stations have remained in compliance with applicable standards for the past 14 years. This reduction is attributed to the lowering of the sulfur content of coal and residual oil through state fuel sulfur regulations, as well as a shift away from the use of heavy fuels.

- Area nitrogen dioxide and nitrate levels have remained below the air quality standard for the past three years.

- Over the past 27 years, particulate concentrations have decreased 61% in New York due to state and Federal regulations controlling particulate emissions from incinerators, industrial sources, and diesel-fueled vehicles. However, because of continuing compliance problems in the New York City area, a designation of nonattainment for particulates is expected from EPA in the near future.

- Ozone is a secondary air pollutant formed when hydrocarbons and nitrogen oxides chemically react in the presence of sunlight. While ozone levels have improved over time, trends in ozone levels are difficult to characterize due to the influence that weather and temperature have on its production. New York City is listed as a "high-severe" ozone nonattainment area and is listed by EPA as the third worst ozone problem area in the nation; the area would have to reduce emissions of ozone precursors by about 80% to achieve "healthy" air.

- Area lead concentrations have remained unchanged or have declined, primarily as a result of the elimination of lead additives from motor fuel, and have remained in compliance with air quality standards.

3.16 HUMAN HEALTH

The State of New Jersey has issued the following advisory information concerning fish and shellfish in the Newark Bay Complex. The selling of striped bass (*Morone saxatilis*), American eel (*Anguilla rostrata*), and blue crab (*Callinectes sapidus*) is prohibited. Harvesting of blue crab is also prohibited. No consumption of these species is advised for recreational fishing. Recreational fishermen are advised not to eat bluefish (*Pomatomus salatrix*) over 6 lb, white perch (*Marone americana*) and white catfish (*Ameiurus catus*) more than once per week, and high-risk populations are advised to forego consumption.

There is a ban of the consumption and commercial fishing of the hard-shell clam (*Mercenaria mercenaria*) and the soft-shell clam (*Mya arenaria*) throughout the entire Newark Bay Estuary, including the lower Passaic and Hackensack rivers, the Arthur Kill, and the Kill Van Kull. There is a prohibition on selling all fish, shellfish, and crustacea from the tidal Passaic River, as well as on harvesting of the blue crab. A non-consumption advisory for all recreational fishing in the tidal Passaic River is in effect.

The available literature for this environment contains data on the sediment and tissue levels of several classes of chemical contaminants including heavy metals, pesticides, PAHs, and PCBs (Breteler 1984; Long et al. 1995; Long and Morgan 1990; O'Connor and Ehler 1991; Pruell et al. 1990; Schimmel et al. 1994; Squib et al. 1991). These studies indicate that portions of Newark Bay have concentrations of many of these compounds well above Federal and State guidelines. Dioxin is one of the two contaminants of concern related to human health for the Newark Bay area because of its being a carcinogen and teratogen, and because of levels of dioxin, particularly the isomer 2,3,7,8-tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD), found in the sediments and biota. The second major contaminant of concern is PCBs. The consumption bans and health advisories are based on the classes of chemicals. In relation to all the other chemicals of concern present in this ecosystem, dioxins and PCBs are considered to have the greatest potential to adversely affect the health of people consuming fish and crustaceans from this estuary. This report will also focus on dioxin because of the high potential hazard of this class of contaminants and the amount of available background data and risk assessments.

The initial study that established the levels of dioxins in the tissues of fish and shellfish from Newark Bay was performed by NJDEP in 1982. Belton et al. (1985) have reported the concentrations listed in Table 3.16-1. As a result of this study, NJDEP performed a risk assessment based on these data and the U.S. Food and Drug Administration (FDA) level of concern of 25 pptr (25 pg/g) of 2,3,7,8-TCDD for limited consumption of seafood. The results of the risk assessment indicated that a significant human health risk existed for populations who would consume fish and crabs from this environment. The prohibition on selling fish and the consumption advisory information was issued jointly by the New Jersey Department of Health and NJDEP in 1983.

Table 3.16-1

Dioxin Level Studies on Tissues from Newark Bay Organisms

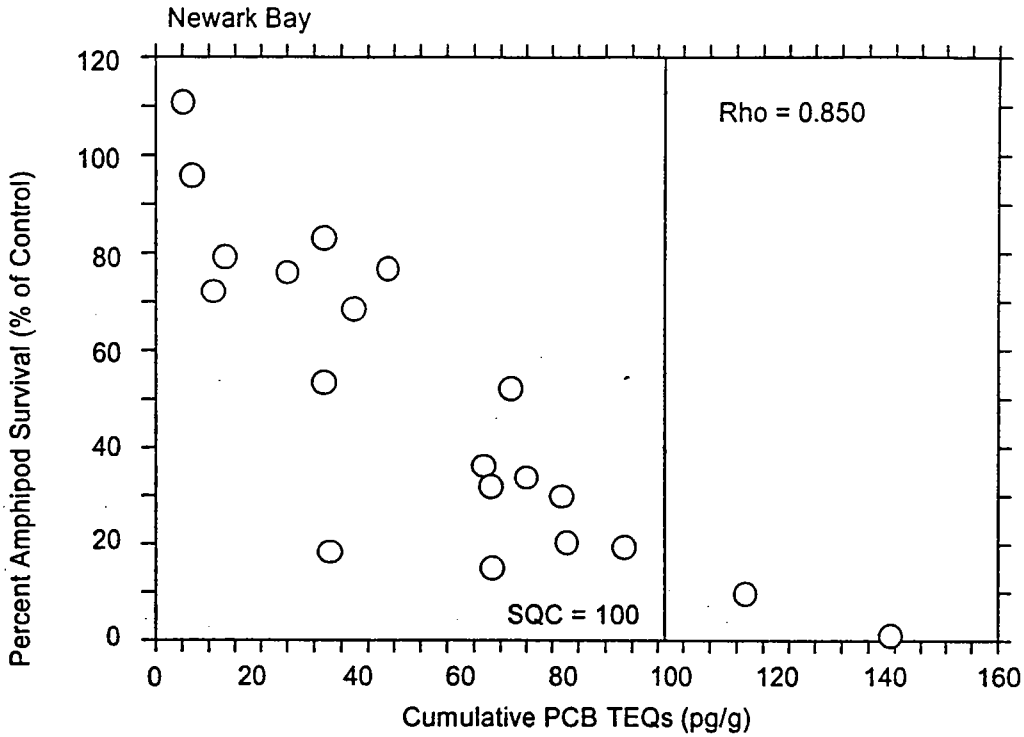
Source	Date	Species	2,3,7,8-TCDD (pptr)
Belton et al.	1985	Striped bass *Morone saxatilis*	23-56 (three composites, five fillets in each composite)
		Blue crab *Callinectes sapidus*	320-630 (four composites, five hepato-pancreas in each composite)
		Catfish *Ameiurus catus*	110 (one composite, five fillets in each composite)
Cai et al.	1994	Blue crab *Callinectes sapidus*	425-940 (four composites, five hepato-pancreas in each composite)
		Blue crab *Callinectes sapidus*	30-45 (four composites, five muscles in each composite)

Since the initial work, additional studies have sampled the tissues of organisms from Newark Bay. Cai et al. (1994) have reported the concentrations of dioxin in the tissues of edible-size blue crabs collected from Newark Bay listed in Table 3.16-1. These concentrations indicate some variation with season but are in the range of those reported by Belton et al. almost 10 years earlier. These levels remain elevated, 40 to 50 times the FDA recommended level in the hepatopancreas (tomalley), and twice the recommended level in the muscle tissue.

Long et al. (1995) examined the magnitude and extent of the toxicity of the sediments from the New York/New Jersey Harbor, including Newark Bay. Samples were collected in central and upper Newark Bay, northern Arthur Kill, Kill Van Kull, the lower Passaic River, the lower Hackensack River, and upper New York Harbor. Samples were collected with a stainless steel modified van Veen grab sampler. At each station, approximately 2 gal (8 liters) of sediment from the upper 1.0 in. (2 cm) were collected in multiple deployments of the sampler. The sediments were completely homogenized before aliquots were prepared for laboratory analyses. The survey, conducted by NOAA's National Status and Trends Program, measured the concentrations of a number of chemical contaminants in the sediment, as well as the results of the exposure of amphipods to these sediments. Their results indicate that 48 of 57 samples from Newark Bay and vicinity were significantly toxic in the amphipod survival tests; only a few samples from the lower Hackensack River and one sample from the upper New York harbor were not significantly toxic. The toxicity of sediments to amphipods was highly correlated with increasing concentrations of dioxins, pesticides, and PCBs. Figure 3.16-1 shows the relationship of amphipod survival and sediment concentrations of 2,3,7,8-TCDD; all the samples that were highly toxic had sediment dioxin concentrations that were higher than the 100 pg/g guideline suggested by EPA in 1993. This study was aimed at toxicity, not accumulation; therefore, the concentration of dioxin in the sediment that would result in the bioaccumulation of this chemical would be lower.

Another study that examined the levels of dioxins in estuarine organisms was performed by EPA (Pruell et al. 1993). Pruell and his colleagues examined the accumulation factors of 2,3,7,8-TCDD and other compounds contained in sediments from Newark Bay into the tissues of sandworms (*Nereis virens*), clams (*Macoma nasuta*), and grass shrimp (*Palaemonetes pugio*). They concluded that this chemical was bioavailable and accumulated in the three species tested. The worms accumulated higher concentrations on a dry-weight basis; however, the accumulation factors were generally higher for the clam and the shrimp.

Cristini and Cooper (1994) examined the uptake and distribution of dioxin in the tissues of blue crabs fed clams containing radio-labeled 2,3,7,8-TCDD. The hepatopancreas rapidly accumulated the highest concentration of 2,3,7,8-TCDD and continued to accumulate it throughout the 96-hr study. The gills, stomach, and muscle tissues also accumulated 2,3,7,8-TCDD, but at lower levels. After 96 hrs the concentration of dioxin in the hepatopancreas was approximately 10 times that in the other tissues because of the



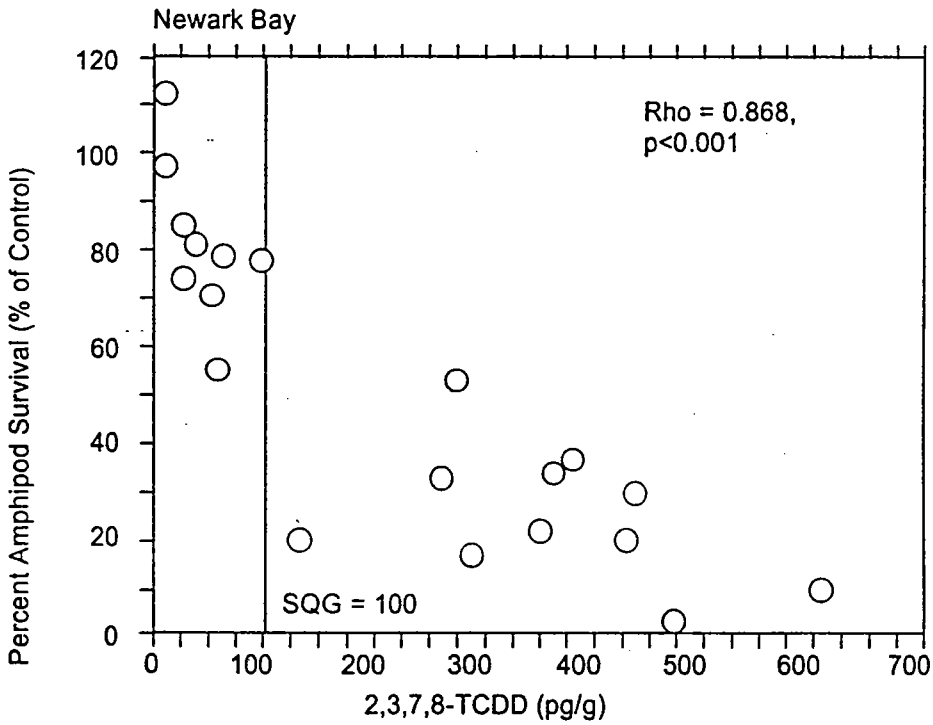


Figure 3.16-1

U.S. Army Corps of Engineers
Newark Bay Confined Disposal Facility

Relationship of Amphipod Survival and the Concentrations of 2,3,7,8-TCDD Equivalency Units and 2,3,7,8-TCDD in Newark Bay Sediments

high lipid content in this organ. The results of these studies and the known insolubility of dioxin in water indicate that the route of exposure for higher trophic levels (including humans) is by trophic accumulation from the dioxin bound on the fine-grained sediments to filter and/or deposit feeders (clams, shrimp, worms) to carnivores (crabs, lobsters, fish) to humans.

All the information presented above suggests that the concentrations of contaminants in the sediments of Newark Bay are acutely toxic to some aquatic organisms and render other species an unsafe health risk for human consumption. Thus, the ecosystem that would be affected by the proposed project presently is supporting populations of organisms that continue to pose a threat to the people of the surrounding communities in the Newark Bay area. Particularly at risk are those who harvest for subsistence and consume the local seafood.

The fishing and fish consumption advisory will persist into the foreseeable future because of resuspension and redistribution of contaminants already in the aquatic system. Only isolation of the high-concentration contaminants in sediment can terminate such resuspension. Removal, burial, or capping is seldom economically viable; however, use of subaqueous CDFs, such as the proposed NBCDF, could result in a viable economic alternative. The future does hold a possible exception when dredging projects can be coordinated with removal and isolation of contaminated sediment. Dredging projects intended to accommodate the cost magnitude associated with significant volumes of sediment excavation and transport presents a unique opportunity. Planned and necessary dredging activities can be managed to enable Newark Bay to improve its aquatic ecosystem, and progress can be made toward lifting the ban on fish and crab consumption.

3.17 SOCIOECONOMICS

This section describes the socioeconomic conditions in the project area, focusing on conditions of particular relevance to the project. For purposes of socioeconomic assessment, the relevant project area includes the City of Newark and Essex, Hudson, and Union Counties, New Jersey. This is the area likely to furnish port facilities (and perhaps equipment) for the dredge crew, and it is the area most likely to experience both beneficial and adverse socioeconomic impacts should they occur.

The scope of the socioeconomic assessment is related to the scope of the potential socioeconomic effects of the project. The project will be implemented with a small staff who will work primarily in offshore dredging and disposal activities. The socioeconomic assessment therefore focuses on the economic impacts of expenditures for materials and salaries.

3.17.1 POPULATION

Long a port location, Newark and the surrounding counties are a part of the densely populated New York-New Jersey urban area. Newark and the surrounding counties have experienced a general decline of population over the last 15 years as a result of suburban expansion. As indicated in Table 3.17-1, the population of Newark declined between 1980 and 1990 by over 50,000 persons, Essex County by over 70,000, Hudson County by about 3000, and Union County by about 20,000. Available projections for Essex, Hudson, and Union counties for 1995 indicate that the population of Essex and Hudson counties were expected to continue their decline, while Union County's population was expected to increase slightly. At the same time, the age distribution of the population in the project area, particularly in Newark, is becoming less like that of the state as a whole.

3.17.2 INCOME

Essex County, Hudson County, Union County, and the City of Newark present very different pictures of individual and family income. Table 3.17-2 shows the per capita income, median family income, and percent of families below the poverty line within these jurisdictions for 1989. Income projections for 1995 for Essex and Union counties are also shown. In general, Union County is wealthier than Essex or Hudson counties and has a considerably smaller proportion of its population below the poverty level than Essex County. This relationship was projected to continue through 1995.

3.17.3 EMPLOYMENT AND ECONOMIC OUTPUT

In 1994 Newark, New Jersey, ranked 26th among urban areas in the U.S. in total size of the labor force. (1995 Statistical Abstract, Table 632, p. 402). Table 3.17-3 provides information on the level of employment in the project area in 1993. Based on the Bureau

Table 3.17-1

Population and Age Distribution in New Jersey and the Project Area

Area	Total Population			Age Distribution, 1990	
	1980	1990	1995	Percent Younger Than 25	Percent Older Than 65
New Jersey	7,365,011	7,730,188	NA	33.4	13.4
Essex County	851,304	778,206	761,113	35.1	12.7
Hudson County	556,972	553,099	552,094	31.9	9.9
Union County	504,094	483,819	497,105	31.5	15
Newark	329,248	275,221	NA	41.5	9.3

Sources: 1980 and 1990 data - U.S. Census of Population, Summary Tape File 1A.
1995 Projections for Counties - Sourcebook of County Demographics, 8th Edition, CACI Corporation, Arlington, Virginia, 1996.

Table 3.17-2

1989 and 1995 Income in New Jersey and the Project Area

Area	Per Capita Income		Median Family Income		Percent of Families Below Poverty Line 1989
	1989	1995	1989	1995	
New Jersey	18,714	NA	40,297	NA	23.3
Essex County	17,574	19,961	34,518	37,997	27.2
Hudson County	14,480	NA	32,250	34,768	12.4
Union County	25,177	20,693	41,791	43,175	15.3
Newark	9,424	NA	21,650	NA	22.8

Sources: 1980 and 1990 data - U.S. Census of Population, Summary Tape File 1A.
1995 Projections for Counties - Sourcebook of County Demographics, 8th Edition, CACI Corporation, Arlington, Virginia, 1996.

Table 3.17-3

Employment and Payroll in New Jersey, Essex County, Hudson County, and Union County, 1993

Industry	New Jersey		Essex County		Hudson County		Union County	
	Employees (1,000)	Payroll ($M)	Employees (1,000)	Payroll ($M)	Employees (1,000)	Payroll ($M)	Employees (1,000)	Payroll ($M)
Total	3,100.2	93,582.2	332.3	10,352.1	204.3	5,237.0	205.3	6,796.7
Agricultural	15.9	314.2	0.8	14.2	0.137	3.1	0.6	13.1
Mining	3.5	203.9	0	0	0	0	0.004	0.09
Construction	120.0	4,230.2	8.7	327.9	6.5	208.2	9.9	369.1
Manufacturing	546.9	20,764.3	49.8	1,770.1	39.8	1,049.0	49.9	2,026.7
Transportation	247.9	9,016.0	41.4	1,438.2	30.3	868.6	19.0	765.0
Wholesale Trade	297.8	11,721.2	25.1	965.4	28.3	910.7	24.9	1,091.2
Retail Trade	565.5	9,320.8	42.5	681.4	36.3	566.1	26.6	458.5
Finance, Insurance, Real Estate	245.8	9,250.2	40.0	1,600.1	15.0	541.1	11.9	386.7
Services	1,055.2	28,725.7	123.8	3,550.0	47.2	1,068.7	62.3	1,684.1
Unclassified	1.5	35.5	0	0	0		.8	1.9

Source: *1993 County Business Patterns,* U.S. Department of Commerce, Bureau of Economic Analysis.

3.18 NAVIGATION

The existing project area is characterized by a series of maintained navigation channels and berthing areas. With regard to the proposed subaqueous NBCDF and attendant alternatives, it is paramount that the facilities not encroach on existing navigation infrastructure or otherwise adversely impact vessel movements. A review of existing channel/harbor area boundaries, together with an assessment of existing and future projected vessel traffic, presented within this section will serve as the basis for evaluating the impact of the proposed NBCDF on existing navigation. Each alternative will be evaluated for both temporary (i.e., construction/operation) and permanent impacts.

This study incorporates New York Haroor vessel movements via the existing water resource projects under the authority of the USACE New York District.

3.18.1 CHANNELS

Figure 3.18-1 indicates that the NY/NJ Harbor Complex contains several main navigation channels and auxiliary channels. The existing Federal projects include the Ambrose Channel from the sea through the Lower Bay to the Narrows with a length of 10.2 miles (16.4 km), a width of 2000 ft (610 m), and a depth of -45 ft (-13.7 m) at MLW. Other channels that extend outward from the main Ambrose entrance are (1) Anchorage Channel, consisting of a 5.7-mile (9.2 km) extension of Ambrose Channel, with a depth of -45 ft (-13.7 m) MLW and width of 2000 ft from the Narrows through the anchorage grounds on the Upper Bay to the Hudson and East Rivers; (2) Sandy Hook Channel, consisting of an East Section and the Bayside Section from the ocean east of Sandy Hook to the junction with the Main Ship Channel, moving a length of 7.1 miles (11.4 km), a width of 800 ft (244 m), and a depth of -35 ft (-10.7 m) MLW; (3) the Main Ship Channel, extending from Bayside Channel to deep water in the Lower Bay, with a length of 5.3 miles (8.5 km), a width of 1000 ft (305 m), and a depth of -30 ft (-9.1 m) MLW; (4) a small channel to the west of Swinburne and Hoffman Islands; and (5) a channel along the New Jersey Pierhead Line, connecting Kill Van Kull with deep water in the Anchorage Channel at a point south of Liberty Island with a length of 3 miles (4.8 km), a width of 500 ft (152 m) (increasing to 800 ft [244 m]) at bends), and a depth of -20 ft (-6.1 m) MLW.

In the Upper Bay auxiliary channel projects exist along Buttermilk Channel, Red Hook Channel, Bay Ridge Channel, Gowanus Creek Channel, Hudson River Channel, East River Channel, and Kill Van Kull Channel. Kill Van Kull Channel, extending from the New York Harbor Anchorage Channel westward to the junction with Newark Bay in the vicinity of Shooters Island, New York, and Bergen Point, Bayonne, New Jersey, is proposed to be deepened from -35 to -44 ft (-10.7 to -13.4 m) with selective widening for safer vessel passage. To date, deepening has been completed to a depth of -40 ft (-12.2 m). The Arthur Kill Channel, extending from Kill Van Kull to Sandy Hook Channel at Perth Amboy, is also proposed to be improved, as are the Port Jersey and

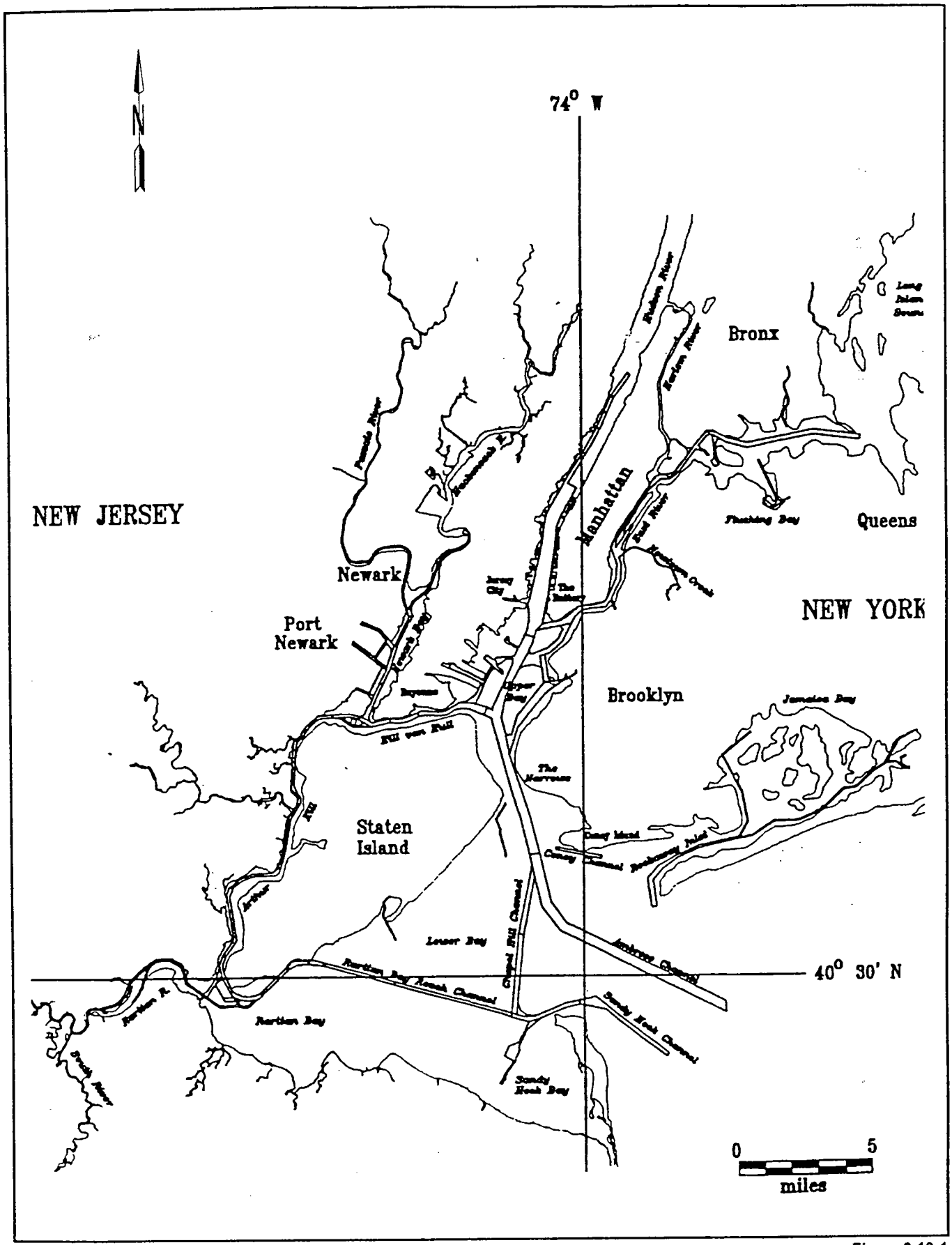


Figure 3.18-1

U.S. Army Corps of Engineers
Newark Bay Confined Disposal Facility

Navigation Channel Reaches in
New York/New Jersey Harbor

Claremont Terminals along the New Jersey shoreline. The Arthur Kill is authorized for deepening from -35 to -40 ft (-10.7 to -12.2 m) and 41 ft (12.5 m) and selective widening for safer vessel passage. Port Jersey Channel is proposed for deepening from -35 to -42 ft (-10.7 to -12.8 m). Claremont Terminal is proposed for deepening from -27 to -34 ft (-8.2 to -10.4 m).

Newark Bay is a relatively wide waterway in comparison to the Arthur Kill, the Kill Van Kull, the Passaic River, and the Hackensack River. Several Federally maintained channels exist within Newark Bay, including (1) Newark Bay South Reach; (2) South Elizabeth Channel; (3) Newark Bay Middle Reach; (4) Newark Bay North Reach; (5) Port Elizabeth Channel; (6) Port Elizabeth Pierhead Reach; (7) Port Elizabeth Inshore Reach; (8) Port Elizabeth Branch Reach; (9) Port Newark Pierhead Reach; (10) Port Newark Inshore Reach; and (11) Port Newark Branch Reach. The Federal channels within Newark Bay provide access to highly active port facilities at the Port Newark and Port Elizabeth Marine Terminals. The marine terminals at Port Newark and Port Elizabeth are located on the western side of the waterway, where the channels and harbor basins are relatively deep and maintained by dredging. The eastern side of the bay is characterized by shallow areas having shallow water depths ranging from 0.5 to 10 ft (0.2 to 3.0 m). The Federally maintained channels have authorized widths ranging from 400 to 600 ft (122 to 183 m) and water depths ranging from -35 to -40 ft (-10.7 to -12.2 m) (MLW).

3.18.2 ANCHORAGE AREAS

The greater New York Harbor, home to marine-related activities for both New Jersey and New York, is served by several anchorage areas. The primary Federally authorized projects are Red Hook (Flats); Gravesend; and Perth Amboy. Two other Federally authorized projects are found at Liberty Island and Sandy Hook. A description of the anchorages follows:

1. **Red Hook Flats** - Located in the Upper Bay, it is divided into three sections designated as 21A, 21B, and 21C. Area 21A is a non-Federal project that covers approximately 350 acres (1.5 km^2) with controlling depths between -10 to -14 ft (-2.0 to -4.3 m). This Anchorage reportedly receives little use because it is too shallow for tugs used for barge movements associated with vessel lightering. Area 21B is a Federally maintained space of approximately 700 acres (2.8 km^2) with a project depth of -35 ft (-10.7 m). It is restricted to vessels with drafts between 10 and 33 ft (3.0 and 10 m). It is used primarily by barges and vessels less than 700 ft (213 m)in length. Area 21C is a Federally maintained space of approximately 390 acres with nominal project depths of -40 ft (-12.2 m) in the northern half and -45 ft (-13.7 m) in the southern half.

2. **Gravesend Bay** - Located off the southwest coast of Brooklyn in the Lower Bay portion of New York Harbor, it is designated as section 25 and

encompasses approximately 335 acres (1.5 km^2) at a project depth of -45 ft (-13.7 m) (MLW). Reportedly, Gravesend receives little use because of water conditions and unstable anchorage that can result in vessel shifting.

3. **Liberty Island** - This area is located northwest of the Anchorage Channel in the vicinity of Ellis Island north to the Kill Van Kull in a series of small spaces that overall constitute approximately 160 acres at a nominal depth of -20 ft (-6.1 m). The discrete spaces of the anchorage limit their use to primarily recreational and pleasure craft.

4. **Perth Amboy** - Located at the confluence of the New Jersey and New York Channels and the Arthur Kill Channel near Ward Point at the southern tip of Staten Island, the anchorage consists of approximately 175 acres (0.7 km^2) at a project depth between -25 to -37 ft (-7.6 to -11.3 m). Reportedly, this facility receives little use because of its depth constraint and location.

5. **Sandy Hook** - Located at the confluence of the Main Ship Channel, New Jersey and New York Channels, and Bayside Channel, the authorized dimensions provide for approximately 270 acres (1.0 km^2) at an authorized project depth of -38 ft (-11.6 m). This anchorage was never constructed.

In addition to the Federal interest projects, there is a non-Federal interest anchorage in naturally deep water located off the coast of the Stapleton section of Staten Island. This anchorage, referred to as "Stapleton," encompasses approximately 850 acres (3.5 km^2) with water depths in some sections exceeding 70 ft (21.3 m). Stapleton is the preferred New York Harbor site for deep-draft vessel anchorage; it is limited by strict enforcement to a 48-hr maximum anchorage occupancy.

3.18.3 TRAFFIC MANAGEMENT/NAVIGATION PRACTICES

An average of 400 to 500 vessel transits take place within New York Harbor per day, including ferries and excursion vessels. Traffic management within NY/NJ Harbor is a cooperative effort between the U.S. Coast Guard, the Maritime Association, tug companies, and docking pilots. The Coast Guard has the lead responsibility for maritime law enforcement, placement and maintenance of aids to navigation, regulation of anchorage use and movement of vessels, and protection of life and property. The Code of Federal Regulations (CFR) specifies the operating rules under which users of channels and anchorages must operate. The CFR is enforced by the Coast Guard under the office of the Captain of the Port. The Coast Guard, assisted by Congressional funding, operates the Vessel Traffic Service in New York (VTSNY) to improve safety and protect the environment. The VTSNY is designed to reduce the probability of collision or grounding by providing advance information on the movements of other vessels, traffic congestion, weather conditions, and other potential hazards to navigation. The VTSNY has been in operation in the NY/NJ port, including the major subsidiary channels in the Upper Bay

3.19 LAND USE

The study area encompasses both the eastern and western shores of Newark Bay, covering waterfront areas of Essex, Union, and Hudson counties. Three municipalities are located in the area: the City of Bayonne, located along the eastern shore of Newark Bay, and the City of Newark and the City of Elizabeth, both located along the western shore.

The waterfront areas of Newark Bay are characterized by industrial, commercial, and residential areas. Newark Bay itself is part of the 31-mile (50-km) Federal navigation area known as the New York and New Jersey Channels. The present land use of the area reflects the nonpassenger ship use of the channel. The western shoreline is dominated by Port Newark and Port Elizabeth, the leading containerized cargo and shipping marine terminals on the Atlantic coast. Transportation facilities and corridors, including Newark International Airport, the New Jersey Turnpike, and railroad right-of-ways encompass most of the remaining area.

The eastern shoreline of Newark Bay is predominantly residential, with public parks and community facilities located in the City of Bayonne. Residential areas include single-, double-, and multifamily housing units. Community facilities include county and city parks, as well as a high school, stadium, and playing fields.

A more detailed description of the existing land use and zoning in the study area is provided below.

City of Newark

The City of Newark is located in the southeast corner of Essex County, immediately north of the City of Elizabeth. The City of Newark, the Essex County Seat, is New Jersey's most populous city, with 275,000 residents. The 24-square-mile (38.6-km^2) city is located along the west banks of Newark Bay and the tidal Passaic River. Newark is an industrial and transportation hub of the state, with highways, railroads, bridges, a major airport, and seaport facilities in the southeastern part of the city. Multistory buildings in the downtown area form the commercial hub of the city. Heavy industries are mostly concentrated in the low-lying southeastern part of the city and along the Passaic River. The more elevated northern, western, and southern sections include a mix of urban residences, commercial development, institutions, parks, and light industry.

City of Elizabeth

The City of Elizabeth is located in the northeast corner of Union County, New Jersey, just south of the City of Newark. Approximately 12 square miles (31.1 km^2) in size, Elizabeth is the county seat of Union County and contains one of the heaviest concentrations of industrial land uses in this otherwise suburban county. Major transportation facilities and corridors include; Newark International Airport, the New

Jersey Turnpike, and Port Newark/Elizabeth marine terminals which occupy large areas of the city.

Situated at the confluence of the Arthur Kill, Kill Van Kull and Newark Bay, the industrial land use of Elizabeth developed around the waterfront. Residential and commercial/retail areas are limited to the interior portions of the city. Approximately 45% of the City of Elizabeth is zoned for industrial activities. With the exception of the Waterfront Redevelopment Area, south of the proposed project area, the entire Elizabeth waterfront is zoned for heavy and medium industrial use. This area is characterized by densely developed industrial activities, including oil storage, manufacturing, metal fabrication, warehousing/distribution facilities, and the Port Newark/Elizabeth marine terminal. This 2100-acre (8.5-km^2) steamship terminal occupies most of the western shoreline of Newark Bay and the northern shoreline of Elizabeth. Industrial activities at the terminal include container storage and handling, liquid and solid bulk storage, warehouse and distribution buildings, and an on-dock rail terminal. Railroad right-of-ways, truck routes and highways, and Newark International Airport occupy most of the remaining land within the study area.

City of Bayonne

The City of Bayonne is located in the southernmost portion of Hudson County, New Jersey, located immediately south of Jersey City. Approximately 5 square miles (13.0 km^2) in size, Bayonne is situated on a peninsula, bounded by Newark Bay to the west, Upper New York Bay to the east, and the Kill Van Kull to the south. The Bayonne Bridge, located at Bergen Point, provides a connection to Staten Island to the south, while the New Jersey Turnpike Extension and Newark Bay Bridge provide a connection to Newark and Elizabeth to the west.

Land use in Bayonne is a combination of residential, commercial, and industrial districts, typical of urban municipalities. Mixed-use, commercial, and residential areas are located primarily along the north-south corridors and western shore of Bayonne, while industrial districts are located along the Upper New York Bay and Newark Bay/Kill Van Kull waterfront. Industrial land uses include heavy manufacturing such as petrochemical and metals industries, light manufacturing firms such as food processing and light assembly, and distribution and warehousing firms.

Four industrial districts are identified within Bayonne - the Port Jersey, Constable Hook, Bergen Point, and 53rd Street areas. Located on the eastern shore of Bayonne and approximately 727 acres (3.0 km^2) in size, Constable Hook, is the largest and most heavily concentrated industrial district. Port Jersey, located along the Jersey City/Bayonne border, is approximately 400 acres (1.5 km^2) (approximately 160 acres [0.65 km^2] in Bayonne) and consists of a container port, the PA Auto Marine Terminal, and the Global Marine Terminal. The Bergen Point and the 53rd Street districts are both located within the project study area, along the eastern shore of Newark Bay. The 53rd Street district, located in the northwest corner of Bayonne, south of the Newark Bay

Bridge, is the smallest of the four industrial districts, covering approximately 19 acres (0.1 km^2). Access to this district is poor, passing through established residential areas. Commercial and industrial development is limited. The Bergen Point district is located at the southern end of the study area, at the tip of the peninsula between Newark Bay and the Kill Van Kull. Development in the district includes basic metal and chemical manufacturing and light industrial firms.

Except for the Bergen Point and 53rd Street industrial districts, land use along the eastern shoreline of the project study area is primarily residential and public. Residential areas include single-, double-, and multi-family housing. The predominant residential land use within the study area is the double-family detached house on relatively small lots (usually 25 x 100 ft [7.6 x 30.5 m]). Some single-family housing is located to the south of Bayonne Park, while some multifamily housing, including mid- and high-rise apartments, is located north of Bayonne Park along the eastern shoreline of Newark Bay.

Community facilities located along this shoreline include Bayonne Park, City Park, Veterans Park, and Bayonne High School. Located between West 37th and West 48th Street, Bayonne Park is bordered by Newark Bay to the west and John F. Kennedy Boulevard to the east. Maintained by Hudson County, Bayonne Park is approximately 98 acres and is the largest park facility located within the city limits. The park includes sitting areas, walking paths, and open areas. Veterans Park and Bayonne High School are located south of Bayonne Park. Approximately 11 acres (0.04 km^2), Veterans Park includes a football stadium, a baseball diamond, and sitting areas. City park, located at West 16th Street and Avenue A, is bordered by Newark Bay to the west and is approximately 20 acres (0.1 km^2). Facilities include sitting and picnic areas, a playground, basketball and tennis courts, playing fields, and an amphitheater. All three parks offer waterfront walkways and access to the Newark Bay waterfront. The City of Bayonne Comprehensive Master Plan recognizes the opportunity of linking these park areas with a waterfront pathway network.

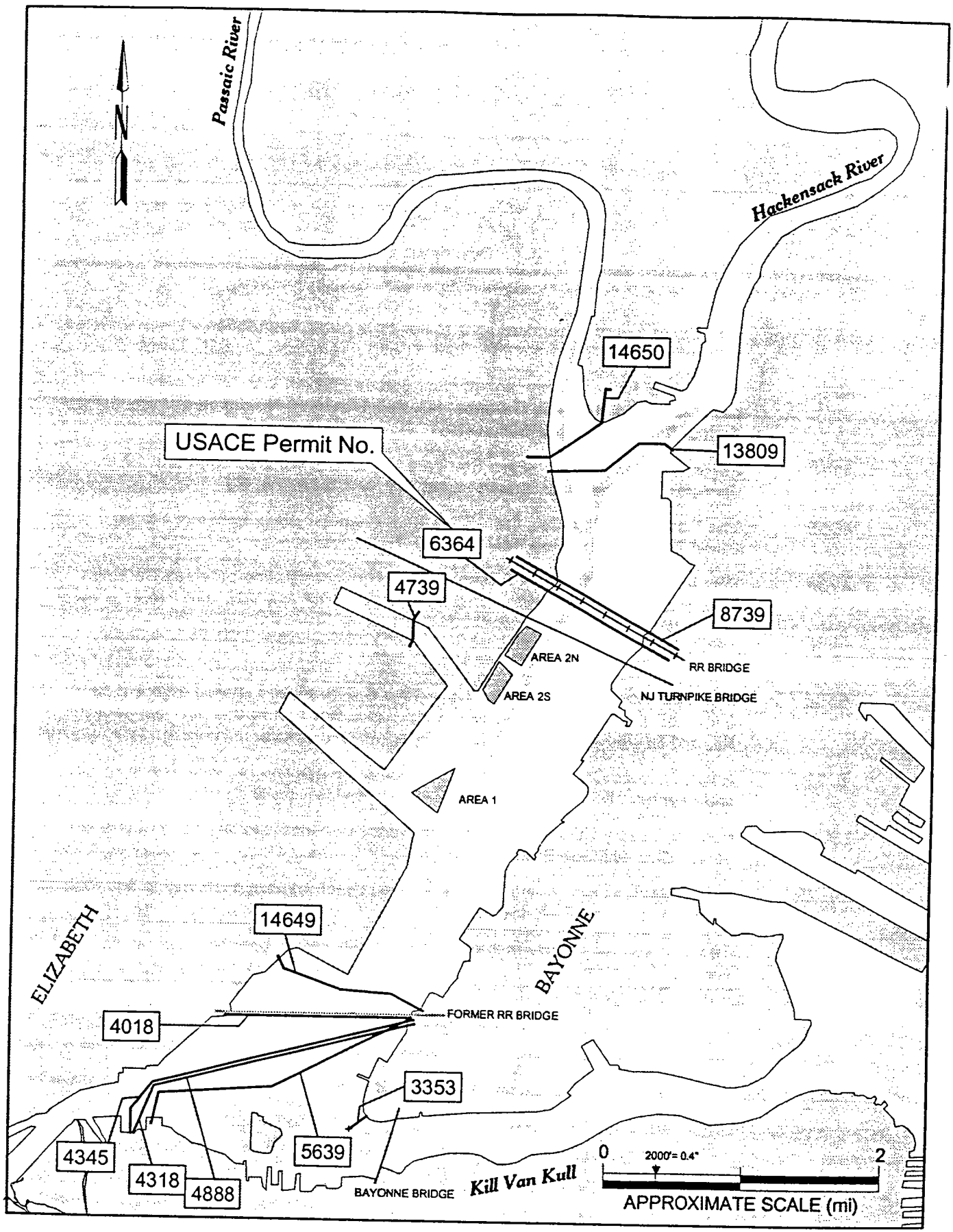
Newark Bay

Newark Bay has several submerged cable and pipeline crossings (Table 3.19-1 and Figure 3.19-1). None of these transverse the areas identified in the alternatives described in Section 2.03.3, including Areas 1, 2S, 2N, and 3. All are north of or clustered in the southern portion of the bay.

Table 3.19-1

Submerged Utilities in Newark Bay

Permit Number (Used as Map Designator)	Descripton of Utility
3353	U.S. Coast Guard - Standard light tower on a riprap foundation with associated submarine cable.
4019	The Central Railroad Company of New Jersey - Seven submarine cables between cables between Bayonne, NJ, and Elizabeth, NJ, located at the Jersey Central Railroad Bridged (removed)
4318	Exxon Company U.S.A. (Esso Standard Oil Co.) - Two 8-in.- and one 12-in.-diameter pipes between Staten Island, NY, and Bayonne, NJ
4345	The Tide-Water Pipe Co., Ltd. - Two 8-in.-diameter pipes between Staten Island, NY, and Bayonne, NJ.
4739	Port Authority of NY/NJ - Twenty-four-inch water pipeline between Doremus Ave. and Export St.
4888	Texas Eastern Transmission Corp. - Twelve-inch pipeline between Bayonne, NJ, and Howland Hook (Staten Island), NY.
6364	Public Service Electric and Gas Co. - Two 8.6-in. pipes installed adjacent to (south of) the Lehigh Valley and Pennsylvania Railroad Bridge between Newark, NJ, and Bayonne, NJ.
8739	Amerada Hess Corp. - Fourteen-inch submarine pipeline between Newark, NJ, and Bayonne, NJ.
13809	Hudson County Utilities Authority - Seventy-two-inch sanitary sewer between Jersey City, NJ, and Bayonne, NJ.
14649	Public Service Electric and Gas Co. - Twelve-inch natural gas pipeline between Elizabeth, NJ, and Bayonne, NJ.
16450	Town of Kearny - Thirty-inch diameter sanitary sewer between Kearny, NJ, and Newark, NJ.



U.S. Army Corps of Engineers
Newark Bay Confined Disposal Facility

Figure 3.19-1
Submerged Cable and Pipeline Crossings

3.20 NOISE

Noise in the project study area originates from a variety of sources, including commercial vehicles, industrial machinery, and steamship operation. The proposed NBCDF sites are bordered to the west by the Port Newark/Elizabeth marine terminals and heavy industrial areas. Noise levels from these sources varies with the level of use (i.e., time of day) and type of machinery operated (e.g., cranes, derricks, loading equipment). The open water of Newark Bay and the Federal Navigation Channel are east of the proposed NBCDF sites, while the New Jersey Turnpike Extension and Newark Bay Railroad Lift Bridge are to the north. Primary sources of noise from these areas are boating/shipping activity, highway traffic, and railroad traffic. Commercial airplanes using Newark International Airport, located approximately 1.5 miles (2.5 km) west of the proposed NBCDF development area, also contribute to noise levels in the study area.

Noise levels are generally expressed as a single value of broadband noise using a frequency weighting that simulates human perception. Noise criteria or permissible sound levels are usually specified in the units of A-weighted noise or decibels A (dBA).

Noise control ordinances exist for all three local municipalities in the study area. These ordinances often designate maximum permissible sound levels from sources to receiving properties/receptors or time of day restrictions on construction activities near residential or sensitive noise receptor areas. Potential noise-sensitive receptors include schools, churches, residences, libraries, parks, recreational areas, hospitals, senior citizen homes, and rehabilitation centers. No noise-sensitive receptors were identified in the vicinity (less than 1000 ft [300 m]) of the proposed NBCDF sites. Bayonne Park, Veterans Park, Hudson County Park, and the Bayonne High School, situated along the Bayonne waterfront area, are the noise-sensitive receptors nearest the proposed NBCDF site. The City of Bayonne and the City of Elizabeth both prohibit construction or repair activities during nighttime hours, i.e., no construction or repair activities between the hours of 8:00 p.m. and 7:00 a.m. and 9:00 p.m. and 7:00 a.m. weekdays, respectively. The City of Newark has adopted maximum permissible sound levels according to the source of the sound and the sound receptor category (e.g., residential, industrial). The following table lists the maximum permissible sound levels in the City of Newark by receiving property type or category:

	Receiving Property Category				
Sound Source Property Category	Residential 7 a.m.-10 p.m.	Residential 10 p.m.-7 a.m.	Commercial All Times	Industrial All Times	Hospital Quiet Zone All Times
Residential	55 dBA	50 dBA	65 dBA	75 dBA	50 dBA
Commercial	65 dBA	50 dBA	65 dBA	75 dBA	50 dBA
Industrial	65 dBA	50 dBA	65 dBA	75 dBA	50 dBA

Source: Noise Control Ordinance of the City of Newark, 17:3A

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4.0 ENVIRONMENTAL IMPACTS OF CONSTRUCTION AND DISPOSAL OPERATIONS INTO THE CDF

The primary objective of the NBCDF is to provide an environmentally acceptable disposal method for dredged material removed from selected locations in the New York Harbor. The need for this special disposal facility is brought about by the presence of chemical contaminants in the sediments, which results in material deemed unacceptable for ocean disposal.

The NBCDF is a project primarily related to dredging and dredged material disposal, but it has the secondary benefit of reducing contaminant levels in the Bay. This assessment focuses on the potential impact of dredging and dredged material disposal, including the potential for contaminant release and organism exposure, as would be done in the evaluation of any dredging and disposal operation. The method of disposal is given special attention because it is a relatively new approach that has not been applied in the Port of New York and New Jersey.

The burial of contaminated sediments has the potential to remove some of the widespread contamination from contact with aquatic life. However, the quantities of contaminated material to be buried in the NBCDF would represent a very small portion of the total residual contamination present in the Harbor. In addition, all of the potential sources of contamination have not been remediated; thus, additional contamination could occur in areas dredged during this project. The relationship of this dredging project to the long-term management of contaminants is discussed, but this is a secondary aspect of this assessment.

The spatial and temporal boundaries for this assessment are based on the unique features of the project. The spatial boundary for the assessment of the disposal facility will be Newark Bay because all reasonable CDF alternatives are wholly within the Bay.

The temporal boundaries for the assessment will be a short-term and a long-term time frame. The objective of the project is to dispose of dredged material that cannot go to the ocean disposal site and then return the disposal area to its original bottom contours, with the expectation that the area will recover and become usable as aquatic habitat. There will be no structure remaining or an ongoing, long-term activity at the disposal site after it is filled and capped. The most likely sequence for implementing the CDF is to construct the pit(s) and begin filling as soon as it is available. The short-term time frame for this assessment will be the construction, filling, and capping of the facility taken as a discrete, continuous impact. The long-term time frame will begin when capping is completed and activity ceases at the site. At this point in time a long-term monitoring program will begin. A major component of this assessment will be an evaluation of the adequacy of the proposed monitoring plan, including the duration of the monitoring.

4.02 PHYSICAL OCEANOGRAPHY

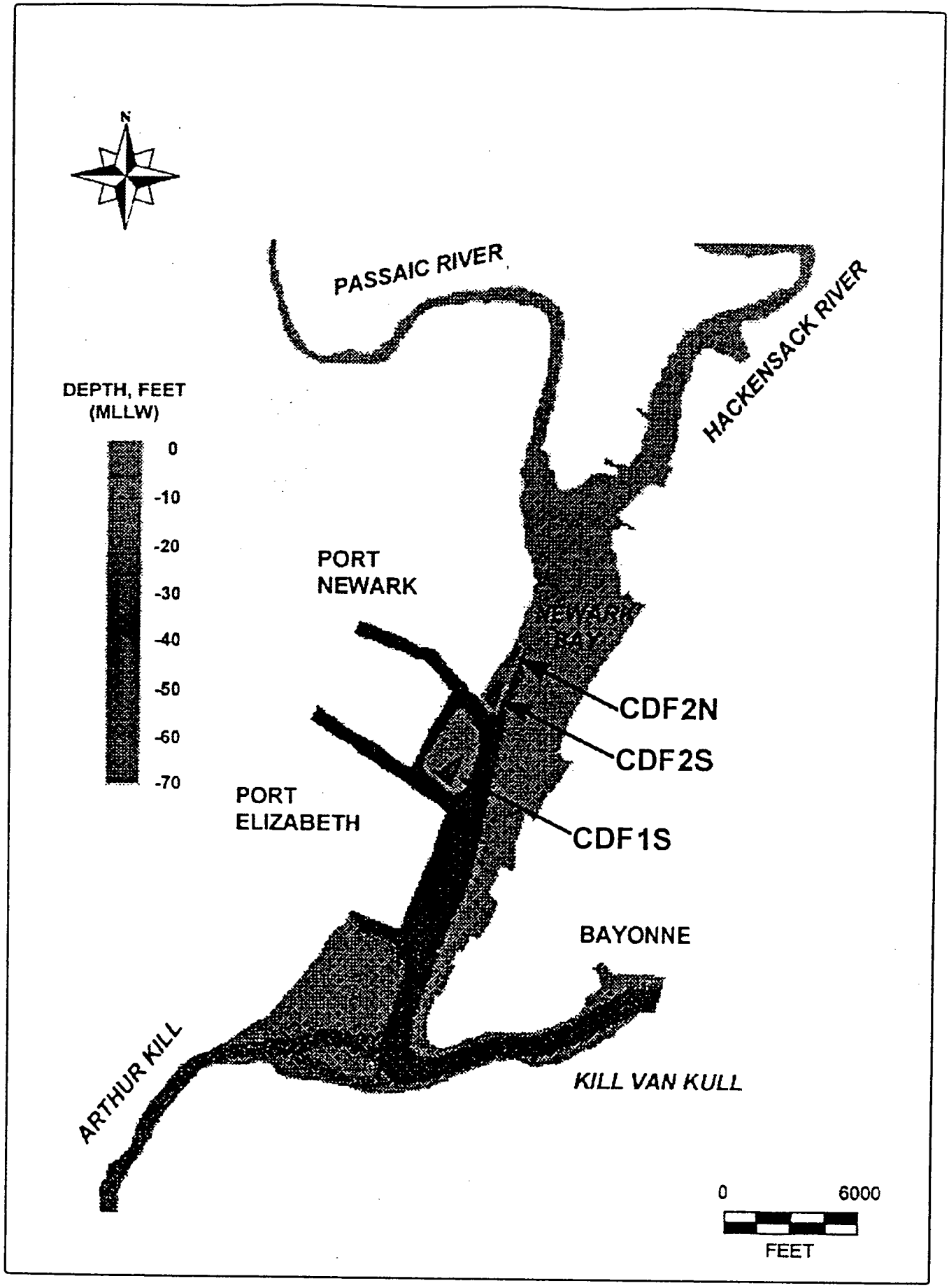
4.02.1 TIDAL HYDRODYNAMICS AND SEDIMENTATION

Tidal hydrodynamics and sedimentation models have been developed for the NBCDF and its environs. The purpose of this modeling effort was to assess the impacts of dredging and disposal operations on area hydrodynamics, erosion of the proposed cap, and area sedimentation. The following sections present a brief description of the model development, calibration/verification and model results. A detailed description of the model is presented in Appendix 4.02.

4.02.1.1 Simulation Models. The TABS-2 numerical modeling system of the USACE-Waterways Experiment Station (WES) used in this study includes hydrodynamic (RMA-2), constituent transport (RMA-4), and sedimentation (STUDH) models (Thomas et al. 1985). The TABS-2 system consists of pre- and postprocessor utility codes and three finite-element, two-dimensional, depth-averaged computational programs. The three basic components of the modeling system are as follows: (1) a two-dimensional model for free surface flow (RMA-2), (2) a two-dimensional, finite-element program for water quality (RMA-4), and (3) sediment transport in unsteady two-dimensional flows, horizontal plan (STUDH). All models are solved by the finite-element method using Galerkin-weighted residuals. The finite-element method provides a means of obtaining an approximate solution to a system of governing equations by dividing the area of interest into smaller subareas called elements. Time-varying partial differential equations are transformed into finite-element form and then solved in a global matrix system for the modeled area of interest. The solution is smooth across each element and continuous over the computational area. Both sand and clay transport can be modeled separately.

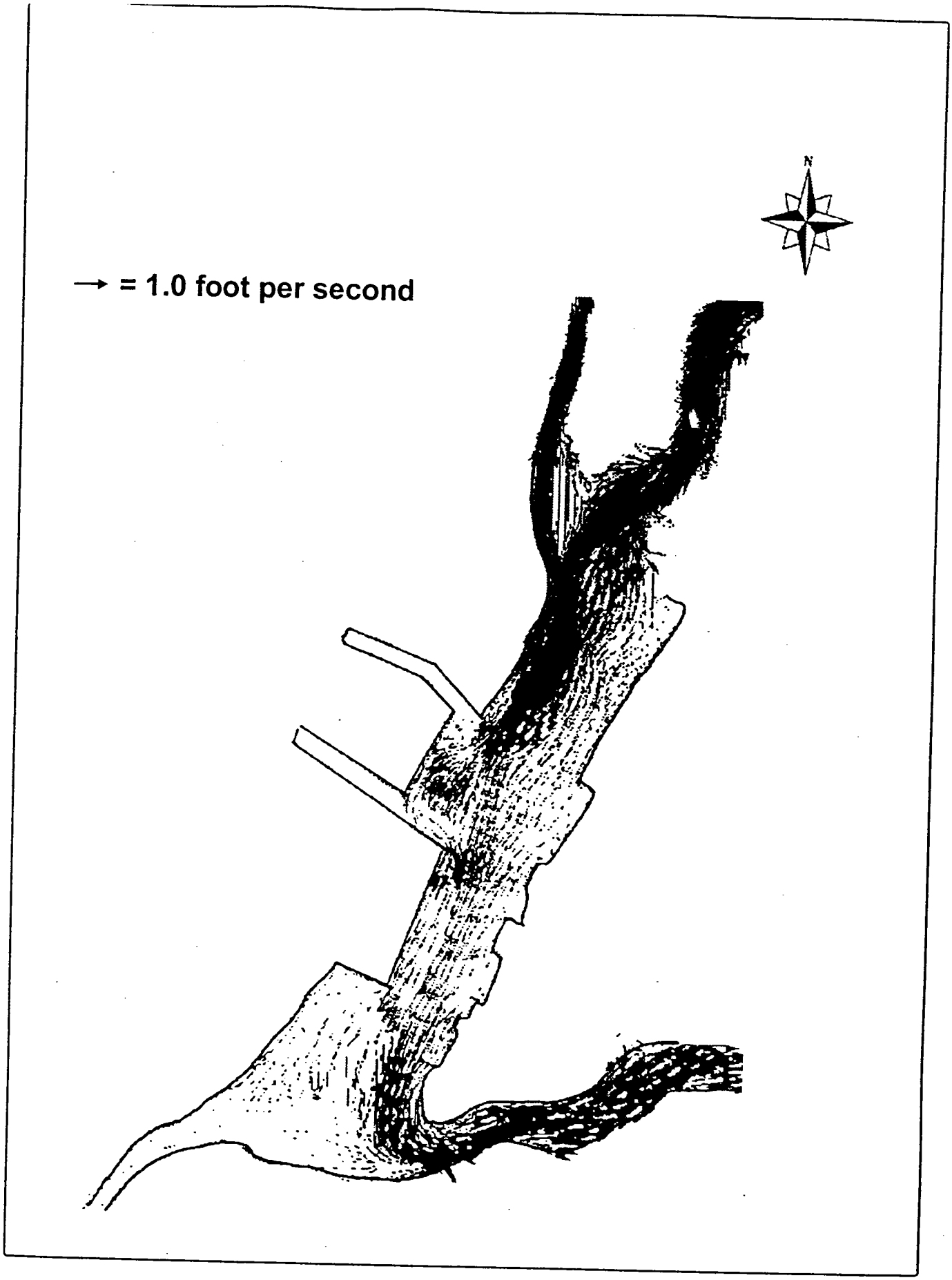
4.02.1.2 Model Calibration. The USACE Waterways Experiment Station (WES) has calibrated and verified the finite-element model with field measurements in order to assure accurate representation of tidal flows within a modeled estuarine system. The calibrated and verified model has been used to evaluate the impacts of proposed changes on the system. Calibration is an iterative process that involves adjusting model parameters so that model predictions match field observations reasonably well.

Hydrodynamic model calibration is best achieved by means of a set of simultaneous measurements both along the model boundaries and throughout the estuarine system. Boundary conditions important to the present study include tidal elevation, flow velocities, and freshwater discharge. For a given set of boundary conditions, the model is calibrated to reproduce tidal elevations and tidal velocities within the estuary by choosing appropriate controlling parameters. The hydrodynamic model was calibrated against field measurements using the Troy Dam discharge at the northern model boundary in the Hudson River, freshwater discharge from the Passaic and Hackensack Rivers, and recorded time-varying tidal elevation and velocities at the other model boundaries.



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Figure 4.02-1
Bathymetry Contour Map for Hydrodynamic Modeling of Dredged CDFs 1S, 2S, and 2N



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Figure 4.02-3
Peak Ebb Tidal Currents
in Newark Bay

4.03 METEOROLOGY

The proposed NBCDF alternatives will not affect meteorological conditions in the vicinity of Newark Bay. The project, when completed, would maintain the same physical configuration as the existing condition because the final elevation of the cap(s) would be placed at the existing bottom elevation.

Table 4.04-2

Noncohesive Sedimentation Parameters

Model Parameters	Units	Values
Crank-Nicholson THETA		0.66
Particle shape factor		0.7
Length factor (deposition)		0.5
Length factor (erosion)		10
Particle specific gravity		2.65
Median grain size	mm	0.1 to 0.3
Effective diffusion	m**2/sec	50
Inflow concentration	kg/m**3	0.005
Settling velocity	m/sec	0.01
Manning's n		0.025

4.04.2 CONSTRUCTED CDFs

Model runs were made to evaluate sedimentation rates that could occur following construction of the NBCDFs. The purpose of the analysis was to estimate the sedimentation that might occur during filling operations and to determine whether sedimentation would materially reduce the volume of the pits for dredged material. The model was used to simulate Area 1S as excavated prior to disposal of dredged sediments. Figure 4.04-1 shows a contour plot of sedimentation rates in Newark Bay, including the NBCDF area. Figure 4.04-1 indicates a sedimentation rate of approximately 6 to 12 in. (15.2 to 30.5 cm) per year. These rates are greater than the sedimentation rate found by Bopp et al. (1991) as described in Section 3.04. Figure 4.04-2 shows baywide sedimentation rates with the pit in place at Site 1S. The sedimentation rates are the same with or without a CDF at Area 1S. The proposed length of time required to complete NBCDF filling is from one to three years. Accordingly, while sedimentation is anticipated, the total sediment volume would have a negligible effect on reducing pit capacity (about 1-2%).

Modeling was also performed to evaluate changes in suspended sediment concentrations within Newark Bay due to dredging and disposal operations at the NBCDF. Figure 4.04-3 shows baywide suspended sediment concentrations. There were no changes in concentrations when the NBCDF was added to the suspended sediments model. This is to be expected because there is no mechanism by which a significant amount of suspended material could be removed from the water column.

After the project is completed, sedimentation of fine-grained material would continue in the Bay and would cover the cap. Eventually, the sediments covering the NBCDF would revert back to the existing fine-grained silt and clay substrate type.

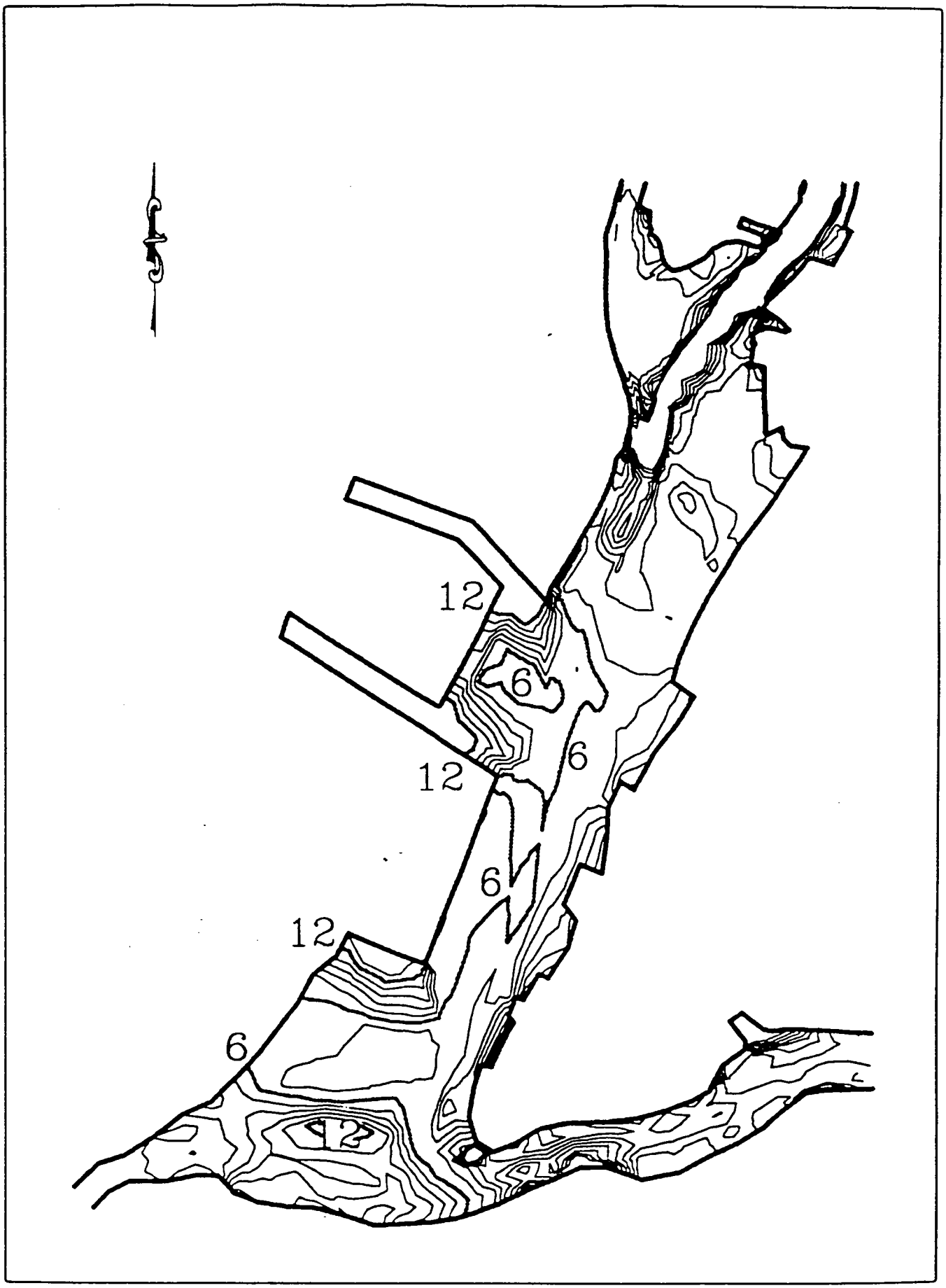


Figure 4.04-1

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Sedimentation Rates Without Pit in Newark Bay
(in./year) - Cohesive Sediments

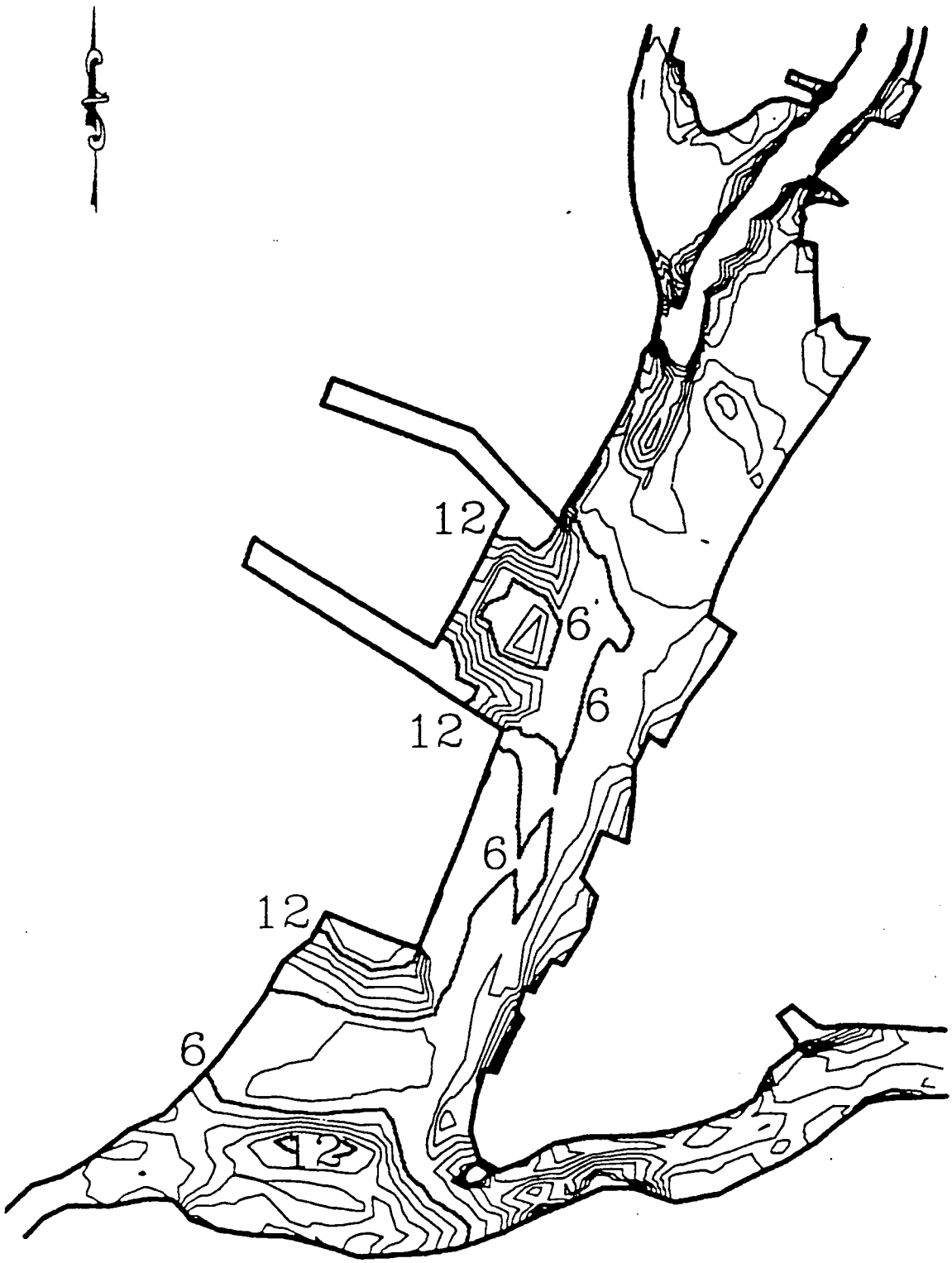


Figure 4.04-2

U.S. Army Corps of Engineers
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Sedimentation Rates With Pit in Newark Bay
(in./year) - Cohesive Sediments

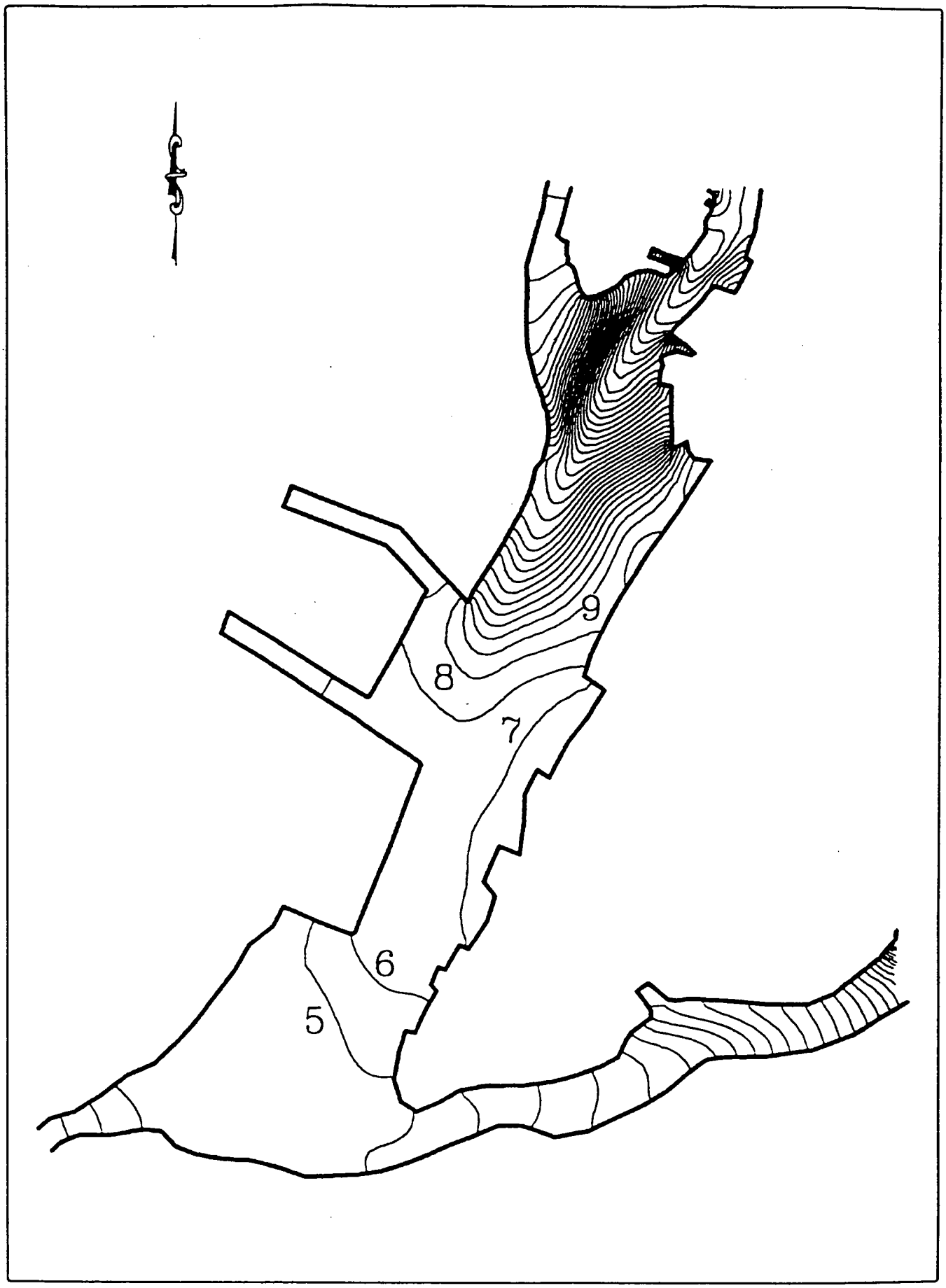


Figure 4.04-3
Suspended Sedimentation Concentrations (mg/l)

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Design of the cap, including required thickness and material, is discussed in Section 5.04. The design criteria included cap integrity with regard to physical and chemical isolation, bioturbation, consolidation, wave- and current-induced erosion, and construction tolerance. Section 5.04 includes an evaluation of cap stability under different conditions, including a 100-year flood event.

4.05 WATER QUALITY

The potential impacts of the NBCDF on Newark Bay water quality are assessed in terms of the short-term (construction, disposal and capping operations) and the long-term (post-capping) periods. Construction and operation of the NBCDF will not affect overall sedimentation patterns and rates or concentrations of total suspended solids (TSS) throughout Newark Bay (Figures 4.04-1 and 4.04-2). However, localized effects will occur in the NBCDF area including a decrease in current velocities causing increased sedimentation. This will result in a decrease in local TSS concentrations. Studies of subaqueous borrow pits within New York Harbor show low DO concentrations within the pits (Bokuniewicz et al. 1986). The disposed sediment will be in a chemically reduced state within the pits so that particle-bound metals (i.e., copper, zinc, cadmium, mercury and lead) are unlikely to migrate. The partitioning of organic contaminants is largely controlled by the organic carbon content of the sediment. As changes in the organic carbon content of the sediments are expected to be minimal, there will be little migration of organic contaminants during disposal.

The effects of the disposal operation on nutrients and DO in the water column surrounding subaqueous borrow pits evaluated as potential CDFs located in lower New York Harbor were reported to be negligible (Bokuniewicz et al. 1986). Therefore, there should be only a negligible short-term impact of the NBCDF on nutrient and DO concentrations in Newark Bay.

The sediment transport modeling indicated that the NBCDF cap will be stable, thus no scour of disposed sediments is anticipated. The pathways for release of contaminants through bioturbation and/or gas bubbles penetrating the cap are expected to produce only minimal releases. The settlement of the cap in the first two years after placement depends on several factors such as the porosity and specific weight (bulk density) of disposed sediments, time span to fill the pit, number and size of blocks of disposed sediment, initial and final porosity of the cap material, and the thickness of the cap. Because these factors cannot be quantified at this time, it is not possible to estimate the settlement of the cap in the first two years after placement. The settlement of the cap may exceed the thickness of the cap and, if the porosities of the dredged material in the CDF and the cap are similar, pore water from the dredged material will be expelled through the cap during this time. The depth of dredged material in the CDFs is approximately 67 ft (20.4 m) and a 3-ft (1.0-m) thick cap is planned. The volume of pore water within the dredged material that will be expelled by compaction is probably a relatively low percentage of the total initial pore water.

If the cap settles and the pit area is depressed below the surrounding bottom of the Bay, deposition of ambient sediment will be fostered to fill in this depression and eventually an equilibrium will be reached. The layer of natural sediment overlying the cap provides an additional buffer to retain pore water from the dredged material.

The flux of contaminants associated with potentially expelled pore water depends primarily on the contaminant concentrations within the dredged material, contaminant partitioning coefficients, and the overlying Newark Bay water concentrations. Because the contaminant concentrations of the dredged material to be disposed of are unknown, it is not possible to estimate the flux of contaminants associated with potentially expelled pore water. Nevertheless, any flux would probably be minimal in relation to the mass of contaminants sequestered because the contaminants have a high affinity for the dredged sediment and therefore will generally remain immobile below the cap. The monitoring of the cap (Section 5.07) will provide a means to assure that contaminants are not substantially released to the overlying Bay.

The net long-term impact of the NBCDF on water quality depends on whether (or not) contaminated sediments only from Newark Bay (e.g., Port Elizabeth, Port Newark channels) are dredged and disposed of in the pits. If contaminated sediments from Newark Bay are disposed of in the CDFs, there would probably be a reduction in contaminant levels in the dredged area because dredging to project depths with an allowable overdepth would remove sufficient amounts of sediment to expose relatively cleaner material. If dredged sediments are not solely from Newark Bay, changes in surficial sediment contaminant levels would be confined to capped CDF areas and dredged areas in the Bay. As the capping material will be uncontaminated, there will be at least a slight reduction in contaminant concentrations at Areas 1S, 2S, and 2N. Reductions in contaminant levels of Newark Bay sediments would have a beneficial impact on long-term water quality. Such changes are difficult to quantify, but are likely to be very small. The natural sedimentation over the cap will tend to minimize these changes with time. In summary, the project will not have significant short- or long-term adverse impact on water quality.

4.06 FISH AND SHELLFISH

4.06.1 HABITAT DISTURBANCE

Dredging to create the NBCDF would temporarily disturb approximately 56 acres (0.23 km^2) of shallow-water habitat in Newark Bay, including the connecting channels from the existing shipping channels to the disposal pits. There would be a removal of all substrate material from this area, with disposal in the ocean, an adjacent CDF or used beneficially. The benthic organisms in this area would be lost and the habitat would be unavailable as a feeding area for fishes. The duration of this impact would be for the length of the CDF operation.

The temporary habitat loss represents approximately 1.4% of the bottom area of Newark Bay and approximately 2.0% of the shoal habitat in the Bay. The fish and invertebrate studies summarized in Chapter 3.0 show that there were no major differences among the shoal areas sampled in the Bay. In addition, many of the species that use the shoal areas are also abundant in the channel areas. There is extensive habitat for fish and shellfish in Newark Bay that could be utilized while the CDF is under construction and in operation.

The sampling data from Newark Bay and a review of agency files shows that there are no endangered or threatened species of aquatic life reported in Newark Bay. In addition, the species of fish and shellfish that are abundant and ecologically important in Newark Bay are widespread and abundant in New York Harbor and nearby coastal waters and estuaries. The areas considered for CDF development in Newark Bay do not represent critical habitat for any of these species.

An important element in the development of the CDF for dredged material disposal was the potential for recovery of the CDF site as functional habitat for aquatic life. Following placement of the cap, natural sedimentation would produce a fine-grained mud substrate identical to the surrounding undisturbed shoal area. The large area of nearby undisturbed habitat would be a source of organisms to recolonize the CDF. The organisms that live burrowed in the substrate, while lacking mobility, may have early life stages that are carried by tidal currents to new areas. There organisms are also moved about when scour takes place through high current velocities and wave action associated with storms. Mobile organisms such as fish and shellfish would move into the area as soon as there is a natural substrate and food resources.

A study conducted in New York Harbor at the Passenger Ship Terminal (PST) showed that the recolonization of a dredged area is very rapid, with productive habitat conditions reestablished in a matter of months (Parish and Weiner, Inc. 1989). The PST is dredged annually to provide adequate depth for berthing large cruise ships. An interpier basin at the PST was sampled for fish and invertebrates just prior to dredging in April and sampled again the following fall and winter. There was no substantial difference in the

abundance of fish and epibenthos between these two surveys even though approximately 5 ft (1.5 m) of sediment had been removed after the first survey. Interpier basins in the Harbor have been found to be important habitat for fish and invertebrates despite the fact they have been subjected to repeated disturbances through dredging. The shoal areas disturbed for the CDF in Newark Bay should recover to useful habitat after several months and be fully recovered in approximately one year. The compaction of the dredged material within the pits would cause the cap to settle approximately 3.5 ft (1.1 m) in the first two years. This settlement will create a depression in the area of each CDF. Sedimentation in the depression may be somewhat greater than in surrounding shoal areas, but the habitat formed would be attractive to aquatic life and a normal complement of organisms would use the area. Their use of the area would continue as the depression fills with sediment, and reaches equilibrium with the surrounding shoals.

4.06.2 EXPOSURE TO CONTAMINANTS

A major factor in the potential exposure of aquatic life to contaminants released during the construction and operation of the CDF is the movement and migratory patterns of the organisms. Many fish and some invertebrates cover broad areas in their search for food and often larger areas associated with their reproductive cycles. The fish community in the New York Harbor/Newark Bay complex can be characterized as transient in that very few species remain in an area as small as Newark Bay throughout their life cycle. Most species, in fact, move into and out of Newark Bay seasonally or over shorter intervals of time.

Invertebrates generally cover relatively small distances compared to fish, but the epibenthos (those invertebrates which move over the bay bottom) can cover substantial distances daily and seasonally. Crabs and a variety of small crustaceans (shrimps) can crawl, swim, or be carried by tidal flows as they respond to a variety of environmental cues. Benthic organisms that live burrowed in the substrate (infauna), in contrast, do not make regular movements, which makes them particularly susceptible to dredging effects and contaminant exposure.

All aquatic organisms present in Newark Bay for all or part of their life cycle are exposed to the widespread, residual chemical contamination present in the water column and sediments. The construction and operation of a CDF constitutes a new source of potential exposure. The following discussion focuses on a CDF, with the existing residual contaminants considered as background conditions. Section 4.24 addresses cumulative effects, including the interactions of the NBCDF and the existing residual contaminants in the Newark Bay system.

Table 4.06-1 lists the fish species commonly found in Newark Bay and provides a description of their movement/migration patterns. This list contains the most common species based on Newark Bay fish sampling studies, summarized in Section 3.06. The movement patterns are based on the known life histories of these species. All the species

levels; however, the contamination levels would be similar to average background levels in the Bay. The placement of this material in the pits has the potential to release a small quantity of the contaminants to the surrounding water.

The food habits of fish and shellfish are a factor in the potential exposure to and uptake of contaminants. Bottom-feeding fish and shellfish have the potential to accumulate more contaminants than species that feed in the water column because concentrations of contaminants are greater in the sediments than in the overlying water. Benthic organisms, through their feeding, concentrate the contaminants, creating a source of contamination for fish that feed on them. Most of the fish and crabs found in Newark Bay feed on the bottom. This is a common feeding location for juvenile fish of many species and some adults. Striped bass, for example, feed on benthic organisms as juveniles, but switch to a diet of fish as they grow larger, whereas Atlantic tomcod feed on bottom organisms throughout their life.

The fish and shellfish using Newark Bay for habitat would be exposed to varying concentrations of contaminants as they move about the Bay feeding in different areas. The CDF, while it is receiving dredged material for disposal, would be an area of relatively high contaminant concentration, but the sediments would have been thoroughly mixed in the process of dredging and mixed again in the dumping of the material into the pits. Any remaining organisms that might serve as food for fish or shellfish would be buried in the dredged material. The constant addition of new dredged material would not allow the site to be recolonized before new material is added. In addition, the ongoing activity at the CDF during construction and operation would be beneficial in that the continual disturbance would render the site(s) unattractive to fish and shellfish for feeding.

Capping of the CDF would isolate the contaminated sediments preventing exposure to aquatic life. Sedimentation on top of the cap would establish a substrate that is suitable for recolonization by benthic invertebrates and the site would return to its former function as a feeding area for juvenile fish and shellfish. The formation of this new sediment substrate would result in the deposition of contaminants from upstream sources. After this area stabilizes the contaminant levels are likely to return to average levels in the Bay unless upstream sources are remediated.

4.07 WILDLIFE

4.07.1 DUCKS

Ducks area seasonal visitors to Newark Bay, with the period of residence generally limited to migratory feeding stops. Feeding by diving and puddle ducks is confined to the extensive shallow areas of the Bay, with the primary feeding areas located along the Bayonne shore area, north of the two Bay bridges, around the mouths of the Passaic and Hackensack rivers, and in the southwest corner of the Bay near Elizabeth Port. Breeding in the Bay is limited due to the small amount of preferred vegetated shoreline habitat.

Impacts to duck populations related to the development of the NBCDF would be minimal. The proposed NBCDF area can be used by ducks for feeding; however, the area is not a preferred feeding area due to the extensive amount of commercial activity associated with Ports Elizabeth and Newark. The temporary loss of the area resulting from the development of the NBCDF would have minimal impact on duck populations as the area represents only a small percentage of the available duck feeding area of Newark Bay. The development of the NBCDF has the potential to minimally benefit duck populations through the reduction of contaminated sediments.

4.07.2 NORTHERN DIAMONDBACK TERRAPINS

The project impact on northern diamondback terrapins is expected to be minimal because the species is an area transient. Terrapins may move through the CDF area during migrations; however, their presence has not been documented.

Northern diamondback terrapins may be attracted to dredging operations by the prey organisms stirred up; however, the NBCDF area is relatively small and is located in an area where transient turtles are not expected to travel.

Terrapins nest in sandy substrate above the high tide. Because of minimal quality and quantity of nesting habitat in nearby shoreline areas it is unlikely terrapins would nest near the CDF site. In any case, marginally suitable nest sites would not be disturbed by the CDF project because all activities are confined to open water. Hatchling terrapins could be impacted by mechanical operations if they moved through the project area during dredging or filling. This is unlikely to occur because of the lack of suitable nest sites near the project area.

4.08 BENTHOS

Development of the NBCDF will involve dredging existing sediments to create the disposal pits, depositing dredged material in the pit, and capping the completed pit with clean dredged material. The elevation of the completed pit would approximate the existing bottom contours and thereby maintain current water depths and hydrographic conditions. In addition, it is proposed that the disposal pits would be open for a short period of time.

Direct impacts to the benthic community from development of the NBCDF could include the permanent or temporary loss, or permanent alteration of aquatic habitat in the footprint of the CDF. Temporary loss of benthic habitat is a less serious impact than a permanent loss because it minimizes the impact to aquatic habitat function, i.e., bottom-feeding predators would suffer a temporary loss of prey until the area is repopulated after the completion of activities at the site.

The initial NBCDF dredging activities would result in the elimination of the organisms that occupy the construction area, and benthos in the immediate vicinity of the CDF would be influenced by stress gradients (McCall 1977), including sedimentation of suspended dredged material, scouring, and periodic disturbances (e.g., dredging activities, boat traffic). Benthic studies conducted in Newark Bay have determined that the benthic community has low overall species diversity, with polychaete worms dominating. No difference was found in the composition of the benthic community between the shallow-water habitat, characteristic of the proposed NBCDF sites, and deeper-water locations in maintained navigation channels. The overall similarity of the Newark Bay benthos provides a vast reservoir of individuals to recolonize the disturbed area. In addition, studies conducted before and after maintenance dredging activities indicate that repopulation is rapid, with no long-term observable alteration in species composition or seasonal abundance patterns.

Dredging at the NBCDF sites would utilize environmentally acceptable equipment and techniques, which would minimize potential impacts on the benthos in the immediate vicinity of the NBCDF sites. The shallow nature of the proposed CDF sites would minimize impacts on the benthos because the pits would act as a natural berm and vessels would be restricted to the Navigation Channel or in the pits. Life cycle activity of benthic infauna is generally limited to the top few centimeters of the bottom sediments (Carreker 1967). Given the limited sediment activity depth of the benthic organisms that would colonize a completed CDF cap, the potential for bioaccumulation of contaminants from the buried dredged material is negligible, and therefore upper trophic level bioavailability would be negligible.

Because the CDF development options result in the final CDF site elevation approximating the current site elevation and not exceeding the high water elevation, there will be no permanent loss of benthic habitat or associated functions. In fact, depending on

the capping material used, potential enhancement of the benthic community - changes in organism abundance and diversity - are possible. In addition, the NBCDF development areas constitute a relatively small percentage of the shallow-water habitat in Newark Bay which indicates minimal impact on the Newark Bay benthic community and on benthic predators that are mobile and thus capable of feeding in undisturbed areas for the short duration that the NBCDF is in operation.

4.09 HAZARDOUS WASTE SITE(S)

To assist in the identification of hazardous waste sites near the proposed NBCDF, LMS obtained a report from Environmental Risk Information & Imaging Services (ERIIS), a company specializing in the performance of database searches for location of current or potential hazardous waste sites. A search for listed hazardous waste sites and potential hazardous waste sites was performed by ERIIS for an area encompassing a 5-mile (8-km) radius around the proposed NBCDF. The following databases were searched as part of the service provided by ERIIS:

- ***National Priorities List (NPL).*** Also known as the Superfund List, this database is an EPA listing of uncontrolled or abandoned hazardous waste sites.

- ***Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS).*** A comprehensive listing of known or suspected uncontrolled or abandoned hazardous waste sites. These sites have either been investigated or are currently under investigation by EPA for the release, or threatened release, of hazardous substances.

- ***Toxic Release Inventory (TRI) System of 1992.*** The TRI report contains information concerning the industrial release and/or transfer of toxic chemicals as reportable under Title III of the Superfund Amendments and Reauthorization Act of 1986 (SARA Title III).

- ***New York Inactive Hazardous Waste Disposal Sites (NYHWS).*** Contains summary information pertaining to those facilities that are deemed potentially hazardous to the public health and welfare by the New York State Department of Environmental Conservation (NYSDEC).

- ***New Jersey Known Contaminated Sites List (NJHWS).*** A comprehensive report of approximately 6000 sites in the State of New Jersey where contamination of soil or groundwater has been confirmed and where cleanup efforts have either begun or are pending.

Other databases were also searched but the ones cited above are the most pertinent for the objectives of this FEIS. The following table summarizes the number of sites found within each of the above databases that were close to Newark Bay, Passaic River, Hackensack River, Kill van Kull and the Arthur Kill:

Database Searched	Number of Sites Found Along Newark Bay, Passaic and Hackensack Rivers, Kill van Kull and Arthur Kill
NPL	5
CERCLIS	10
TRI	3
NYHWS	0
NJHWS	14

Table 4.09-1 provides descriptions, threats and contaminants, response action status,and environmental progress for the five NPL sites within a 5-mile (8-km) radius of the proposed NBCDF; Figure 4.09-1 shows their locations.

Table 4.09-2 summarizes the locations of the 10 CERCLIS and 14 NJHWS sites and Figures 4.09-2 and 4.09-3, respectively, show their locations. These data bases do not provide specific information on types of contaminants present and potential for migration to water bodies.

The TRI database search resulted in 65 sites with reported releases within the 5-mile (8-km) radius as of 31 December 1992. However, of these 65 sites only three reported releases to water, and only these are summarized in the following table.

Facility Address EPA #	Distance From Site Discharge Location	Chemicals Released to Water	Quantity (lbs)
Goody Products, Inc. 999 Newark Tpke. Kearny, NJ 07032 NJD001340876	4.5 miles Passaic River	Nickel compounds: Glycol ethers:	5 17,334
Allied-Signal, Inc. 10 North Ave E Elizabeth, NJ 07201 NJD002451490	2.4 miles Elizabeth River	Dichlorodifluoromethane: Dichlormethane: Acetone: Trichloroethylene: 1,1,1-Trichloroethane: Dichlorotetrafluoroethane: Trichlorofluoromethane:	7 36 30 66 153 5 782
Rona, Inc. 4 Hook Rd. Bayonne, NJ 07002 NJD080619067	2.6 miles Kill Van Kull	Ammonium nitrate:	240,000

Table 4.09-1 (Page 1 of 3)

Description of National Priorities List (NPL) Sites within 5 miles Radius of Proposed Project Site

Site Name:	Syncon Resins
Address:	77 Jacobus Ave
	Kearny, NJ 07032-4512
EPA ID Number:	NJD064263817
Map ID #:	38
Distance from Project Site:	3.71 Miles
Site Description:	The site encompasses approximately 15 acres and is located on the peninsula formed by the Passaic and Hackensack River. In addition to the buildings on site there were two unlined lagoons, numerous large bulk storage tanks, underground storage tanks and at least two chemical reactor buildings. The site also contained approximately 12,800 55-gallon drums, some of which had rusted spilling their contents onto the soil. The Syncon Resins facility produced Alkyd resin carriers for pigments, paints and varnish products. In the production process excess xylene or toluene was separated from wastewater and reused. Remaining wastewater was pumped to an unlined lagoon to evaporate or percolate into the soil. Soil investigations of the site have found that there is extensive contamination of the groundwater and soil.
Threats and Contaminants:	Groundwater is contaminated with VOCs including toluene, xylene, TCE and heavy metals such as lead and nickel. Contaminants in the sediments include heavy metals, VOCs and PCBs. Soil is contaminated with the pesticides DDT and Aldrin as well as heavy metals, VOC and PCBs. Potential health threats exist through direct contact, inhalation of contaminated dust and accidental ingestion of soils. The site is situated within a coastal wetland area which could be at risk from contaminant runoff.
Response Action Status:	Between late 1982 and early 1984 the State removed all of the exposed 55 gallon drums, cleaned up the lab area and stored the materials found on site. In early 1990 the site was fenced to provide additional security. The following remedies for site cleanup were performed: In 1986 the contents of the storage tanks and vessels were removed for offsite disposal; decontamination of buildings and tank structures; excavation of lagoon liquids, sediments and contaminated surface soil with disposal off site; installation of a cover over the site that allows natural flushing of underlying soil and groundwater contaminants, collection and treatment of contaminated water from the shallow aquifer with discharge to the Passaic River. The State and EPA are evaluating the need for further studies to identify the most appropriate methods to increase the effectiveness of the flushing program.
Environmental Progress:	EPA has determined that the site is safe to the surrounding community and the environment but is still evaluating methods that will make natural flushing of soil and groundwater more effective.
Site Name:	Diamond Alkali Co
Address:	80 Lister Ave
	Newark, NJ 07105-4524
EPA ID Number:	NJD980528996
Map ID #:	63
Distance from Project Site:	3.78 Miles
Site Description:	The Diamond Alkali co. owned and operated a pesticides manufacturing facility at 80 Lister Ave in Newark adjacent to the Passaic River. The property has been used for manufacturing by numerous companies for more than 100 yrs. The mid 1940s marked the beginning of the manufacturing operations related to the current site conditions including the production of DDT and phenoxy herbicides. The Diamond Alkali Co. later known as Diamond Shamrock acquired the property in 1951 and produced various chemicals and pesticides until 1969 when the company ceased operations. Subsequent owners used the property until 1983 when sampling at the site revealed high levels of Dioxin. Municipal water is drawn from the Wanaque Reservoir, roughly 35 miles from the site.

Description of National Priorities List (NPL) Sites within 5 miles Radius of Proposed Project Site

Threats and Contaminants:	Dioxin, pesticides and other hazardous substances have been found in the soil at 80 Lister Ave and to a lesser extent at 120 Lister Ave. Other properties in the area were also contaminated by Dioxin but cleanup work has been completed. At these properties the Dioxin contaminated soil and debris resulting from the cleanup work is now stored in containers at 120 Lister Ave. Dioxin has also been found in sediment samples taken from the Passaic River and from nearby waterways.
Response Action Status:	Exposed soils on the property were covered with geofabric to prevent potential migration of contamination at other properties. Dioxin contaminated soils and debris were removed by excavation, vacuuming and other means and were transferred to 120 Lister Ave for storage. In 1987 EPA selected an interim remedy for the 80 and 120 Lister Ave. properties that relies on construction of a slurry wall around the properties, installation of a cap over the properties and pumping and treating the groundwater to reduce the migration of contamination.
Environmental Progress:	Securing the property and covering the contaminated soils at 80 Lister Ave. reduced the potential for off site migration and on site contact. The cleanup work that removed contaminated soil and debris from other properties in the area reduced the potential for contact with contaminated materials on those properties.
Site Name:	White Chemical Corp.
Address:	660 Frelinghuysen Ave
	Newark, NJ 07114-1324
EPA ID Number:	NJD980755823
Map ID #:	100
Distance from Project Site:	3.81 Miles
Site Description:	The White Chemical Corp. site is a 4.4 acre inactive facility that formerly manufactured acid chlorides and flame retardant compounds. WCC operated the facility from 1983 until July 1990 when it ceased most operations. During its operational years WCC was issued numerous violation of RCRA by NJDEP. Initially, EPA found over 10,000 55-Gal drums and other containers of hazardous substances precariously stacked or in other ways improperly stored. Throughout the site, drums and other containers were found in various stages of deterioration, fuming or leaking their contents onto the soil.
Threats and Contaminants:	Site circumstances suggested that the previously unstable situation could have led to a catastrophic release of hazardous material that would likely have affected the surrounding community.
Response Action Status:	In early 1993 the potentially responsible parties completed all cleanup activities associated with surface contamination including removing 7,787 drums of hazardous substances, 4,497 empty drums, the contents of 191 tanks and wells, 58 gas cylinders and 14,806 laboratory containers.
Environmental Progress:	Removal of surface contamination has reduced the risk to people and the environment while further studies to determine final cleanup remedies for the remainder of the site are being planned.
Site Name:	PJP Landfill
Address:	400 Sip Ave
	Jersey City, NJ 07306-6729
EPA ID Number:	NJD980505648
Map ID #:	56
Distance from Project Site:	4.276 Miles
Site Description:	The PJP landfill covers 87 acres in Jersey City. The site may have been used as early as 1968 to dispose of an unknown quantity of chemical & industrial wastes. The site is bordered by the Hackensack River on the West. The river is used for boating and for commercial shipping.

Description of National Priorities List (NPL) Sites within 5 miles Radius of Proposed Project Site

Threats and Contaminants:	The shallow water in the vicinity of the site is contaminated with the heavy metal chromium, phenols, various pesticides & volatile organic chemicals (VOCs). The leachate from the site is contaminated with VOCs including benzene & chlorobenzene & the heavy metal lead. The deeper groundwater has not been significantly impacted by the landfill.
Response Action Status:	Interim cleanup actions involving major excavation work & capping were conducted by the state in early 1986 to extinguish landfill fires. In addition, a gas venting system was installed to prevent the buildup of gases under the landfill surface entire site. All phases of the site investigation, which included field sampling of groundwater, sediment , soil & surface water from the Hackensack River have been completed. A plan for the final remedy is being proposed.
Environmental Progress:	Initial actions to extinguish underground fires at the site & the installation of a gas venting system have reduced the potential for exposure to hazardous contaminants at the site.
Site Name:	Chemical Control
Address:	23 South Front Street
	Elizabeth, NJ 07202-3007
EPA ID Number:	NJD000607481
Map ID #:	8
Distance from Project Site:	4.32 Miles
Site Description:	The Chemical Control site consists of a 2 acre parcel of land adjacent to the Elizabeth River. The site was formerly a marsh, is flat and barely above sea level. The surrounding area is mostly industrial. From 1970 to 1978 Chemical Control operated the site as a hazardous waste storage, treatment and disposal facility accepting various types of chemicals including acids, arsenic bases, cyanides, flammable solvents, polychlorinated biphenyls, compressed gases, biological agents and pesticides. Chemical Control was cited for discharge and waste storage violations in 1979. The state of NJ initiated a site cleanup that included bulk solids and liquids drums at and below the soil surface, gas cylinders, infectious wastes, radioactive wastes, highly explosive liquids, debris, tanks and 3-ft of soil that was excavated. Soil areas were replaced with a 3-ft gravel cover. An explosion and fire in 1980 interrupted the site cleanup and created additional cleanup needs by destroying the site and reportedly launching drums of burning waste in the air. Contaminated runoff from firefighting efforts entered the Elizabeth River. After the fire and explosion cleanup was accelerated and was completed in 1981.
Threats and Contaminants:	The sediments of the Elizabeth River and the on site soils were contaminated with volatile organic compounds, pesticides, acid and base neutral extractables and metals. The subsurface soil was contaminated with VOCs. Eating contaminated fish, shellfish, crabs and other marine organisms, and direct contact with sediments in Elizabeth River was a potential health threat. Other industrial pollution sources in the area probably contributed to contamination of the Elizabeth River.
Response Action Status:	The EPA performed immediate actions at the site to ensure public and environmental safety which involved decontamination of box trailers and containment and removal of gas cylinders. EPA reconstructed storm sewer catch basins and grates, constructed curbing to prevent runoff of contaminated sediments.
Environmental Progress:	EPA has performed numerous immediate actions and eliminated the source of contamination at the site which have reduced the potential for exposure to hazardous materials. The EPA is presently overseeing maintenance activities and has determined that the site is safe.



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SITE INFORMATION

Confined Disposal Facility
Newark Bay
Port Newark, NJ
Essex County
Job Number: 112910A
Map Plotted: Sep 24, 1996

MAP LEGEND

- Site
- Radii 1, 2, 3, 4, 5 Mi
- Hydrography
- Railroads
- Roads
- Highways
- NPL 5 Sites

Miles

0 1 2

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Figure 4.09-1
National Priorities List Sites in Vicinity of Project Area

Table 4.09-2 (Page 1 of 4)

Summary of CERCLIS and HWS Facilities Within 5-mile Radius of Proposed Project

Facility Address EPA #	Distance from Site Map ID Number	Description	
CERCLIS Database			
Roosevelt Drive-in Route 440 Jersey City, NJ 07305 NJD030250484	2.5 miles Map # 328	Discovered: Inspected:	12/1/80 08/01/82
Standard Tank Cleaning Corp 1 Ingham Ave Bayonne, NJ 07002 NJD068292648	2.58 miles Map # 422	Removal Action: Inspected:	12/12/94 09/25/90
Pitt-Consol Chemical Co. 191 Doremus Ave Newark, NJ 07105 NJD004948188	2.96 miles Map # 289	Discovery: Inspected:	06/01/81 03/31/85
AT&T Technologies 100 Central Ave Kearny, NJ 07032 NJD002139053	3.8 miles Map # 168	Discovery: Prelim. Assess:	11/1/91 09/29/92
American Chrome & Chemicals 155 Front St Elizabeth, NJ 07206 NJD000764910	3.8 miles Map # 113	Discovery: Prelim. Assess:	01/29/92 09/24/92
Perk Chem Co. Inc. 217 S 1st St Elizabeth, NJ 07206 NJD002200046	4.31 miles Map # 229	Discovery: Prelim. Assess: Inspected:	06/01/79 05/22/89 03/28/91

Table 4.09-2 (Page 2 of 4)

Summary of CERCLIS and HWS Facilities Within 5-mile Radius of Proposed Project

Facility Address EPA #	Distance from Site Map ID Number	Description	
CERCLIS Database (*Continued*)			
St. Paul Ave. Trailer Site Duffield Ave & St Paul Ave Jersey City, NJ 07305 NJ0001039676	4.8 miles Map # 38	Removal Action:	05/01/95
Borne Chemical Co. 632 S Front St. Elizabeth, NJ 07202 NJD002167237	4.89 miles Map # 200	Discovery: Site Inspection:	06/01/80 08/24/81
Standard T Chemical 2600 Richmond Terrace Staten Island, NY 10303 NYD001601327	3.39 miles Map # 129	Discovery: Prelim. Assess.:	08/24/90 09/25/91
Berman Enterprises 2945 Richmond Terrace Staten Island, NY 10303 NYD986936953	3.63 miles Map # 640	No information provided	
NJHWS Database			
Darling Delaware Company Inc. 825 Wilson Ave Newark City, NJ NJD986602316	2.025 miles Map # 2261		
Hudson County Chromate 125 60 Kellogg St Jersey City, NJ 07305 NJL000001255	2.34 miles Map # 2903		

Table 4.09-2 (Page 3 of 4)

Summary of CERCLIS and HWS Facilities Within 5-mile Radius of Proposed Project

Facility Address EPA #	Distance from Site Map ID Number	Description
NJHWS Database (*Continued*)		
Quantun Chemical Corp. USI Div 300 Doremus Ave Newark City, NJ NJL600163513	2.7 miles Map # 2360	
NJ Bell Telephone Newark City 268 Doremus Ave Newark City, NJ NJL840001556	2.77 miles Map # 2341	
Jersey City, NJ 07305 NJL800003683	2.93 miles Map # 2805	
Blue Circle Atlantic Incorporated 194 to 200 Doremus St. Newark City, NJ	2.95 miles Map # 2231	
Rollins Leasing Corp. Br 207 299 Roanoke Ave Newark City, NJ NJD067519025	3.06 miles Map # 2363	
Avon Drum Company 185 Foundry St. Newark City, NJ NJD000000000	2.98 miles Map # 2224	
Industrial Petrochemicals Inc. 128 Doremus Ave Newark City, NJ	3.108 miles Map # 2304	

Table 4.09-2 (Page 4 of 4)

Summary of CERCLIS and HWS Facilities Within 5-mile Radius of Proposed Project

Facility Address EPA #	Distance from Site Map ID Number	Description
Getty Refining & Marketing Corp. 86 Doremus Ave Newark City, NJ	3.213 miles Map # 2289	
Hudson County Public Safety & Health Building 549 Duncan Ave Jersey City, NJ 07306	3.89 miles Map # 2877	
Entin Associates 265 Broadway Jersey City, NJ 07306 NJL800011660	4.517 miles Map # 2849	
West End Gas Works Saint Pauls & Duffield Ave Jersey City, NJ 07306 NJD981084817	4.82 miles Map # 3047	
Hudson County Chromate 86 123 Duffield Ave Jersey City, NJ 07306 NJL000071266	4.96 miles Map # 2952	



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SITE INFORMATION

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Newark Bay
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MAP LEGEND

- Site
- Radii 1, 2, 3, 4, 5 Mi
- Hydrography
- Railroads
- Roads
- Highways
- CERCLIS 71 Sites

Miles

0 1 2

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Figure 4.09-2

U.S. Army Corps of Engineers
Newark Bay Confined Disposal Facility

Comprehensive Environmental Response, Compensation, and Liability Sites in Vicinity of Pr[illegible] Area



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SITE INFORMATION

Confined Disposal Facility
Newark Bay
Port Newark, NJ
Essex County
Job Number: 112910A
Map Plotted: Sep 24, 1996

MAP LEGEND

- Site
- Radii 1, 2, 3, 4, 5 Mi
- Hydrography
- Railroads
- Roads
- Highways
- HWS - 206 Sites

Miles

0 1 2

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Figure 4.09-3

U.S. Army Corps of Engineers
Newark Bay Confined Disposal Facility

Hazardous Waste Sites in Vicinity of Project Area

The previously summarized NPL, HWS, and CERCLIS sites as well as the TRI sites represent areas with the potential for contributing toxic contaminants to Newark Bay or waters contiguous to the Bay. There are other sources of contamination to Newark Bay, including deposition from the air and rain, upstream sources in the Passaic, Hackensack and Elizabeth rivers as well as existing contaminated sediments of Newark Bay.

It is not anticipated that these sites or any other unidentified sites will have a particular impact on the proposed NBCDF. Contamination in Newark Bay comes from numerous sources, all of which contribute to sediment contamination. After the proposed NBCDF is closed it can be anticipated that clean cap material would eventually equilibrate to contaminant concentrations similar to those in the surrounding sediments.

However, it is possible that some catastrophic event could result in the discharge of contaminants, a portion of which would deposit at the proposed CDF site. Such an event could result in contamination of sediments during construction, operation, or closure that could require remediation. However, the chances of such an event are small and because most of the identified sites are several miles from the proposed NBCDF area, released contaminants would be subject to substantial dilution before impacting the proposed CDF area.

4.10 WETLANDS

No impacts on defined jurisdictional wetlands are anticipated as a result of NBCDF construction, dredging to fill the CDFs (so long as all dredging takes place in defined navigational channels and/or berthing areas), or CDF capping so long as proper dredging and sedimentation control procedures (see Section 5.08; Mitigation Measures) are employed and followed.

Secondary impacts that could occur as a result of Newark Bay Complex dredging and NBCDF construction activity may include temporary displacement of wetland-oriented wildlife, short-term increased sedimentation, and temporary smothering of benthic organisms and loss of fish habitat as a result of sedimentation. Potential fisheries impacts are discussed in Section 4.06 and impacts on benthos are discussed in Section 4.08. Waterfowl that currently use the shallow area north of the Elizabeth Channel as a feeding site will be temporarily displaced until the project is completed and benthic macroinvertebrate populations reestablish themselves. Adequate alternate habitat for foraging currently exists in the vicinity of Shooters Island and the Hudson County and Bayonne City parks to accommodate any displaced waterfowl or shorebirds. Due to the amount of existing boat traffic and development in the area, the noise and human presence associated with the dredging and fill operations is not expected to be a factor in the displacement of waterfowl. Increased sedimentation and smothering of benthic organisms may occur if materials suspended by the dredge and disposal operations are transported out of the work area and are deposited in low-velocity areas. Deposition of project-generated sediments is not expected to be significant due to the proposed mitigative measures (outlined in Section 5.08) and the currents in the navigation channel located east of the work area that would transport any sediments away from the tidal flats east of the channel.

4.11 ENDANGERED AND THREATENED SPECIES

4.11.1 LEAST TERN

Least terns may feed on bay anchovy and other small surface fish in the NBCDF area (see Section 3.06). The potential impact to least terns is minimal because dredging and disposal activities would drive schools of small fish from the project area to other areas where terns could continue to forage. The project area has not been identified as a significant or high-use area for least terns, further reducing any potential impacts caused by the proposed projects.

4.11.2 PEREGRINE FALCON

The project could have adverse impacts on falcons during the construction phase. Several New York City area falcons have been injured or killed after perching on the tops of cranes or areas with exposed petroleum lubricants. Birds can ingest oil and grease indirectly when eating prey contaminated by the perch or their own contaminated feet. Falcons can also become coated with oils and grease, resulting in the loss of flight ability. This impact can be mitigated by employing bird-exclusion devices where falcons and other birds may perch. Collisions with dredging equipment are not likely to occur because of the peregrine's flight ability and the slow speed at which heavy equipment moves. The overall project effect on peregrine falcon, will be minimal.

Project operation (long-term impact) is not expected to have any detrimental impact on the peregrine falcon because the project is over 2 miles (3.2 km) from existing nest boxes and because the area will be left as natural habitat. Positive impacts on the peregrine falcon will result from slight reductions in contamination of potential prey species feeding on benthic invertebrates in the CDF area. Capping with clean material may reduce overall average pollution concentrations in prey species.

4.12 CRITICAL HABITATS AND MARINE SANCTUARIES

4.12.1 HARBOR HERONS COMPLEX

The Harbor Herons Complex located on Shooters Island (the nearest rookery, over 2 miles [3.2 km) south of the project area) would not be impacted by the proposed CDF project because of distance from the proposed project area. Wading birds originating from this rookery forage to the south and north. To the north, most wading birds utilize foraging areas in the Hackensack River marshes and shallows. These areas are over 4 miles (6.4 km) north of the project. To the south, foraging areas are over 1 mile (1.6 km) from the project area. The project area does not contain suitable habitat for wading birds. No wading birds were observed using the adjacent shoreline of Newark Bay as a foraging area.

4.12.2 FISH SPAWNING, NURSERY, AND FEEDING AREAS

The Newark Bay shoals area is used by a variety of fish for spawning, nursery, and feeding areas. The project will result in the temporary loss of approximately 56 acres (0.23 km^2) of contaminated shallow-water habitat. Newark Bay contains over 2800 acres (11.3 km^2) of similar habitat; therefore these species will continue to utilize available habitat in the Project vicinity and throughout Newark Bay and the NY/NJ Harbor Estuary. The short-term loss will not be a significant impact because of the amount of other similar habitat nearby.

4.12.3 ESTUARINE SHELLFISH BEDS AND PRODUCTIVE SUBTIDAL SHOAL AREAS

The proposed project would result in the temporary loss of up to 56 acres (0.23 km^2) of potential estuarine shellfish beds and productive subtidal shoal areas. The area temporarily lost represents 2% of the potential estuarine shellfish beds and productive subtidal shoal areas in Newark Bay. The short-term loss would not be a significant impact because of the amount of other similar habitat nearby.

The project over the long term would result in a minor positive impact for these habitats because contaminants available to the biota are reduced in the project area and in channel areas of the NY/NJ Harbor area.

4.13 AESTHETICS

No potential visual impacts were identified from the proposed project. The viewsheds surrounding the proposed NBCDF sites and Newark Bay will be maintained, with no change or impact to visual resources identified in the study area.

Visual resources viewed from the Bayonne waterfront, including the Newark Bay Bridge and Port Newark/Elizabeth marine terminals, will remain. Dredging activities associated with the proposed project, including crane operation, drilling, or dipper dredge operations, will maintain the industrial nature and backdrop of the existing viewscape. Machinery heights, including cranes, or drill rigs, will not exceed existing container cranes or steamship heights that currently dominate the western skyline.

The marine terminals at Port Elizabeth and Port Newark provide the closest viewshed of the immediate project area. However, views of Newark Bay and the project area from the terminal are often obstructed by container handling/storage operations and berthed steamships. Additional barge traffic and dredge operations associated with the proposed project will not impact the already restricted views from marine terminal piers. Viewers in this area are limited to longshoremen, steamship crews, and other marine terminal employees.

When the CDF has been capped at the end of the disposal operation, all equipment will be removed and views across the Bay will not be altered from existing conditions.

4.14 CULTURAL RESOURCES/SECTION 106 COMPLIANCE

There are no previously reported archaeological sites, ship wrecks, or historic properties within the proposed NBCDF. Examination of historical maps indicates that, at least from the mid-19th century to the present, the proposed NBCDF location has been submerged. No development is shown within the area although development has occurred to the west.

Cultural resource investigations conducted in the Newark Bay area to the south of the proposed NBCDF areas have suggested the possibility that prehistoric cultural resources from the Paleo and/or Archaic periods may be located in undisturbed, shallow areas of the bay (Kardas and Larrabee 1976, 1980, 1985). Kardas and Larrabee's research indicates that Newark Bay shorelines have changed considerably since prehistoric times, and that previous shorelines may exist as deeply buried strata under water. Such shorelines may have been occupied by prehistoric populations. If cultural resources were located in the construction area, the project could have adverse impacts on any existing cultural resources during the construction period, although project operation (long-term) would not have adverse effects.

In order to analyze the prehistoric environment of an underwater project, it is common to examine the area's stratigraphy, as reflected in the data provided by subbottom cores. To comply with the request of NJHPO to complete a cultural resource investigation of the area, core logs and photographs of cores collected from the NBCDF area were reviewed and evaluated for evidence of cultural resources. No anthropomorphic material was observed (see Section 3.14). Examination of these materials constitutes an investigation pursuant to the requirements of 33 CFR, Part 325, Appendix C, paragraph 5.

If any anthropomorphic material is uncovered during construction of the NBCDF, work will immediately stop, and the National Park Service and NJHPO will be notified. Work will not be allowed to proceed until all data recovery stipulated by these agencies is completed.

4.15 AIR QUALITY

It is not expected that any of the activities associated with the development and operation of the proposed NBCDF will cause a contravention of applicable air quality standards or a measurable departure from existing conditions at the identified sensitive receptors. Any odors associated with dredging and disposal operations would probably be dissipated by the prevailing winds prior to reaching the receptors on the east side of Newark Bay. The proper maintenance of dredging and transportation equipment during the NBCDF development and operation phases will assist in reducing any localized air quality impacts.

4.16 FLOODPLAIN VALUES HYDROLOGY

The potential for impact of the NBCDF on floodplain values and hydrology is limited to the construction phase only because the bottom of Newark Bay will be restored to its pre-construction elevations. During construction, the areas would be dredged sequentially. A channel would be constructed from the current navigation channels and then widened and deepened for the CDF beyond this entrance channel. The entrances would be approximately 300 ft (91 m) wide at the top and 200 ft (61 m) wide at the bottom to allow for maneuvering of construction equipment.

The areas of the three CDFs in relation to the surface area of Newark Bay (4082.5 acres, 16.5 km^2) are:

	Surface Area		
CDF Area	Acres	km^2	Percent of Newark Bay (%)
1S	26.0	0.11	0.67
2S	20.9	0.08	0.51
2N	9.8	0.04	0.24
Total	56.7	0.23	1.34

If all three areas were open simultaneously, the deepened portion of Newark Bay is limited to a little more than 1% of the total area. The effect on hydrodynamics of the Bay would be localized changes in velocity near the preconstruction sediment-water interface (see Section 4.02). The streamlines of flow will veer only slightly downward into the top of the pits, and the deeper portion of the pits will have virtually stagnant water (Bokuniewicz et al. 1986). Therefore, the flow-through volume of the Bay remains virtually unchanged by pit construction. Tidal elevations are also expected to remain unchanged because of the limited localized change in velocity. Wave action imparted by high tides in the Harbor such as hurricane surges would not be changed by the NBCDF.

The movement of salinity from the Bay into the Passaic and Hackensack rivers will not be affected by the project. The hydrology of these rivers is also unchanged by the project, which is situated downstream of the mouths of these rivers. Because the tidal elevations of Newark Bay will not be altered, the floodplain would also be unaffected by the NBCDF.

Dredged sediments would not be deposited in the Bay other than in the CDF; thus, there would not be a decrease in the cross-sectional area for conveyance of water. The project would not have a short- or long-term adverse impact on hydrology and floodplain values.

4.17 HUMAN HEALTH

4.17.1 DREDGING FOR CONSTRUCTION OF CDF

The potential for resuspension and movement of fine-grained sediments during dredging operations at the proposed NBCDF would not significantly increase the ecological and human exposure above existing Newark Bay levels. Best management practices during dredging and subsequent disposal in the CDFs would further ensure that suspended materials could be prevented from redistributing toward lower New York Harbor and Raritan Bay, decreasing the exposure of benthic organisms to dioxin and other contaminants (e.g., PCBs) in these areas.

4.17.2 DISPOSAL

Alternative 1 has a maximum storage volume of approximately 1.5 MCY (1.2 MCM) and Alternative 2 has a maximum storage volume of 0.41 MCY (1.8 MCM). Because these volumes are similar in scale, both alternatives are discussed together. Both alternatives would improve water quality and isolate contaminated surficial sediments from biota. However, the vastness of the remaining contaminated acreage would result in a redistribution of the surficial contaminants and an equilibration of contaminant levels over time among the areas dredged for this project.

The removal of contaminated surficial sediments from availability to the biota of Newark Bay would result in short-term changes in the accumulation of contaminants in the benthic fauna. However, unless the major sources of dioxin and PCBs are contained, there would not be any changes in the human health risks associated with the consumption of fish and crustaceans from this ecosystem as a result of these alternatives.

The sediments that would be sequestered in the pits are fine-grained (high TOC, high contaminants) that could be resuspended by activities in the estuary and settle in any depositional areas. These sediments would be ingested by burrowing, deposit, and filter-feeding benthic organisms; contaminants such as dioxin and PCBs accumulate in their tissues as well as in the tissues of the animals that consume them.

The following factors would also lead to a reduction in the contaminated materials that will be bioavailable as a result of Alternatives 1 and 2.

- The Federal navigation channels and berthing areas located within the draw area that would be dredged have sediments that are more likely to resuspend in the estuary because of vessel "prop-wash" in shallow channels and berths.

- For a short period after dredging is finished, sediments at the bottom of the berths would not be contaminated.

- After the pits are filled, the clean dredged material used for capping would create areas that benthic organisms can colonize that are relatively free of contamination.

- As dredging for pit construction proceeds down to levels where uncontaminated material is present some of this (Category I) material would resuspend, settle in depositional areas, and mix with contaminated sediments.

The reduction in available contaminants in these areas (surface of CDFs, navigation channels, and berths) would decrease the body burden of animals at lower trophic levels that live in these habitats. The animals that forage on the benthos from these "cleaned areas" would also be expected to accumulate lower concentrations of contaminants in their tissues. However; in order for fish and crustaceans to be considered safe for human consumption, the tissue levels of dioxin and PCBs must be reduced by factors from 2 to 50 times their present concentrations (depending on the species). This would require the concentration of dioxin in the surficial fine-grained sediments to fall well below 100 pptr in all depositional areas in the ecosystem.

Most food source species have spent at least 2-3 years in this ecosystem before they would be used for food by humans. During this time it is doubtful, in light of the above discussion, that they would not have accumulated enough dioxin to warrant a consumption ban or advisory. The removal of dioxin from potentially accumulating in aquatic organisms through Alternatives 1 and 2 will produce short term benefits. However, longer term improvements that have a direct relationship to the health risks associated with the consumption of fish and crustaceans will not be accomplished if additional remedial activities are not taken.

4.17.3 NO ACTION

The resuspension of fine-grained sediments through activities in the estuary would continue to result in the accumulation of dioxin and other contaminants in the biota at all trophic levels. The human health risks associated with the consumption of fish and crustaceans from this environment would continue as described in Section 3.16.

4.18 SOCIOECONOMICS

This section assesses the potential socioeconomic impacts that could result from construction and operation of the NBCDFs. Considered in terms of the total range of construction projects, this project is neither very small nor very large. As the analysis below shows, the socioeconomic impacts attending this project are primarily associated with job creation and the additional revenue generated by project expenditures for materials and wages. These impacts are beneficial to the local economy. The project staff would be too small to generate adverse impacts related to an influx of population or increased demand for services.

The greatest socioeconomic influence of the proposed NBCDF is related to having a place for the disposal of dredged material that will permit the continued viability of the Port of NY/NJ through unrestricted and full level operation of maritime facilities, including Port Elizabeth and Port Newark. The ability to dispose of dredged material deemed unsuitable for ocean disposal from Federal navigation channels and berthing facilities located within the designated draw area will permit maintenance of current activity levels and, potentially, a return to previously higher levels attained when berthing facilities currently unavailable due to sediment buildup are returned to operation. The dredging of Federal navigation channels and port facilities will have a positive affect on the area's economy through increases in jobs and salaries.

4.18.1 ALTERNATIVES

Table 4.18-1 shows the estimates of project cost and size of workforce developed for the alternatives considered in this EIS. The estimate is based on an analysis of the activities required to complete the project. For purposes of this impact assessment, project activities have been separated into those associated with NBCDF construction and those associated with operation (mangement, facility closure, and monitoring). The basis for classifying the activities into these two classes is economic: construction activities involve one labor category, while operation involves different labor categories.

Table 4.18-1

Estimated Workforce and Expenditures for Construction and Operation for Each Action Alternative

Activity	Estimated Value for Each CDF		
	2N	2S	1S
Total Workforce	10	19	19
Construction Cost ($)	23,100,000	45,700,000	36,200,000
Planning, Engineering, Administration and Other Costs($)	6,200,000	12,300,000	9,600,000
Total Project Cost* ($)	29,600,000	58,600,000	45,800,000

*Includes project management, monitoring, and closure costs.

The alternatives differ in terms of total expenditures. The differences result from the location and capacity of the disposal sites, as well as the engineering and construction required to develop them. For CDF 2N a dredging workforce of 10 persons working full time for 1.5 years is assumed, at the end of which the disposal site will be filled and closed. This alternative involves a total estimated expenditure of $29.6 million. Of this amount, $23.1 million is related to dredging and disposal operations. Project planning, engineering, administration, and other costs are estimated at $6.2 million.

For CDF 2S the same amount of time - 1.5 years - required to excavate, dredge, fill, and close the disposal site is assumed. Because the capacity is larger, it will require a labor force of 19. The total estimated expenditure for this alternative is $58.6 million, which includes $45.7 million for dredging and disposal, and $12.3 million for planning, engineering, admininstration, and other costs.

For CDF 1S a workforce of 19 is assumed. Because of the engineering and construction requirements, the total expenditure for this alternative is estimated to be $45.8 million, with $36.2 million for dredging and disposal, and $9.6 million for planning, administration, engineering, and other costs.

In addition to the alternatives for which cost estimates were completed, this analysis also considers the socioeconomic effects of the no action alternative. Under the no action alternative, the dredging and disposal activities would not occur. Sediment would continue to accumulate in shipping channels and berths, making it difficult, if not impossible, to maintain sufficient depth to accommodate the variety of water transportation (local and ocean-going freight carriers, as well as passenger carriers) currently using the NY/NJ Harbor.

4.18.2 POPULATION IMPACTS

Large-scale construction often requires large numbers of workers. If the project occurs in a relatively unpopulated area, or in an area without a sufficient number of available workers, project implementation may result in an influx of population consisting of workers and their families. These conditions would not occur for this project under any of the alternatives. The largest workforce anticipated is about 38 persons for 1.5 years. Assuming that a local contractor will be selected to implement the project, the New Jersey-New York metropolitan area has a sufficient workforce to supply this labor.

Dredging on this scale requires equipment such as clamshell dredges, which are in limited supply. It is possible that existing dredging contractors in the New Jersey-New York area may already be contracted, or, for some other reason, do not have the capacity to undertake the work. In such a case, a dredging contractor from some other East Coast port may perform the project. Even in this case, the influx of population is inconsequential in terms of the total population of the project area, and is highly unlikely to result in beneficial or adverse impacts to public services.

4.18.3 DIRECT AND INDIRECT ECONOMIC IMPACTS

The expenditures associated with the alternatives described in the previous section will have significant direct and indirect economic impacts on Newark and throughout the state of New Jersey. Regional economic analysis typically classifies these impacts in terms of changes in output, earnings, and employment. Output is the total level of economically productive activity for a given region, measured in dollars. Earnings are the money paid to households employed in industries within the region. Employment is the total number of jobs within the region.

New expenditures within a region, such as expenditures for the projects described above, result in changes in the levels of output, earnings, and employment within the region. These changes consist of both direct and indirect impacts. The direct impacts are represented by the project expenditures themselves. However, these direct expenditures will also result in additional rounds of spending and job creation. Industries providing construction supplies may increase their output. Construction workers will spend some of their additional earnings on housing, clothing, food, and other goods. Taken together, the total economic impacts are thus much broader in scope and magnitude than the direct expenditures by themselves.

The analysis below estimates the total economic impacts using the U.S. Department of Commerce, Bureau of Economic Analysis (BEA) regional economic output modeling system (RIMS II) multipliers developed for New Jersey. The multipliers allow the estimation of total change in economic activity (total output, change in family earnings, and employment) that would result from changes in project-related expenditures. These multipliers, shown in Table 4.18-2 below, are based on the BEA's national input-output

analysis table. Input-output analysis is a form of economic analysis that attempts to describe the relationship between changes in one sector of an economy and all other sectors. BEA's multipliers are based on historical studies of the relationships between 500 different economic sectors.

Table 4.18-2

Economic Output, Earnings, and Employment Final Demand Multipliers for New Jersey

Activity	Multipliers		
	Output	Earnings ($)	Employment
Dredging and Disposal	2.4210	0.7571	27.9
Monitoring	2.1817	0.7048	34.4

Use of the BEA multipliers requires definition of the appropriate economic sectors in which the initial expenditure will be made, as well as the appropriate geographic area considered to be affected by the project. For this analysis, the appropriate industrial sectors are new construction (for the dredging and disposal) and miscellaneous services (for the monitoring sampling and analysis). The appropriate geographic area is the State of New Jersey.

The multipliers indicate that for every additional $1.00 of new construction expenditure, total economic activity actually increases by nearly two-and-a-half times. Family earnings is increased by $0.75. For each $1 million of additional construction expenditure, 27.9 jobs are created.

Once the correct multipliers are selected, their use is straightforward. The multiplier is applied to the total expenditure to derive an estimate of the total change in output, earnings, and jobs. The results of this procedure are found in Tables 4.18-3 through 4.18-5. For each alternative, the total impacts to output, earnings and employment are positive. Output impacts range from an increase of about $70 million (Alternative 1) to over $307.5 million (Alternative 3). These total changes in economic activity will mean an increase in household earnings ranging from about $21.9 million (Alternative 1) to over $97.7 million (Alternative 3), and the creation of between 826 jobs (Alternative 1) to over 3619 jobs (Alternative 3). All of these are substantial beneficial impacts.

4.18.4 ESTIMATED FEDERAL TAX REVENUES

The analysis outlined above focuses on the total impact of the project economic output, earnings, and employment within New Jersey. The multipliers are those developed by

Table 4.18-3

Estimated Output, Earnings, and Employment Impacts: Alternative 1

Activity	Total Annual Expenditure ($ million)	Multipliers			Impacts		
		Output	Earnings ($)	Employment	Output ($ million)	Earnings ($ million)	Employment (# of Jobs)
Dredging		2.421	0.7571	27.9	65.12	20.37	750.51
Monitoring	2.2	2.1817	0.7048	34.4	4.80	1.55	75.68
Total Impact					69.92	21.92	826.19

Table 4.18-4

Estimated Output, Earnings, and Employment Impacts: Alternative 2

Activity	Total Annual Expenditure ($ million)	Multipliers			Impacts		
		Output	Earnings ($)	Employment	Output ($ million)	Earings ($ million)	Employments ($ of Jobs)
Dredging	40.0	2.421	0.7571	27.9	96.84	30.28	1,116.00
Monitoring	2.2	2.1817	0.7048	34.4	4.80	1.55	75.68
Total Impact					103.60	32.46	1,222.64

Table 4.18-5

Estimated Output, Earnings, and Employment Impacts: Alternative 3

Activity	Total Annual Expenditure ($ million)	Multipliers			Impacts		
		Output	Earnings ($)	Employment	Output ($ million)	Earings ($ million)	Employments ($ of Jobs)
Dredging	127.0	2.421	0.7571	27.9	307.47	96.15	3,543.30
Monitoring	2.2	2.1817	0.7048	34.4	4.80	1.55	75.68
Total Impact					312.27	97.70	3,618.98

BEA for economic activity within New Jersey, and no effort has been made to estimate the proportion of benefits that will actually accrue to the study area (Essex and Union counties). This approach emphasizes the geographically widespread nature of the benefits that can occur as a result of the project. In addition, the creation of jobs will lead to increased Federal tax revenues. These tax revenues represent returns to the Federal government.

The method used to estimate tax revenues is straightforward. The Annual Report of the Commissioner and Chief Counsel of the Internal Revenue Service (IRS 1996) identifies the per capita individual income tax paid in each state. A simple method of estimating the returns to the Federal government is to multiply the number of jobs created for each alternative by the average income tax paid. As shown below in Table 4.18-6, the estimated taxes resulting from project-related employment range from approximately $2.4 million for Alternative 1 to over $10.0 million for Alternative 3.

This method includes only income taxes paid by individuals. It does not include corporate taxes. Therefore, this calculation may underestimate the total tax revenues that might result from the project.

Because each alternative would be implemented over a period of years, the annual return would be only a portion of the total amount represented here.

Table 4.18-6

Project Socioeconomic Benefits: Comparison of Estimated Federal Tax Revenues for Alternatives

Factor	Alternative 1	Alternative 2	Alternative 3
Total Employment (Number of Jobs)	826	1,222	3,618
Average Per Capita Taxes Paid in New Jersey (Dollars)	2,866	2,866	2,866
Total Estimated Federal Taxes Paid (Dollars)	2,367,316.00	3,502,252.00	10,369,188.00

4.18.5 THE NO ACTION ALTERNATIVE

Under the no action alternative, the dredging and disposal activities would not occur. The potential socioeconomic effects of not conducting dredging and disposal of dredged material include:

- The potential costs of decreased shipping because the harbor would accommodate fewer vessels, as well as a different mix of vessels

- The expenditures not undertaken because the dredging and disposal activities do not occur

The potential costs of decreased shipping revenue are not known at this time. However, it is likely that, unless the shipping channels and berths are maintained, the costs are potentially quite significant. New York Harbor shipping revenues are over $20 billion annually, and account for some 200,000 jobs. Some portion of this would be lost.

The costs of dredging activities are outlined in the previous sections.

4.19 NAVIGATION

The vicinity of the project area is characterized by a series of maintained navigation channels and berthing areas. With regard to the NBCDF, it is paramount that the NBCDF not encroach on existing navigation infrastructure or otherwise adversely impact vessel movements. Several Federally maintained channels exist within Newark Bay, including (1) Newark Bay South Reach; (2) South Elizabeth Channel; (3) Newark Bay Middle Reach; (4) Newark Bay North Reach; (5) Port Elizabeth Channel; (6) Port Elizabeth Pierhead Reach; (7) Port Elizabeth Inshore Reach; (8) Port Elizabeth Branch Reach; (9) Port Newark Pierhead Reach; (10) Port Newark Inshore Reach; and (11) Port Newark Branch Reach. The Federal channels within Newark Bay provide access to highly active port facilities at the Port Newark and Port Elizabeth Marine Terminals located on the western shore of the Bay.

Approximately 50 vessel movements per day (25% of 200) are self-propelled, ocean-going ships consisting primarily of tankers and container carriers (Section 3.18). Tankers are bound principally for the oil and product terminals on the New Jersey shore of the Arthur Kill, but some tankers are bound for Newark Bay. They typically arrive via the Kill Van Kull and leave through the Arthur Kill to the south. The largest container carriers are 60,000-dry-weight-ton (DWT) (44,800 metric tons) ships bound for Port Newark or Port Elizabeth. They enter Newark Bay through the Kill Van Kull and travel through Newark Bay South Reach Channel to Newark Bay Middle Reach Channel and then to either Port Elizabeth Channel or Port Newark Branch Channel.

The primary channels that would be affected by the NBCDF are the Port Elizabeth Channel adjacent and to the south of area 1S, Newark Bay Middle Reach Channel to the east of area 1S, the Port Newark Branch Channel adjacent and to the south of area 2S, and Newark Bay North Reach Channel adjacent and to the east of areas 2N and 2S.

The primary concern is container carriers sailing into Port Elizabeth through the Port Elizabeth Channel and into Port Newark through the Port Newark Branch Channel. Areas 1S and 2S, respectively, are adjacent to these channels, and the entrances to the proposed pits are through these channels. The number of vessels reported to move through the area is about 50 per day (including tankers not bound for Port Newark or Port Elizabeth), which is about two vessels per hour. In Newark Bay, deep-draft vessels operate at about 7.0 knots (3.6 m/sec). At this speed, the time required for a vessel to go from the entrance to Port Elizabeth or Port Newark Branch Channels and into Port Elizabeth or Port Newark (about 0.5 nautical mile [926 m]) is less than 5 min. It is not expected that the project would impact these vessel movements, or conversely, that the vessel movements would significantly impact tug and barge movements associated with the project. It is assumed that tugs and barges would give right-of-way to the container vessels, and wait the short time necessary for container vessels to pass before moving from the pit into the channel.

4.20 LAND USE

No potential impacts to existing land use in the study area were identified from the proposed project. Lands adjacent to the proposed NBCDF sites include the Port Newark/Elizabeth marine terminals and the New York and New Jersey Federal Navigation Channels. The proposed NBCDF sites and related dredging operations are consistent with the existing industrial zoning and port-related activities associated with the western shoreline of Newark Bay.

Residential zoning and land use located along the eastern shoreline of Newark Bay and the Bayonne waterfront will not be impacted during construction or operation of the NBCDF sites. These residential areas are a considerable distance from the proposed NBCDF sites.

4.21 NOISE

Potential noise or sound level impacts from the proposed project would be minimal. Some increase in noise levels is expected in the near vicinity of the proposed NBCDF sites. However, noise produced by construction dredging and disposal operations would be temporary and likely inaudible and overshadowed by existing noise levels from the nearby marine terminals and Newark International Airport. Sources of additional noise include barge traffic and dredging operations. Typical construction equipment that may be used at the proposed NBCDF site includes air compressors and dredging cranes. Noise levels from these sources are expected to be similar to the heavy machinery and loading equipment already used along the industrial waterfront areas of the Port Newark/Elizabeth marine terminals. Some typical noise levels from heavy construction equipment are listed in the following table:

	Distance and Sound Level (dBA)			
Equipment	0 ft	100 ft	400 ft	700 ft
Compressor	120	80	67	62
Stationary Crane	125	85	72	67
Front Loader	120	80	67	62
Truck	100	90	77	72
Pile Driver	140	100	87	82

The dredging cutter itself moves very slowly, propelled by a diesel engine. As such, the resulting noise is very limited and comparable to that produced by a passing steamship (T. Patin, pers. commun.).

Increases in noise levels over existing levels at properties adjacent to the proposed NBCDF site would be minimal due to the industrial nature of the properties. Noise receptors adjacent to the proposed NBCDF site include the industrial areas of Port Newark/Elizabeth marine terminals to the west and south and the New Jersey Turnpike Extension and Newark Bay railroad lift-bridge to the north. These industrial areas and transportation corridors are not considered noise-sensitive receptors and are therefore not expected to be impacted by increases in sound levels from the proposed project.

The closest noise-sensitive receptors identified within the study area are located along the Bayonne waterfront, a considerable distance (approximately 4000 ft [1220 m]) from the proposed NBCDF site. These sites include Bayonne Park, Veterans Park, and Bayonne High School. Due to the distance separating these areas from the proposed project site no noise impacts from the proposed project are expected. Local ordinances governing noise levels and construction periods are maintained by all three municipalities (Newark, Elizabeth, and Bayonne) in the study area. Local noise ordinances governing maximum

permissible sound levels and construction periods permitting elevated sound levels would be adhered to throughout the project.

4.22 SOLE-SOURCE AQUIFERS AND GROUNDWATER

Groundwater in the area of New Jersey adjacent to Newark Bay is classified as II-A. Class II-A is the default classification for groundwater in New Jersey, and its primary designated use is for potable water and conversion (through conventional water supply treatment, mixing, or other similar technique) to potable water. Secondary designated uses include agricultural and industrial water. Both existing and potential potable water uses are included in the designated use (NJAC 7:9-6). This information was verified by Tom McKee of the Bureau of Water Planning, which is under the jurisdiction of NJDEP. This classification is the most recent, and supersedes any previous EPA designation as a Sole-Source Aquifer or otherwise. Groundwater in Staten Island, directly south of Newark Bay, is classified as Class GA or Class GSA (6 NYCRR 701.18). Class GA groundwaters are fresh groundwaters that are best used as a source of potable water supply (6 NYCRR 701.15). Class GSA groundwaters are saline groundwaters that are best used as a source of potable mineral waters, or conversion to fresh potable waters, or as raw material for the manufacture of sodium chloride or its derivatives or similar products (6 NYCRR 701.16).

Groundwater generally flows from land to sea, given that groundwater elevations are greater than sea level, and groundwater flows from areas of higher head to areas of lower head. As such, groundwater could be assumed to flow into Newark Bay from both the east and the west. In addition, Newark Bay is tidally influenced and the mean range of tides is 4.9 ft (1.49 m) (Suszkowski 1978), so groundwater will flow into the Bay during low tides, and groundwater may be recharged by Newark Bay as the water level rises. It is probable that no prevailing direction of groundwater flow exists, and there is some localized mixing between water from the Bay and groundwater.

Newark Bay is enclosed by Hudson County to the east, and by Union and Essex counties to the west. It is of significance to note that the water supply from 76% of Union County and 100% of Hudson and Essex Counties are from surface water sources. The remaining 24% of the water supplied to Hudson County is pumped from the ground (NJDEP 1995). Groundwater is not heavily relied upon in this area as a water supply, although it is still classified as II-A. Any material placed in Newark Bay having contaminants that leach at a concentration greater than the criteria for Class II-A groundwater in New Jersey has the potential to impact the groundwater. Factors such as solubility, density, miscibility, and adsorption properties may raise or lower the potential for the contaminated material to impact the groundwater. The contamination would most likely propagate by diffusion rather than physical transport due to the probable lack of groundwater flow direction, and concentrations could decrease markedly with distance from the source.

The stratigraphy and geology of the sediments in the proposed NBCDF areas, based on shallow and deep core sampling surveys (PA 1996) is similar. The general characteristics of the proposed NBCDF area sediments are a surface layer of compressible organic clay,

overlying sand, and finally stiff clay and silt or varved silt and clay overlying a shale bedrock. The general sediment geology and thicknesses are presented below:

Material	Typical Thickness (ft)	Typical Thickness (m)	Typical Elevation of Top of Stratum
Water	0 to 7	0 to 2.1	295 (MLW)
Black/Gray Organic Clay	15 ±.3	4.6 ± 1	292
Sand	7 ± 3	2.1 ± 1	277
Stiff Clay and Silt or Varved Silt and Clay	60	8.3	265
Shale Bedrock	—	—	205

The proposed bottom depth of the NBCDF is -70 ft (-21.3 m) to an elevation of approximately 225. Constructing the NBCDFs to elevation 225 will result in approximately 20 ft (6.1 m) of clay between the bottom of the CDF and the shale bedrock. The 20 ft (6.1 m) clay layer between the bottom of the NBCDF and the bedrock should provide ample groundwater protection.

4.23 TRAFFIC

The proposed NBCDF would not affect traffic patterns in the vicinity of Port Newark and/or Port Elizabeth. A minimal increase in traffic and parking needs would be required for dredging crews performing the construction of the facilities. Parking space is more than adequate at the Port Newark and Port Elizabeth marine terminals. The terminals are adjacent to north-south Interstate 95 (New Jersey Turnpike) and east-west Interstate 78 (New Jersey Turnpike extension); entrance and exit ramps at the intersection of these two highways provides direct access into the two ports. Additionally, other highways within 5 miles of the terminal include the Garden State Parkway (north-south), Interstate 280 (east-west), and highways 22 and 1-9. Impacts to these high-volume roadways from construction crews traveling to the terminals would be negligible.

4.24 INDIRECT AND CUMULATIVE IMPACTS

Indirect, or secondary impacts are those impacts induced by the decision to implement the project. The preceding sections evaluated the potential for direct impacts; this section will evaluate the potential for those impacts to cause additional impacts on natural and human resources.

Cumulative impacts are those impacts resulting from the combined effects of similar projects occurring in the same general area and time frame as the proposed project. Cumulative impacts occur when the combined effects are greater than the sum of the individual impacts. In other words, the fact that similar projects are occurring simultaneously creates conditions that could stress the environment beyond a threshold level that would not be reached by the individual projects alone.

4.24.1 INDIRECT IMPACTS

The preceding sections did not identify significant direct adverse impacts related to the construction and operation of the NBCDF. The direct impacts identified were of short duration and limited to the area of Newark Bay in the vicinity of the disposal facility. This level of direct impact reflects the initial conceptual development, which attempted to minimize adverse effects on natural resources during construction and operation and in the long term after closure of the facility.

The major potential indirect effects on natural resources would be related to the disruption and temporary loss of aquatic habitat, and effects related to the disturbance of contaminated sediments. The magnitude of these two effects is minimized by the selection of the disposal site location and by the procedures employed to construct and operate the facility. The disturbance of aquatic habitat is limited to a small area of Newark Bay that does not contain high-value habitat and has relatively low levels of chemical contamination. The techniques employed to construct the facility would minimize the loss of sediments during dredging and would cap the contaminated material at the disposal site in the ocean. The disposal of contaminated dredged material in the facility would confine this material to a small area during disposal and ultimately, through capping, isolate this material from contact with the water and aquatic life in Newark Bay. The capping process would restore the original contours of the Bay at the disposal site, which would facilitate the rapid redevelopment of an aquatic community at this location. Long-term monitoring of the disposal site would ensure that the dredged material would remain isolated. The lack of significant direct adverse effects minimizes the possibility of indirect effects on natural resources from the NBCDF.

An important indirect effect on human resources from the NBCDF would be maintenance of the economic infrastructure related to the existing commercial shipping operations in Newark Bay and adjacent areas of the Harbor. The need to dredge berthing areas and shipping channels was discussed in Chapter 1.0. Without a disposal mechanism for

contaminated dredged material the existing facilities could not continue to operate, resulting in significant economic impacts. The loss of shipping would have far-reaching effects on economic activities related to the movement of goods and products through the local and regional economy. The maintenance of the economic infrastructure associated commercial shipping is a significant indirect beneficial impact of the NBCDF.

4.24.2 CUMULATIVE IMPACTS

There are two areas of potential impact that could result in cumulative effects because related activities are occurring simultaneously in the general vicinity of the NBCDF. One potential impact is dredging and disposal because several areas may be dredged simultaneously when the NBCDF is available for disposal. In addition, other dredging activities could be occurring in the Harbor simultaneously with dredging activities related to the NBCDF. The other potential impact is the disturbance of and remediation of contaminated sites. Chemical contamination is widespread in the sediments of Newark Bay and upstream of the Bay in the Hackensack Meadowlands. Some sites continue to discharge contaminants to the Bay and its tributaries, while other sites are being remediated to remove contaminants or stop the loss of contaminants to the aquatic environment. The NBCDF would disturb and release to the environment some existing contaminants during dredging and disposal operations, as well as serve as remediation for existing contamination by isolating contaminated sediments. The NBCDF thus has a dual effect in relation to the contaminant issue. The potential cumulative effects will be addressed from the point of view of the balance between disturbance and remediation of contaminants.

4.24.2.1 Dredging and Disposal. Dredging and dredged material disposal has been an ongoing activity in New York Harbor since the development of facilities to accommodate deep-draft vessels. Associated with the development of deepwater port facilities was the physical modification of the Harbor shoreline through bulkheading and the construction of extensive arrays of large finger piers. During the first half of this century frequent dredging was required to maintain these facilities due to the high sedimentation rate in some areas of the Harbor. The amount of waterborne commerce in the Harbor has declined in the second half of the century and as a result the frequency of dredging has declined. The recent restrictions on the disposal of contaminated sediments at the Mud Dump Site have reduced dredging activities to a low level.

There were no aquatic life studies conducted in the Harbor when dredging occurred on a frequent basis. However, a number of studies in the past 15 years related to proposed waterfront development projects provide insight on the effects of dredging on aquatic life in the Harbor. Many of these studies included sampling in interpier basins, some of which were still being dredged and others which had not been dredged for many years.

The recent studies show that fishes and invertebrates that can utilize the highly modified physical environment of the Harbor made liberal use of recently dredged areas. As

discussed in Section 4.06, fishes and invertebrates returned to dredged areas less than one year after dredging. An interesting relationship found for juvenile striped bass was that when they were seasonally abundant in the Hudson River between the Battery and the George Washington Bridge, they showed a preference for the deeper interpier basins, which were the most recently dredged areas. The reduction in the frequency of dredging in the Harbor may have had the effect of reducing the quality of habitat for juvenile striped bass.

The proposed NBCDF, the dredging projects that would contribute dredged material for disposal, and other dredging projects in the Harbor, collectively would represent an increase in dredging activity compared to recent levels of dredging. However, these projects collectively are probably substantially less than the magnitude of dredging over a similar time period during the first half of this century. Although the cumulative effects of relatively high levels of dredging on aquatic life were never evaluated, it is apparent from recent observations that fishes and invertebrates can adjust rapidly to the habitat disruption associated with dredging activities and utilize the dredged areas for habitat. Dredging associated with and occurring simultaneously with the NBCDF would not result in adverse cumulative impacts on aquatic life.

Since the harbor was physically modified as a major shipping facility there has been a mix of maintained channels, berthing areas, and relatively undisturbed shoal areas. The distribution of these habitat types is evident on the navigation charts of Newark Bay. The NBCDF would be placed in a shoal area, but the adverse effect on aquatic habitat would be negligible because the area would recover to usable habitat approximately one year after closure. All the dredging contributing to the NBCDF would be maintenance and therefore would be done in previously dredged areas. After the NBCDF has been closed and the habitats have redeveloped, the mix of channel, berthing, and shoal areas would be the same as conditions just prior to the NBCDF. This is further support for the position that there would be no adverse cumulative impacts on aquatic habitat from the project.

The NBCDF would provide an alternative disposal method for dredged material to the conventional method of ocean dumping. Long-term dredged material disposal at the Mud Dump Site has had an adverse impact on aquatic habitat at the Mud Dump. The disposal of low-level contaminated material (with capping) and the uncontaminated sediments from the deep areas of the pit(s) at the Mud Dump Site would not alter existing habitat conditions at the Mud Dump. The NBCDF would reduce the exposure of aquatic life to contaminated sediments, while not significantly altering habitat effects at the Mud Dump. The disposal of dredged material from the NBCDF and associated dredging operations would not have an adverse cumulative impact on aquatic life or habitat.

4.24.2.2 Chemical Contaminants. The NBCDF was conceived as a dredged material disposal facility for sediments not suitable for ocean disposal. Although the disposal and confinement of chemical contaminants is not the primary purpose of the NBCDF, the fact

that the facility would handle sediments with Category II or III contamination necessitates a consideration of the interaction of the NBCDF with chemical contamination in the general area of Newark Bay (see Section 4.09 for a listing of known hazardous waste sites). As discussed above, the NBCDF (and its associated dredging sites) is both a potential source of contamination and a method to remediate existing contamination in Newark Bay and adjacent areas.

The dredging activities at the NBCDF and associated sites has the potential to release some contaminants during dredging and disposal. As discussed in Chapter 5.0 a variety of techniques would be used at the dredging sites and disposal facility to minimize the loss of sediment to the surrounding water. The loss rate would be very low and the vast majority of sediments that do escape would resettle in the vicinity of the dredging and disposal sites.

The contaminants in the dredged material were deposited from chemicals released from upstream sources. Because there is no source of chemicals at the dredging sites, the dredging activity does not contribute any new quantities of contaminants to the aquatic environment. The disturbance and loss of a small amount of contaminants during dredging and disposal results in a redistribution of these contaminants in the Bay. Because there is widespread chemical contamination in the Bay sediments, the redistribution of a small quantity of contaminants in the Bay would not appreciably alter the exposure levels of aquatic life to these contaminants.

Upstream sources of chemical contamination are in various stages of remediation. Remedial action may occur at some upstream sources while the NBCDF is being constructed and in operation. However, the operational life span of the NBCDF is expected to be between 1 and 2 years. It is unlikely that there would be any major change in the sources of contamination during the construction and operation of the NBCDF. Dredging and disposal activities could not alter the source of new contamination to the Bay and would cause only a minor redistribution of a very small quantity of contamination already present in the Bay. There would be minimal adverse cumulative effects on the quantities and distribution of chemical contaminants in Newark Bay.

The NBCDF would isolate a small percent of chemical contamination from contact with aquatic life in Newark Bay. Although the distribution of various chemical contaminants in Newark Bay has not been well documented, the contaminants are known to be widespread. NBCDF could accommodate only a small portion of all contaminated sediments because of its limited capacity. The dredging sites that would be the sources of dredged material placed in the NBCDF would provide relatively clean habitat areas immediately after dredging compared to existing contamination at these site. However, because there are existing upstream sources of contamination that will not be remediated in the near future, these sites would be recontaminated as new sediment is deposited in these areas. If remediation of upstream contaminant sources eventually takes place, then the sediments

at the surface in these dredged areas may become progressively less contaminated over time.

The confinement of contaminated sediments is a benefit of this dredging project, but because large areas of the Bay would remain contaminated and some upstream sources of contamination have not been remediated, the long-term beneficial impact of the project on chemical contamination is very small. The presence of the NBCDF should have no cumulative interaction with any remedial actions proposed for contaminated waste sites.

4.25 REFERENCES

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5.0 IMPLEMENTATION STRATEGIES FOR USE OF NBCDF

5.01 PROCEDURES FOR IDENTIFICATION OF DREDGED MATERIAL FOR FACILITY USE

USACE-NYD evaluated several dredged material disposal options for the Port of NY/NJ and concluded that the use of subaqueous borrow pits (confined disposal facilities [CDFs]) is the environmentally preferred disposal method for potentially contaminated dredged material deemed unsuitable for unrestricted ocean disposal (USACE-NYD 1988). The preferred use of CDFs is based on their long-term ability to isolate contaminants from the water column, minimal impacts to aquatic resources and human health, and their immediate availability and high probability of success. The New York Harbor Dredged Material Management Plan: Phase I Report - Plan of Study (USACE-NYD 1996) identifies subaqueous pit containment facilities as potential locations for the disposal of both Category II and Category III dredged material. A CDF located in Newark Bay was identified by Governor Whitman's Task Force Report in February 1995 (DMMT 1995) as a potential short-term disposal site for dredged material not suitable for ocean disposal. In the Joint Dredging Plan for the Port of New York and New Jersey (NJ/NY 1996) the Newark Bay borrow pit(s) (NBCDFs) are listed as short-term options for the disposal of approximately 1.7 MCY of dredged material from the designated draw area deemed unsuitable for ocean disposal.

The State of New Jersey in the March 1996 draft report titled The Management and Regulation of Dredging Activities and Dredged Material in New Jersey's Waters (NJDEP 1996), defines subaqueous disposal pits as "submarine trenches or pits excavated below the ocean/bay bottom for the specific purpose of containing contaminated dredged material." General testing requirements to determine dredged material contaminant levels and therefore eligibility for disposal in the CDFs include grain-size analysis and bulk sediment chemistry for dredged material. Bulk sediment chemistry on dredged material to be disposed of in the NBCDF will be conducted in accordance with NJDEP permit requirements.

Dredged material considered for disposal in the NBCDF will be from permitted dredging operations located in the draw area defined as waters in New York-New Jersey Harbor contiguous to the State of New Jersey, including Newark Bay, the Arthur Kill, and the Kill Van Kull. Only dredged material deemed unsuitable for ocean disposal will be considered, i.e., Category III dredged material and Category II dredged material to the extent required. Dredged material testing to determine disposal categories will be in compliance with USACE and NJDEP guidelines and requirements in force at the time of the permit application.

Table 5.01-1 presents the estimated New Jersey and New York dredged material volumes by category type for the three-year period 1997-1999 (the maximum period the proposed

Table 5.01-1

Estimated Quantity of Category II and Category III Maintenance and Channel Improvement Dredged Material
Port Authority of New York and New Jersey Harbor Area

Site		Estimated Quantity of Dredge Material (CY)					
		1997		1998		1999	
Organization	State	Category II	Category III	Category II	Category III	Category II	Category III[a]
Port Authority NY/NJ	New Jersey	0	170,000	0	0	0	0
	New York	0	88,000	0	75,000	0	75,000
USACE - NYD	New Jersey	70,000	0	0	300,000	45,000	0
	New York	860,000	1,174,000	362,000	551,000	490,000	629,000
	NY&NJ	0	586,000	5,170,000	0	0	0
State and Local Agencies	New Jersey	0	29,000	0	1,100,000	0	0
	New York	161,500	1,340,500	16,500	219,500	16,500	219,500
Private Organizations	New Jersey	358,000	570,250	0	35,200	25,000	13,800
	New York	105,000	170,500	50,000	0	75,000	52,000
Total	New Jersey	428,000	769,250	0	1,435,200	70,000	13,800
	New York	1,126,500	2,773,000	428,500	845,500	581,500	975,500
	NY&NJ	0	586,000	5,170,000	0	0	0

NBCDF will be available). Information presented in Table 5.01-1 is from the PA's MudOne database; the disposal category of dredged material in the MudOne database is based on recent permit applications and information received from the respective organizations and is not based on actual sediment testing.

5.02 CAPACITY AND LIFE SPAN OF THE FACILITY

This section provides a description of the size and operational life of the proposed NBCDF, and includes surface area, estimated volumes, and approximate filling rates.

5.02.1 CAPACITY OF THE FACILITY

Area 1S. Area 1S has a generally triangular configuration, with a surface area of 26 acres (0.11 km^2). The east-west base is about 1250 ft (380 m) long and the north-south altitude is about 1700 ft (520 m) long. The side slope of the excavation to a depth of approximately 16 ft (4.9 m) (surficial sediments) is designed to be 3 horizontal to 1 vertical (3:1); the side slope to a depth of approximately 70 ft (21 m) is calculated to be 1.5:1. The in situ estimated volume of the excavation based on these figures is 1.98 MCY (1.52 MCM), which includes 579,000 CY (442,700 CM) of surficial sediments. Volume of the 3-ft (1-m) cap (see Section 5.04) will use about 125,000 CY (95,575 CM) of this volume. Considering construction methods available and capping requirements associated with construction of Area 1S, it is estimated that the net capacity of Area 1S will be 1.55 MCY (1.18 MCM) of dredged material.

Area 2S. Area 2S has a roughly rectangular surface area of about 20.9 acres (0.08 km^2). The east-west side is about 650 ft (198 m) long and the north-south side is about 1300 ft (396 m) long. The side slope of the excavation in the unconsolidated surface sediments to a depth of 16 ft (5.0 m) is calculated to be 3 horizontal to 1 vertical (3:1); the side slope in the deeper undisturbed sediments to a depth of approximately 70 ft (21 m) is calculated to be 1.5:1. The in situ estimated volume of the excavation based on these figures is approximately 1.36 MCY (1.04 MCM), which includes about 485,000 CY (370,830 CM) of surficial sediments. Emplacement of a 3-ft (1-m) cap (see Section 5.4) will fill about 97,000 CY (74,166 CM) of this volume. It is estimated that the nominal usable volume of Area 2S would be about 1.05 MCY (802,830 CM) of bulked dredged material.

Area 2N. Area 2N has a roughly rectangular surface area of 9.8 acres (0.04 km^2). The east-west side is about 450 ft (137 m) long and the north-south side is about 1000 ft (305 m) long. The side slope of the excavation in the surficial sediments to a depth of 14 ft (4.3 m) is calculated to be 3 horizontal to 1 vertical (3:1); the side slope in the undisturbed bottom sediments, to an approximate depth of 70 ft (21 m) is calculated to be 1.5:1. The in situ estimated volume of the excavation based on these figures is approximately 645,000 CY (493,167 CM), which includes about 200,000 CY (152,920 CM) of surficial sediments. Emplacement of a 3-ft (1-m) cap (see Section 5.4) will fill about 50,000 CY (38,230 CM) of this volume. It is estimated that the bulked dredged material net storage capacity of Area 2N would be about 495,000 CY (378,477 CM).

Total Capacity. Based on the above computations and using a bulking factor of 1.2, the three CDFs are estimated to have a total net storage capacity of about 2.4 MCY (1.8

MCM). Sediment chemical and biological test data obtained during the preparation of the DEIS indicates that the surficial sediments in proposed CDFs 2S and 2N are not suitable for ocean disposal. Usable capacity of the project contained in Area 1S is then 1.55 MCY (1.18 MCM).

5.02.2 LIFE SPAN OF THE FACILITY

Operational life span of the facility depends on the sediment characteristics and the type of equipment used for placement of dredged material, the rate at which dredged material is conveyed to the site, and management of the operations. Section 5.5 describes methods used for placement of dredged material into the facility. The facility has a relatively small volume (1.55 MCY [1.18 MCM]) that is greatly exceeded by the short-term (1997-1999) projected volumes of dredged material deemed unsuitable for ocean disposal in the NY/NJ Harbor (approximately 13.5 MCY [10.4 MCM]). Equipment is available that could fill Area 1S fairly rapidly. It is estimated that for Alternative 2, Area 1S, would be in operation for approximately one year, inclusion of Areas 2S and 2N would extend the operational time frame up to three years.

5.03 DISPOSAL METHODS

NBCDF dredged material disposal options and strategies are described in this section. The dredged material that would be disposed of at the NBCDF would be material that is deemed unsuitable for ocean disposal and would be from waters in New York-New Jersey Harbor contiguous to the State of New Jersey, including Newark Bay, the Arthur Kill, and the Kill Van Kull, and could possibly include surface sediments from Area 2 CDFs.

5.03.1 DREDGED MATERIAL DISPOSAL OPERATIONS

In general, dredged material determined to be unsuitable for ocean disposal can be deposited within the demarcated perimeter of the NBCDF by bottom dumping from split-hull scows until the material reaches the base of the entrance channel at -20 ft (-6.1 m) MLW. The entrance channel will then be partially filled to about -10 ft (-3.0 m) MLW and bottom dumping continued. The disposal operations conducted following partial filling of the entrance channel may require smaller scows, more lightly loaded scows, or high tide transit to allow travel over the partial entrance closure. When bottom dumping is no longer feasible due to lack of water depth, the entrance channel will be filled with non-contaminated material to about three ft (1.0 m) below the original surface elevation.

Final filling of the CDF storage capacity will be by removing dredged material from scows with a clamshell bucket. Scows will be positioned inside the CDF at high tide by shallow draft tugs. Dredged material will then be removed with clamshells, lowered through the shallow water to the depth of the previously placed dredged material and opened to release the dredged material. This process will minimize any suspension of dredged material in the water column, prevent the surge due to bottom impact, and keep the effects of placement to the immediate vicinity of the clamshell bucket.

The filling of the CDF will proceed from the area farthest from the entrance channel and proceed toward the entrance channel for all methods of filling in order to maintain the maximum clearance at the entrance channel and to measure the natural slope for the placed dredged material.

When the fill reaches the base of the planned cap, placement of dredged material will cease and the cap will be placed on the CDF to isolate the contaminated sediments from the overlying water column. The sand cap will be placed by sprinkling sand from the end of a hydraulic pipeline. Sprinkling the cap material minimizes displacement of dredged material and the potential for resuspension of contaminated sediment. At this stage the CDF is complete and the long term integrity monitoring will begin.

5.03.2 RECOMMENDED EQUIPMENT

Scows and barges that bring the dredged material to the NBCDF will vary in size depending on equipment availability and the water depths in the CDF. Bottom dumping scows are available in sizes ranging from 500 to 6000 CY (380 to 4600 CM). It is

scows are available in sizes ranging from 500 to 6000 CY (380 to 4600 CM). It is anticipated that smaller scows will be used in the confined areas of the project and during the last stages of CDF filling. Larger scows will be used during the initial disposal operations. The basic equipment a contractor would use for NBCDF disposal operations will likely consist of a nominal 3000-CY (2300-CM) scow. It is anticipated multiple scows will be used to service each operating dredge, which will require movement sequencing between the dredge site and the NBCDF to maximize dredge and disposal operations. The scows will probably be moved from the draw area dredge sites to the NBCDF by harbor tugs. Additional equipment that might typically be on site may include a survey/crew boat crane barge, equipment barge, and possibly a small boat to move the floating pipeline during final filling of the CDF.

The disposal operation will be continuously monitored to assure that specific minimum performance criteria are met. The monitoring will include verification of CDF depth by periodic hydrographic soundings performed in accordance with USACE Class 1 standards, requiring accuracy to 0.5 ft (0.15 m).

Disposal activities, such as the positioning of a scow during dumping operations, will not ordinarily require the accuracy of a Class 1 survey. Positioning of the scows to within approximately 15 ft (5 m) will be sufficient. Monitoring of potential movement of the dredged materials placed in the CDF will be performed to the more demanding accuracy required of a Class 1 survey because of the need to accurately determine the slopes of the materials placed in the CDF.

5.04 CAPPING STRATEGIES

Several factors determine the design, efficacy, and long-term performance of a protective cap for dredged material including: (1) the vulnerability of the cap to wave- and current-induced erosion, (2) the extent to which the cap chemically and biologically isolates the underlying contaminated sediments from the surrounding aquatic environment, and (3) construction methods and design features that minimize the potential for contaminated sediment remobilization.

5.04.1 CAP DESIGN

The required total cap thickness, T_{Total}, depends on several components and is computed as follows (Moffatt and Nichol 1993):

$$T_{Total} = T_{chemical} + T_{bioturbation} + T_{consolidation} + T_{erosion} + T_{tolerance}$$

where

$T_{chemical}$	=	thickness required for physical and chemical isolation, which depends on the properties of the contaminated and capping sediments
$T_{bioturbation}$	=	thickness required to isolate against bioturbation
$T_{consolidation}$	=	thickness required to combat cap consolidation after placement
$T_{erosion}$	=	thickness required to protect against wave- and current-induced erosion
$T_{tolerance}$	=	an additional cap thickness to account for inaccuracies associated with cap placement during construction

The governing equation used to obtain the estimate of the total cap thickness follows the accepted USACE and USEPA formula used for total required cap thickness, that is, the additive thicknesses required for chemical isolation, bioturbation, consolidation, and erosion (Palermo et al. 1995). Palermo (1991) presents a detailed discussion of the criteria used to determine the required cap thickness. A brief summary of each of these factors is presented in the following paragraphs.

A sediment cap must provide a barrier between the underlying contaminated material and the surrounding aquatic environment. The thickness necessary to achieve chemical isolation of contaminated sediment is normally determined through laboratory testing of the contaminated and cap sediments. On the basis of such tests, Sturgis and Gunnison (1988) have shown that typical minimum cap thicknesses for chemical isolation are on the order of 1 ft (0.3 m) for most contaminated sediments. Bioturbation is a term used to describe the vertical extent of organism movement within a sediment cap. An appropriately sized cap must be thick enough to prevent organisms from burrowing into either the portion of the cap designated for chemical isolation or the contaminated sediment itself. Accordingly, the thickness required for bioturbation is dictated by the maximum burrowing depth of organisms likely to colonize the site in significant numbers. Bioturbation depths are site-specific, highly variable, and best determined on

the basis of field measurements. Typical bioturbation depths range from 1 to 2 ft (0.3 to 0.6 m) for organisms known to populate the NBCDF area in great numbers (USACE 1985). The results of numerous studies on capping strategies (Rhoads and Carey 1997 and studies cited in their paper) indicate that one ft (30 cm) of a three ft (1.0 m) sand sap is sufficient for biological isolation. Boudreau (cited in Rhoads and Carey 1997) gives a universal average bioturbation depth of 3.9-in. (10 cm) for macrofauna, the most abundant organisms on disposal sites in the New York Bight. Nilsen et al. (cited in Rhoads and Carey 1997) notes that the bioturbation depth in reduced salinity areas, such as Newark Bay, are less than in areas of full marine salinity. Rhoads and Carey (1997) conclude "A conservative management approach for isolating contaminated sediments from the ecosystem for very long periods of time would be to reserve one ft (30 cm) of cap thickness for bioturbation; three-fold thicker than the universal mean biotu.bation depth for macrofauna and two times thicker than the plus (+) one standard deviation value . . ." A one ft (30 cm) cap thickness was used for bioturbation in determining the total thickness for the NBCDF cap.

Thicknesses for bioturbation and chemical isolation are additive since, as previously stated, it is undesirable to allow organisms to reach the portion of the cap intended for chemical isolation. In the absence of detailed design, the minimum cap for chemical isolation and bioturbation is taken as 2 ft (0.6 m).

A loosely placed cap may consolidate after construction, resulting in a gradual thinning of the chemical/bioturbation barrier. Consolidation must be estimated in order to determine whether there is a need to overbuild the cap to maintain the minimum cap thickness. Conversely, settlement of the cap would allow fine material to redeposit into the area, causing the site to biologically revert back to the existing substrate condition. The potential for cap consolidation was examined using the USACE LTFATE model (see Appendix 4.02) and was found to be negligible.

Wave-current-induced erosion can reduce the thickness of the cap and additional cap thickness may be provided in order to account for losses resulting from erosion. The additional cap thickness is designed to assure that the minimum cap thickness for chemical isolation and bioturbation is maintained for the life of the project. It should be noted, however, that it may be necessary to periodically replenish the cap thickness lost to erosion. Cap erosion potential was evaluated using the FASTTABS numerical model (see Appendix 4.02) and is addressed in Section 5.04.3.

Care must be taken to ensure that the proper cap thickness is distributed over the site. As it is difficult to place the cap at the exact thickness required for design, the specified cap thickness should include a contingency that accounts for uneven placement of material. This contingency should be about 0.5 to 1 ft (0.15 to 0.3 m). The tolerance is analogous to the allowable pay overdepth used in conventional dredging projects.

5.04.2 AVAILABLE CAPPING MATERIALS

Pending final design, it has been assumed that the cap will consist of a fine- to medium-grain sand or other suitable clean dredged material. Sand would be the preferred cap material because of its ease of placement. This material would be dredged from one of several approved sources in the NY/NJ Harbor area and would likely be taken from Lower New York Bay or offshore.

Extensive offshore investigations in the NY/NJ Harbor area were conducted from 1974 through 1992 for the purpose of obtaining geotechnical data on existing sediment (USACE 1993). The data were used to evaluate and select potential sediment sources with suitable characteristics and volumes for use as borrow material for beach nourishment/shore protection projects. The investigations included locations within Lower New York Bay and along the Atlantic coasts of New Jersey and Long Island, New York; they consisted a combination of seismic profiling and vibratory coring techniques to obtain the data. Locations within Lower New York Bay included the East Bank Shoal due south of Coney Island and the area within Rockaway Inlet.

The investigations found several potential sediment borrow source locations (Note: Cap material must come from a permitted borrow site or a dredging project with appropriate material.):

- East Bank Shoal south of Coney Island
- South of Rockaway Beach (offshore) between the west end of Coney Island and Atlantic Beach, Long Island
- Within Rockaway Inlet
- South of Rockaway Beach near East Rockaway Inlet
- South of Atlantic Beach

The above borrow sources were evaluated with respect to sediment grain size, and the analysis is used here to assess suitability as cap material for the NBCDF project. The assessment included using the borrow source sediment grain size as input into the STUDH sediment transport model (see Appendix 4.02), and evaluating erosion characteristics of the cap when subject to various wave and current conditions. Sediment samples obtained from the East Bank Shoal and South of Rockaway Beach (offshore) contained material having mean grain sizes ranging from 0.012 to 0.019 in. (0.30 to 0.48 mm). Based on analysis of the modeled wave and current conditions, the grain size of material contained in these two locations should be adequate for the cap. (See the following section for details regarding sediment transport modeling of the cap.)

Approximate volumes of suitable material from these sources indicate that there is a sufficient quantity available for the capping of the three NBCDF areas. An estimated volume of about 275,000 CY (208,800 CM) would be needed to place a 3-ft (1-m) thick cap over the three NBCDF areas (1S, 2S, and 2N). Material contained within the potential borrow sources are on the order of tens of millions of cubic yards.

5.04.3 EVALUATION OF CAP EROSION POTENTIAL

As previously stated, the FASTTABS model was used to investigate the stability of the cap against wave and current forces. Modeling efforts were conducted in order to evaluate the vulnerability of a sand cap to: (1) 100-year river flow conditions, (2) an extreme 100-year storm-induced wave coupled with normal tidal surface water elevation conditions, and (3) average wave conditions coupled with normal tidal surface elevation conditions. Physical parameters used in the modeling for the cap are presented in Table 5.04-1. The simulation of cap erosion potential entailed noncohesive sediments because sand is considered the best choice for the cap of the CDFs.

100-Year River Flow and Normal Surface Water Elevation. The first modeling effort was directed toward evaluating the integrity of a sand cap with grain sizes of 0.001 and 0.012 in. (0.1 and 0.3 mm) during 100-year flow conditions of the Passaic and Hackensack rivers. As the grain sizes used in the model are finer than the available capping material, the model is conservative, i.e., tends to overestimate erosion. Special hydrodynamic model runs were prepared in order to route the 100-year flow hydrograph through the Newark Bay area. The methodology for modeling the 100-year conditions was taken from work developed by the USACE - Waterways Experiment Station (WES). Example plots of peak storm flow velocities for 100-year conditions are presented in Figures 5.04-1 and 5.04-2 for ebb and flood tidal flows, respectively. STUDH sedimentation model runs were made for a sand cap having a mean grain sizes of 0.001 in. (0.1 mm) and are presented in Figure 5.04-3 for a 14 day model simulation period. As shown in Figure 5.04-3, the sand cap is not expected to suffer any significant erosion as a result of 100-year river flow conditions.

100-Year Wind/Wave Conditions and Normal Tidal Surface Water Elevation. STUDH computations were prepared for a cap consisting of 0.001- to 0.012-in. (0.1- to 0.3-mm) median grain size sand under normal tidal conditions along with 100-year wind (82 mph [132 km/h]) and resulting wave conditions. These STUDH results indicate that the sand cap would be vulnerable to erosion under these wind/wave conditions. During a normal tidal cycle, however, only for a fraction of the time is the surface water elevation high enough, i.e., water depths great enough at or near high tide, to allow these extreme waves to reach the NBCDF, travel over the cap, and impart an erosive energy to the cap. Erosion of the cap as a result of these high waves would be limited in time to about one-fourth of a tidal cycle (approximately 3 hrs) and would scour approximately 6 to 12 in. (15 to 30 cm) from an unsettled cap.

Table 5.04-1

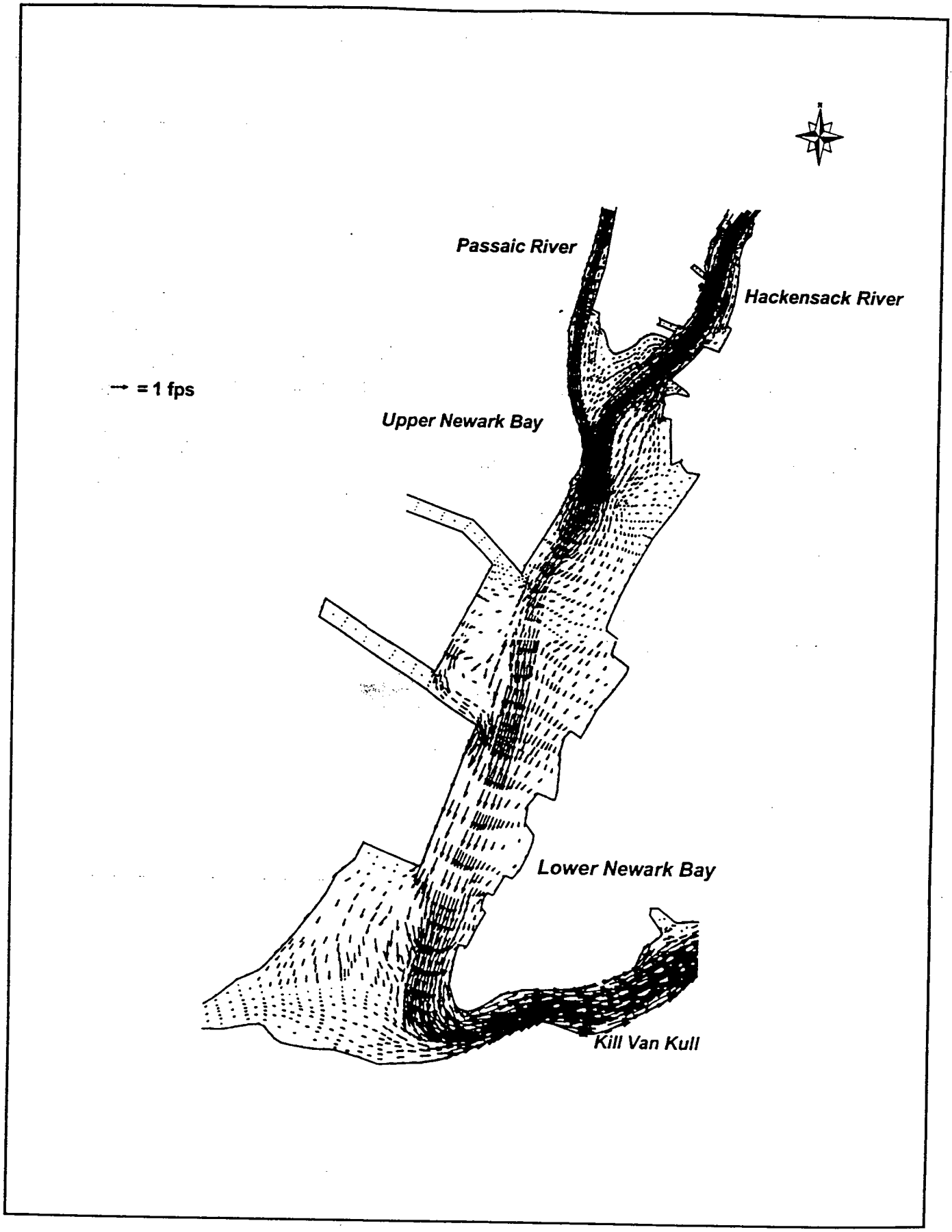
Noncohesive Sedimentation Parameters

Model Parameters	Units	Values
Crank-Nicholson THETA		0.66
Particle shape factor		0.07
Length factor (deposition)		0.05
Length factor (erosion)		10
Particle-specific gravity		2.65
Median grain size	mm	0.1
Effective diffusion	m**2/sec	50
Inflow concentration	kg/m**3	0.005
Settling velocity	m/sec	0.01
Manning's n		0.025

Normal Wave and Tidal Surface Water Elevations. Model efforts also considered cap erosion under normal tidal conditions, waves of 1 to 2 ft (0.3 to 0.6 m), and periods of 3 sec. Results indicate that a cap constructed of sand having median grain size ranging from 0.001 to 0.012 in. (0.1 to 0.3 mm) would be subject to minimal erosion, on the order of 2 to 3 in. (5 to 8 cm) per year, assuming that waves occur constantly. Because in the absence of waves net deposition is projected, there would be a dynamic equilibrium between slight erosion due to normal waves and deposition during calm conditions.

Summary. The model results described above show that the proposed sand cap would be stable under 100-year flood flow conditions due to relatively high water surface elevations and high suspended sediment concentrations. However, the cap may be vulnerable to wave-induced erosion. A relatively high degree of erosion might be expected during a 100-year wind/wave and normal tidal conditions. Erosion may also occur during relatively frequent occurrences where wave heights are as low as 1 to 2 ft (0.3 to 0.6 m). Such waves can be generated by boat wakes or winds from the northeast having speeds on the order of 20 to 25 mph (32 to 40 km/h). For the purposes of the present work, it will be assumed that a 1.5-ft (0.5-m) sand cap thickness is sufficient to counter long-term erosion; however, this estimate requires engineering verification.

Two factors make the modeling of erosion potential conservative, or tending toward overestimating erosion. The first factor is that, in general, the bed of Newark Bay is composed of 34% sand, 38% silt, and 28% clay (Suszkowski 1978). This introduces some error in to the calculation of cap thickness, as the sediments in the CDF area of Newark Bay are predominantly silt. Therefore, sediments outside the cap, which have a lower threshold for scour compared to the sand cap, will tend to scour before the sand cap. The second factor is that settlement of the cap within two years of its placement would result in greater water depths over the cap than outside the cap. Therefore, velocity and shear stress along the surface of the cap will be lower than the outlying Bay area and scour of the cap is less likely to occur. Cap settlement will induce greater deposition of Newark Bay sediments over it, and eventually a dynamic equilibrium condition will be reached in which the bed over the cap is practically level with the surrounding area. This natural sediment overburden resulting from a normal sedimentation rate of 6 to 12 in./year (15-30 cm/year) on the cap provides an additional margin of protection against erosion of the cap.



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Figure 5.04-1
Peak Ebb Tidal Currents in Newark Bay

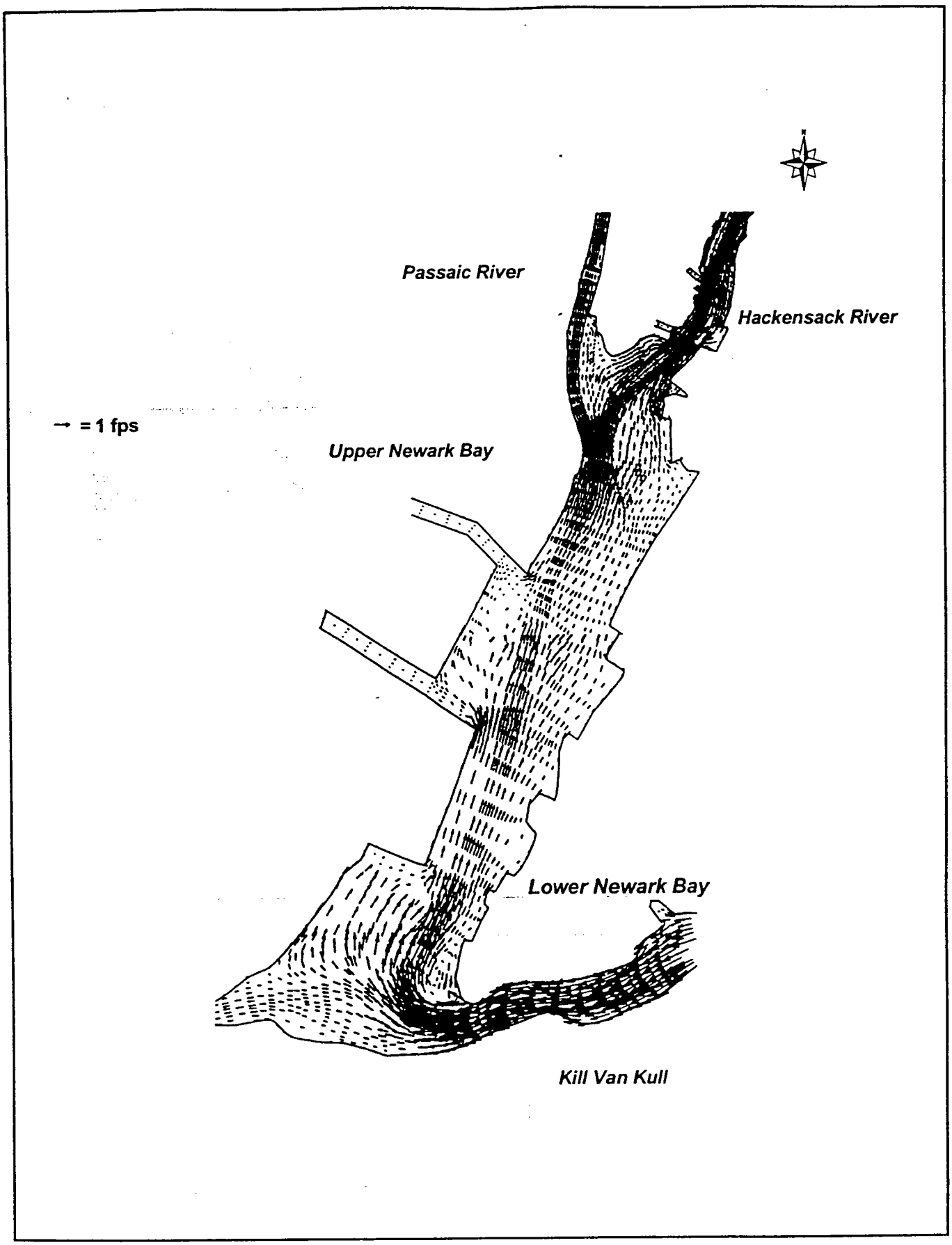
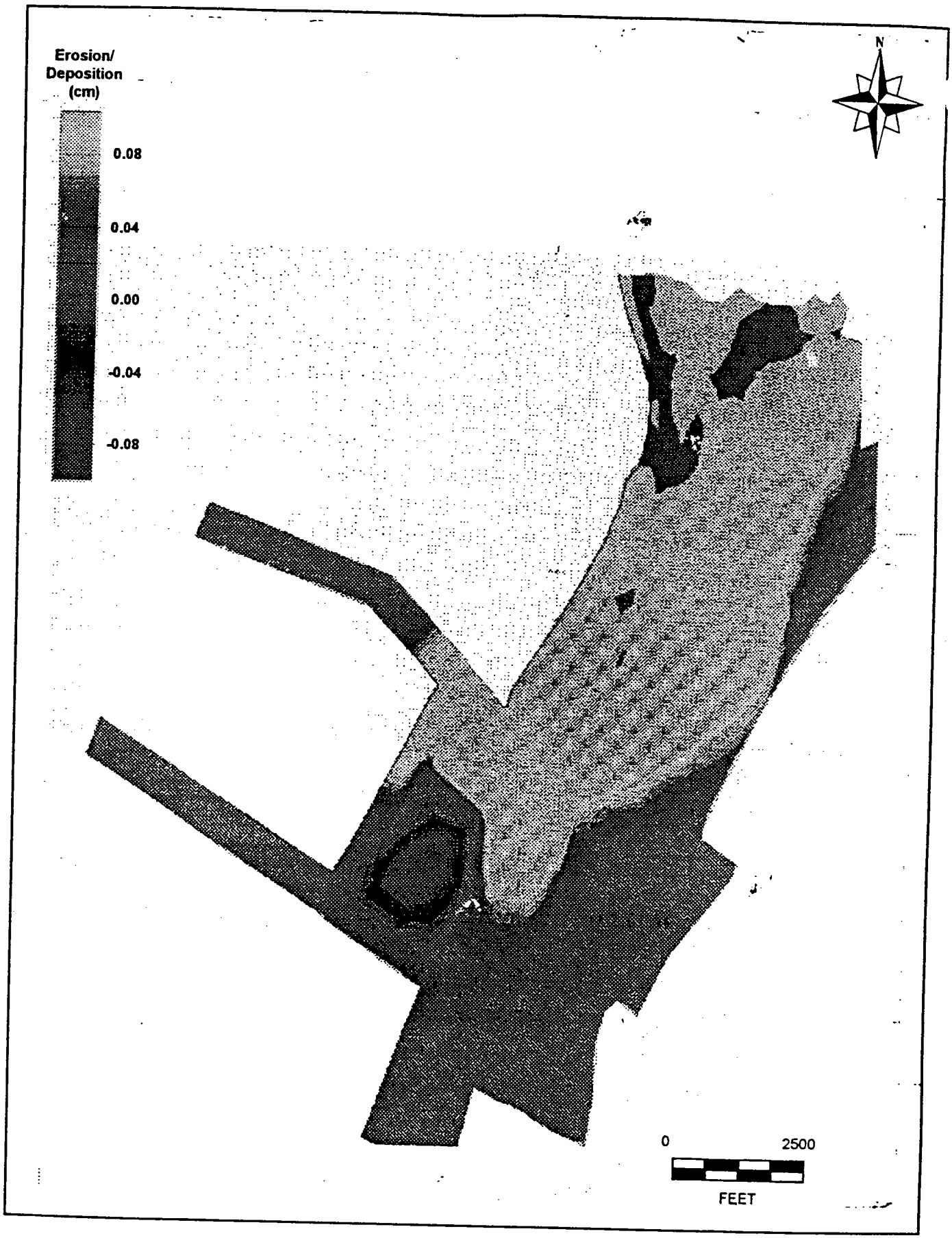


Figure 5.04-2

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Peak Flood Tidal Currents in Newark Bay



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Figure 5.04-3
Sand Cap Erosion/Deposition for 100-Year Storm (Grain Size 0.1 mm)

5.04.4 SUMMARY OF CAP THICKNESS

The various contributions to the total cap thickness, T_{Total}, are summarized below:

$$T_{chemical} = 1.0\ ft$$
$$T_{bioturbation} = 1.0\ ft$$
$$T_{consolidation} = 0.0\ ft$$
$$T_{erosion} = 1.5\ ft$$
$$T_{tolerance} = 0.5\ ft$$

The total cap thickness is computed as follows:

$$T_{Total} = T_{chemical} + T_{bioturbation} + T_{consolidation} + T_{erosion} + T_{tolerance} = 4.0\ ft$$

The relatively high Newark Bay sedimentation rate (6-12 in./year [15-30 cm/year]) and the relatively rare occurrence of storm events that would result in cap erosion suggest that the NBCDF closure should include a sand cap thickness of 3 ft (1 m), with cap monitoring and replenishment if scour is noted following storm events or regular monitoring intervals.

5.05 EQUIPMENT AND CONSTRUCTION TECHNIQUES

This section provides a detailed description of the equipment and construction techniques expected to be used on the project, operating and production characteristics of the equipment, and "best management" dredging practices that are applicable to the project. The following subsections address the proposed construction sequence. This sequence could be applied to any of the proposed NBCDF subareas.

5.05.1 DREDGING ENTRANCE CHANNEL TO NBCDF AND REMOVAL OF UPPER-LAYER MATERIALS

Area 1S will be used as an example for the discussion of equipment and construction techniques. Figure 5.05-1 shows Area 1S with a cross section drawn through the CDF and the entrance channel. The closed clamshell dredge will create an access to the NBCDF from the navigation channel by digging a 200-ft (61-m) (bottom width) wide by 20-ft (6.1-m) deep entrance channel to the NBCDF. Once access is provided to the NBCDF, the upper layers of the NBCDF will be removed. The unconsolidated surface sediment layer is characterized as gray silty clay and sand, with surface layer sediment depths ranging from 14 ft (4.3 m) in Area 2N to 16 ft (4.9 m) in Areas 1S and 2S. With compliance of the NJDEP barge overflows will be permitted during surficial sediment dredging operations.

Once within the CDF perimeter, the dredge will widen the excavation to within a minimum setback of 40 ft (12.2 m) from the edge of the CDF perimeter. This setback will ensure that any local sloughing of material will not cause material from outside the identified CDF footprint to enter the CDF area. The slope stability can also be monitored to determine the maximum final slope. This will allow for the maximum storage capacity to be developed later in the excavation process without concern that material that had not been environmentally characterized could affect the construction of the CDF. Once the first dredge has removed a sufficient amount of the surficial sediments to permit work in the area by two dredges, a second dredge will be used to complete the construction of this phase. It should be noted that only a clamshell dredge(s), or a hydraulic marine excavator (backhoe) dredge, employing slow lift rates, will be used to remove the surficial black silty clay. This phase of excavation is shown as the vertical lined area in Figure 5.05-1.

When the clamshell dredge is no longer effective in removing deeper or stiffer material, either a dipper, cutter-head, or hydraulic marine excavator dredge will be brought to the site to complete the excavation. Modern dipper, cutter-head and hydraulic marine excavator dredges can excavate to about -80 ft (-24 m) depth. Cutter-head and hydraulic dredge activity, which will only be used to excavate the deeper undisturbed clean sediments, will be accompanied by overflow barge discharging, with the barge located within the perimeter of the CDF. This phase of material excavation is shown as the cross-hatched area in Figure 5.05-1.

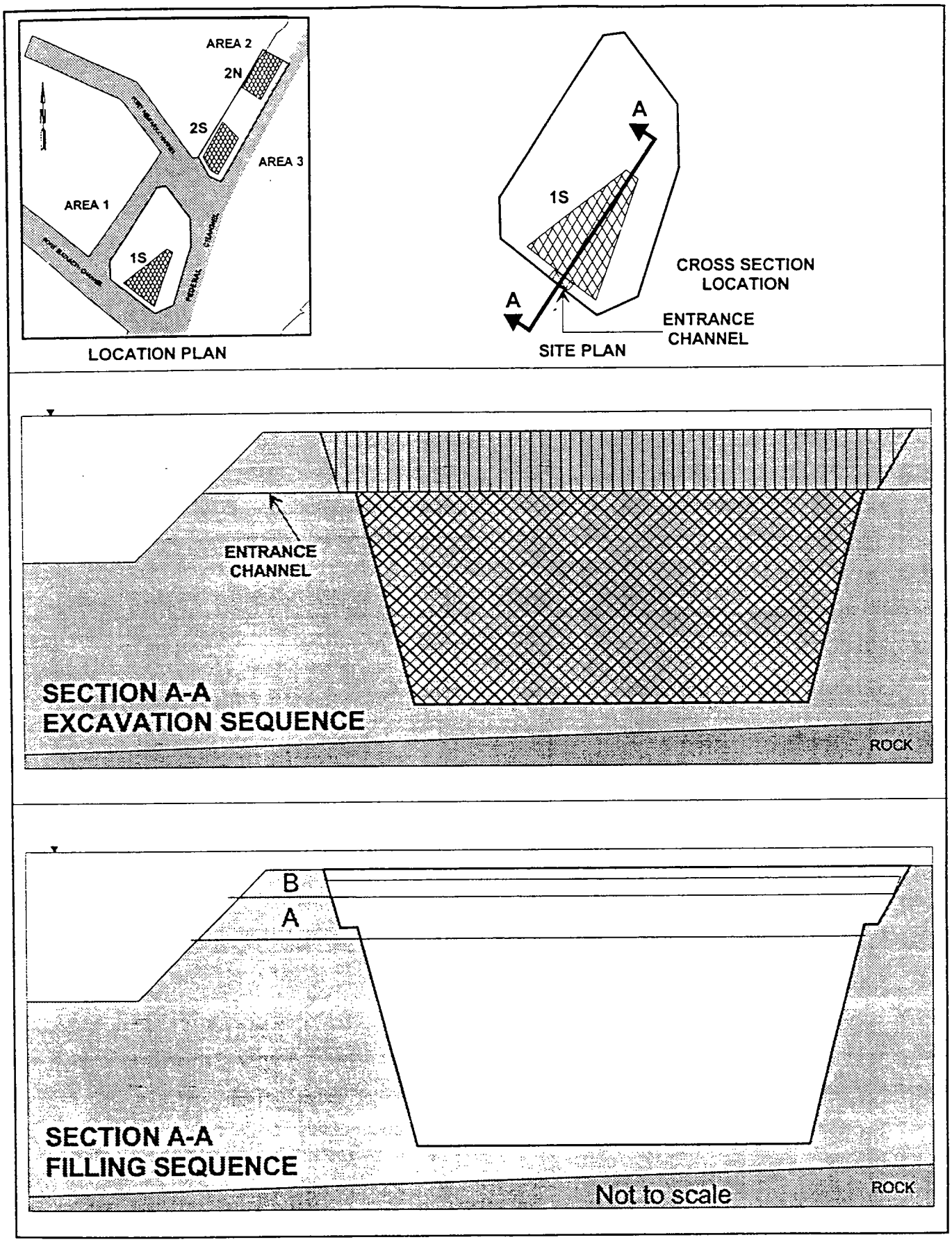


Figure 5.05-1

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CDF Excavation and Filling Sequence

DESCRIPTION OF EQUIPMENT

Both the entrance channel to the NBCDF and the surficial silt and clay found in the upper layers of the NBCDF will be dredged by a clamshell bucket. The dredges likely to perform this work have dimensions ranging from 45 ft by 120 ft (13.7 by 36.6 m) to 75 ft by 225 ft (22.9 by 68.6 m) and draw from 7 ft to 20 ft (2 to 6 m) of water.

Attendant plant required for dredge operations and estimated size ranges are listed below:

Vessel	Number on Site	Length (ft)	Beam (ft)	Draft (ft)	Capacity (CY)
Hopper or dump scows	2-4	60-180	25-50	3-15	1500-6000
Tug boats	1-4	30-65	10-18	2-5	
Survey/crew boat	1-2	27-45	9-14	2-4	
Crane/derrick barge	1-2	45-80	15-30	3-6	
Equipment barge	0-1	60-120	25-45	3-8	

Conventional clamshell dredges, hydraulic marine excavator (backhoe) dredges and environmental versions of both of these dredges have been used successfully for remediation dredging applications (see Section 5.05-1).

Conventional Clamshell Dredge. Conventional clamshell or bucket dredges operate from a barge-mounted crane. Once the open bucket is positioned over the target area, it is lowered by the cable to the subsurface bed. Upon contact with the bottom, the crane operator closes the bucket to excavate the sediment. The speed at which the bucket is lowered and brought back to the surface can be manipulated to minimize sediment resuspension and dispersion. The level of vertical accuracy available on conventional clamshell equipment is in the range of 1-4 ft, depending upon sediment characteristics, operator skill level, tides, and sea state. The bucket capacities of conventional clamshell dredges that could complete the work range from approximately 5 to 50 CY (4-38 CM). The conventional clamshell dredge is most effective in excavating unconsolidated silts and sands. A smaller, heavier bucket is required for excavation of dense material such as consolidated (stiff) clay.

Environmental Clamshell Dredge. The environmental clamshell dredge was developed to excavate sediment on projects requiring tight vertical tolerance and minimal sediment resuspension/dispersion. The environmental clamshell dredge operates from the same barge platform as the conventional clamshell dredge and moves in the same manner. More precise vertical and horizontal control is achieved by the environmental clamshell by using pressure (depth) sensors, differential global positioning systems, and modern computer software. Modifications to the bucket permit the excavation of sediment in

level cuts, as opposed to pockets. Additionally, the environmental clamshell bucket provides a cover and seal closure to minimize sediment dispersion into the water column as the excavated material is brought to the surface. The environmental clamshell dredge is most effective in excavating unconsolidated silts and sands and is less applicable to the excavation of stiffer clays.

Marine Excavator (Backhoe Dredge). Marine excavators use a turret-mounted backhoe as the primary excavator, and are capable of performing both the surficial dredging of unconsolidated contaminated sediment and the excavation of the stiffer, consolidated clay expected to be encountered deeper in the NBCDF. A number of new hydraulic marine excavator (backhoe) dredges have been constructed by the U.S. dredging industry in recent years. Ranging in size from 6 to 40 CY (4.6-30.6 cm), these backhoe dredges are capable of tight-tolerance excavation of marine sediment with minimal water entrainment. Vertical dredge tolerances of 0.5 to 1 ft (0.2-0.3 m) are possible, as is submeter horizontal positioning, with these modern, highly computerized excavator dredges. Achievable tolerances are dependent on sediment characteristics, operator skill level, tides, and sea state.

Production. The production capacities of the dredges capable of performing this project are highly variable and depend on operating parameters that include dredge sediment characteristics, depth of excavation, size of excavator bucket, dredge cycle time, and crew skill level. Of particular consequence to the dredge production, while excavating the surficial unconsolidated sediment, may be the necessity to decrease the rate of descent and rate of haul of the excavator to reduce resuspension of sediment as a result of washing from the bucket. This will lengthen the cycle time of the dredge.

Estimated Production Ranges of Dredges - Surficial Unconsolidated Sediments

Dredge	Bucket Size (CY)	Cycle Time (Min)	Operating Day (Hr)	Operating Efficiency	Production (CY/Day)
Conventional clamshell	5	2	24	0.65	2,300
	10	2	24	0.65	4,700
	30	2	24	0.65	14,000
	40	2	24	0.65	18,700
	50	2	24	0.65	23,400
Environmental clamshell	8	2.5	24	0.45	2,100
	16	2.5	24	0.45	4,100
	26	2.5	24	0.45	6,700
Marine excavator	12	1.5	24	0.65	7,500
	24	1.5	24	0.65	15,000
	40	1.5	24	0.65	25,000

CONSTRUCTION METHODOLOGY

Working inward from the Port Elizabeth Channel, the dredge will advance in set ranging from 5 to 15 ft (1.5 to 4.5 m). Once the dredge advances it will lower and set its spuds into the bottom sediment, providing a stable and fixed platform from which the excavator can operate. Dredge mobility will be supplied either by tugboats or an on-board spud carriage. If a dredge with a spud carriage is used, the dredge will be capable of a certain amount of self-propulsion, setting itself ahead up to 30 ft (9.1 m) per set of the carriage, before the tug assist would be required for resetting. If the dredge is not equipped with a spud carriage, the dredge will be moved into position for its next cut sequence by one or more tugboats. Material dredged from the entrance channel and unconsolidated surface layer will be placed in hopper or dump scows for transport to the Mud Dump Site (MDS). One scow will be moored alongside the dredge for filling when excavation is in progress, while one or more scows are in transit to/from the disposal location. The dredge sequence will proceed along a predetermined cut path, preferably in long, straight lines, to optimize production.

Production is based on dredging operations being conducted 24 hrs per day. Delays due to weather and mechanical repairs are inevitable, but these will be minimized by the contractor. Little to no delay due to navigation traffic is expected for the dredge operations as the dredge area is not a navigation area. Hauling operations are more susceptible to weather and navigation delays. Weather and mechanical delays are incorporated into the operating efficiency used to calculate production.

5.05.2 DREDGING STIFFER NBCDF MATERIALS

Based on information gathered during the geotechnical borings, stiffer, previously undisturbed, consolidated and unconsolidated sediment is expected to be encountered at around -16 ft (-4.9 m) MLW.

DESCRIPTION OF EQUIPMENT

The stiffer, more consolidated clays expected to be encountered in the lower depths of the NBCDF will likely require the use of either a marine excavator dipper or other dredge for effective bulk material excavation. Attendant plant required for dredge operations in this phase of the project are the same as that listed in Section 5.5.1

Marine Excavators (Backhoe Dredge). Marine excavators, also described in Section 5.5.1, are capable of performing both the surficial dredging of unconsolidated contaminated sediments and the excavation of the stiffer, consolidated clays expected to be encountered deeper in the NBCDF. However, because of the large volume of material to be excavated in this phase and the depth at which dredging is to occur, only the larger marine excavators with larger buckets and with vertical reaches exceeding 70 ft (21 m) could be used.

Dipper Dredge. The dipper dredge offers superior excavation power in the removal of stiff clays and rock. With bucket capacities up to 28 CY (21 CM), the dipper dredge operates from the same barge and crane as the clamshell dredge. The dipper dredge provides efficient bulk excavation of material utilizing a cantilever arm mounted bucket. The dipper is lowered to the target dredge area and digs forward and upward into the bank. The dredged material is placed in the dump scow by opening the bottom cover of the dipper bucket. The bucket is reset and another dredge cycle begins.

Production. The production capacities of the dredges capable of performing this phase are less dependent on sediment characteristics and depth of excavation than are the dredges evaluated for the shallow-dredging phase of this project. This is because the dredge cycle time will not vary significantly whether the material is consolidated or unconsolidated. The size of the excavator bucket, dredge cycle time, and crew skill level will impact production. Because neither contaminated nor loose sediment is anticipated, it is not expected to be necessary to decrease the rate of descent and rate of haul of the excavator. This could increase production.

Estimated Production Ranges of Dredges - Deeper, Consolidated Sediments

Dredge	Bucket Size (CY)	Cycle Time (Min)	Operating Day (Hr)	Operating Efficiency	Production (CY/Day)
Hydraulic marine excavator	24	1	24	0.65	22,500
Hydraulic marine excavator	40	1	24	0.65	37,400
Dipper dredge	28	1	24	0.65	26,200

CONSTRUCTION METHODOLOGY

The dredging sequencing and construction methodology used for the deeper-dredging phase of this project is much the same as that employed for the shallow-dredging phase described in Section 5.05.1. The depth of excavation in this phase, to -70 ft (-21 m), may require the use of an anchor and cable system rather than spuds for dredge mobility and stability. Most dredges capable of performing the work in this phase can use spuds in this depth range. Material excavated from the dredge area in this phase will be placed in scows for transport to the MDS. One scow will be moored alongside the dredge for filling when excavation is in progress, while one or more scows are in transit to/from the disposal location. The dredge sequence will proceed along a predetermined cut path, preferably in long, straight lines to optimize production. It is assumed that dredge operations will be conducted 24 hrs per day.

5.05.3 HAULING MATERIAL EXCAVATED FROM NBCDF TO MDS

Material excavated from the NBCDF will be transported to and placed in the MDS located east of Sandy Hook, New Jersey. The filled scows will be towed by tugboats from the NBCDF to the MDS via Newark Bay, the Kill Van Kull, and the Ambrose Channel to the disposal site offshore. The total round trip is roughly 55 to 60 nautical miles (92 to 111 km). The transport rate should range from 5 to 10 knots (2.6 to 5.1 m/sec), depending on tugs and scows utilized, vessel traffic, currents, and weather. Hauling operations are more susceptible to weather and navigation delays than the dredge operations and at times could affect the dredge production and project schedule. All Category II material will be properly and appropriately capped with clean material at the MDS. Category I material may be used for remediation at the Historic Area Remediation Site (HARS).

5.05.4 FILLING NBCDF WITH CONTAMINATED MAINTENANCE MATERIALS USING DUMP SCOWS

Placement of contaminated material in the NBCDF with dump scows will be conducted in two phases. The initial phase will fill the NBCDF to the bottom of the 20-ft-deep access channel. When the NBCDF reaches this level, the access channel will be filled to a 10-ft depth with clean sediment. This reduced entrance channel depth will prevent access to the NBCDF for some larger dump scows. The second phase - placement of contaminated dredged materials in the NBCDF - will use shallower-draft dump scows or lightly loaded dump scows, and may take advantage of the tides.

Contaminated material to be placed in the NBCDF will be transported and placed via hopper or dump scows. The scows likely will be towed to the site with bridle connection or side connection to tugboats and maneuvered into place by the tugboats. Prefill hydrographic surveys will aid in determining optimal placement location for the material. Using differential global positioning systems, the scows will be maneuvered to within 16 ft (5 m) of the desired dump location and alignment. Once positioned, the scows will open their bottom dump doors, or hopper, to release the contaminated material.

A number of measures can be taken to minimize the resuspension and dispersion of contaminated sediment released from the scows. If necessary, operational controls, such as limiting placement of fill material to periods of slack tide or intermittent disposal, can be implemented to control resuspension of sediment. If operational controls are not sufficient to meet water quality standards, intermittent use of a silt curtain or containment booms will be considered.

5.05.5 PLACEMENT OF CONTAMINATED MAINTENANCE MATERIALS INTO THE NBCDF

When the NBCDF has been filled to the level of the 10-ft (3.1-m) deep entrance channel, the entrance channel will be filled with clean material. Shallow draft or lightly loaded dump scows will continue the disposal of dredged material until site access is precluded. Additional contaminated dredged material will then be placed in the NBCDF using a clamshell dredge with underwater release to a depth of -3 ft (-1.0 m). Underwater release of contaminated dredge material will minimize sediment resuspension and the effect of tidal currents since release will be below the sediment-water interface.

5.05.6 CAPPING CONTAMINATED MAINTENANCE MATERIALS IN NBCDF

Clean sand material will be used to cap the NBCDF. Due to depth restrictions, bottom dump scows will not be capable of navigating into the cap fill area. A pipeline system is best used for this activity. The cap material slurry will be transported to the area in barges and pumped directly from the barge depositing the sand material over the NBCDF.

To control resuspension of contaminated sediments, the discharge velocity should be minimized. To avoid creation of humps and reconstruct as level a depth contour as possible, one small boat or shallow-draft tug would be used to control the pipeline discharge location. A diffuser can also be used at the discharge to reduce the discharge velocity and provide a more even distribution of the capping material.

5.06 BEST MANAGEMENT PRACTICES

In March 1996 NJDEP published its draft guidance document on "The Management and Regulation of Dredging Activities and Dredged Material in New Jersey's Tidal Waters" (NJDEP 1996). This draft document presents the policies and procedures under which the NJDEP proposes to conduct regulatory reviews of dredging activities in tidal waters of the State of New Jersey. The policies and procedures were developed to ensure that proposed dredging projects and the management of dredged material are conducted so as to minimize the potential for adverse impacts to the environment and public health.

The NJDEP draft guidance document presents and includes a discussion on Best Management Practices (BMPs) as they relate to the management of dredging and disposal operations. BMPs are procedures that the guidance document states should be used to minimize the potential for, and magnitude of, adverse environmental impacts that could result from dredging and disposal operations. The BMPs to be employed during the construction and disposal operations at the NBCDF will be determined by the NJDEP and will be included as permit conditions. The applicability of the use of a particular BMP for a dredging and/or disposal project will be evaluated by the NJDEP, on a case-by-case basis, in consultation with the permit applicant. The BMPs determined to be applicable to the applicant's project will be incorporated as permit conditions.

The document presents several potential environmental impacts and regulatory objectives related to dredging operations and the management of dredged material disposal operations. Potential environmental impacts and human health risks considered by the NJDEP in reviewing dredging and dredged material management operations include:

- Physical disruption of benthos at/or in the immediate vicinity of the dredge/disposal site
- Water column toxicity and contamination
- Benthic toxicity and contamination
- Interference with anadromous fish migrations
- Ecosystem impacts if capped contaminated dredged material is not adequately contained and isolated from the marine environment

Following are summaries of BMPs included in the NJDEP draft guidance document (NJDEP 1996) related to dredging activities and the management of dredged material disposal operations that are considered applicable to the construction and operation of the proposed NBCDF:

- ***Closed Clamshell Bucket***: The use of a closed, watertight clamshell dredge bucket (i.e., environmental bucket) reduces the production of suspended

solids at the dredging site. The use of an environmental bucket is applicable for the dredging of the top layer of contaminated sediments (down to 12 to 20 ft [3.7-6.1 m]) at the proposed NBCDF.

- ***Dredging Practices***: Procedures employed to minimize the creation and dispersal of suspended sediments when using a clamshell dredge. The following dredging practices are applicable for proposed NBCDF surface sediment dredging operations:

  - maximizing the size of the "bite" taken by the clamshell bucket. This also results in a minimization of the number of "bites" needed to dredge a particular volume of sediment;

  - slowly withdrawing the clamshell bucket through the water column;

  - not hosing down or rinsing sediments off the sides and gunwales of the barge while at the dredge site.

- ***Barge-Overflow***: At the dredge site, the elimination of barge-overflow reduces the creation and dispersal of suspended sediments when finer-grained sediments are dredged. Barge-overflow will not be permitted by the NJDEP when the dredged material is contaminated at levels warranting concern (NJDEP 1996). NJDEP may permit barge overflow when the dredged material will be taken to a designated ocean disposal site. Use of barge overflow tends to produce a more consolidated dredged material which results in less dispersal at the ocean disposal site. The use of barge-overflow and the relative impacts at the dredge site and the disposal site during the dredging of the proposed NBCDF will be reviewed by the NJDEP and any restriction listed as a permit condition. Barge overflow is currently anticipated for the dredging of all NBCDF sediments.

- ***Split-hull Barges***: Split-hull barges should only be used in dredging projects which will use open water disposal methods. The use of split-hull barges is projected for both the construction and disposal operations at the proposed NBCDF.

- ***Point Disposal:*** Adherence to strict navigational requirements designed to ensure point disposal of dredged material into the subaqueous CDF. Proper placement of dredged material in the CDF will be part of the facility operational plan.

- ***Weather and Tide Restrictions:*** Dredging and dredged material disposal operations may be restricted during severe weather and/or tidal conditions. High wind speeds and unusually high tidal ranges (such as

those that occur during severe storms or during particular spring tides) may result in increased current velocity over the subaqueous CDF and could cause dispersal of contaminated sediments away from the disposal area. Permit conditions related to weather and tides may be applicable during the construction and operation of the proposed NBCDF. Permit conditions will be determined by NJDEP.

- ***Geotextiles and Direct Shunting:*** No use of geotextiles is considered feasible for the proposed NBCDF. The feasibility of using direct shunting of dredged material into the pit will be considered. For this alternative, concerns about weather and tide are less important than if dredged material is dropped from the surface of the water into the pit. Direct shunting would involve a conduit leading from above the surface well into the CDF into which dredged material would be dropped. The use of direct shunting may be used during the final stages of dredged material disposal, when it is projected to use hydraulic pumping to complete filling of the CDFs.

- ***Silt Curtains:*** Silt curtains or turbidity barriers are vertical barriers designed to enclose or contain the turbid water generated by a dredging operation. Curtains are manufactured for a variety of depths and, in general, their design includes four elements: a skirt that forms the barrier, flotation material at the top, ballast weight at the bottom, and usually a tension cable. The flotation and ballast serve to maintain the deployed curtain in a vertical position, while the tension cable absorbs the loads imposed by the hydrodynamic (current) forces (JBF 1978). However, when current speeds exceed 1.6 ft/s (0.5 m/s), silt curtains may not be practical (NJDEP 1996). Thus, depending on the hydrodynamics of the study area silt curtains may or may not be feasible. Silt curtains or containment devices may be used around the end of the barge-overflow discharge pipe to minimize the plume area and facilitate sediment settling. The use of silt curtains is not currently considered necessary or feasible for construction or operation of the proposed NBCDF.

- ***Dredging Inspector:*** The use of an on-site inspector is anticipated for both dredging and dredged material disposal operations at the proposed NBCDF.

- ***Biological Windows:*** Dredging and dredged material disposal operations conducted during appropriate biological "windows" may be required in some areas of New York Harbor to avoid interference with anadromous or other migratory finfish, nesting shorebirds, overwintering waterfowl, and other biological populations. Evaluation of the biological information from Newark Bay and surrounding environs does not indicate the need for "windows" for the construction or disposal operations at the proposed NBCDF.

Another management practice that should be considered for disposal operations at the proposed NBCDF is the use of bathymetric surveys to monitor CDF disposal capacity. Furthermore, inadvertent creation of mounds along the pit boundary could result in premature topping of the pit. Thus, periodic bathymetry surveys can be used to determine whether the placement location of the dredged material needs to be modified to prevent this from happening. Additionally, an even application of dredged material in the CDF will tend to maximize its consolidation, which would also increase its stability and maximize capacity.

Additional BMP items to be incorporated involve site safety procedures and determining the best operation schedule to minimize interference with shipping and operations at Ports Elizabeth and Newark.

In addition, potential environmental impacts can be minimized upon closure of the subaqueous CDF by designing an appropriate cap and maintaining the cap's integrity. The final cap needs to be thick enough to prevent burrowing organisms from reaching the contaminated sediment, and also to effectively isolate contaminated sediments from release. In general, NJDEP indicates that one meter of suitable clean material will be required as a final cap thickness.

Restoration of the natural bathymetry of the subaqueous CDF using appropriate clean material as a final cap will serve as de facto mitigation for the loss of benthic habitat resulting from the construction of the pit. Capping at the proposed NBCDF will restore the bottom bathymetry to pre-existing conditions. Monitoring of the subaqueous CDF, its final cap, and the surrounding environment is required to ensure the integrity of the cap. A monitoring plan for the NBCDF is presented and discussed in Section 5.07.

Any pertinent Occupational Safety and Health Administration (OSHA) safety regulations in 29 CFR 1926 (Construction) will be followed, as well as any pertinent General Industry standards in 29 CFR 1910. Furthermore, specific guidance on safety issues regarding dredge-related projects are included in USACE (1992). This document will provide guidance on safety practices.

5.07 MONITORING AND MANAGEMENT PLAN

The purpose of the monitoring and management plan is to establish the organizational framework and information needed to manage the dredging and disposal operations at the proposed NBCDF. The potential adverse environmental impacts associated with the construction, operation, and closure of a CDF depend directly upon the location and existing ecological functions of the proposed CDF site. Potential impacts which may require evaluation include physical disruptions during construction and disposal operations, short-term benthic and water column toxicity impacts as a result of the disposal of contaminated dredged material, and water column impacts associated with the resuspension of sediment. In addition, long-term impacts to biota and the ecosystem may result if the contaminated dredged material placed in a CDF is not adequately contained and isolated from the marine environment.

Due to the short time period that the proposed NBCDF will be open and the implementation of BMP permit conditions, the construction and operation of the NBCDF will not have long-term negative environmental impacts. A project-specific monitoring and management program has been designed to gather sufficient information to: 1) ensure that water quality standards are complied with during construction and operation, and 2) ensure that the closure activities (capping) sufficiently contain the contaminated sediments. In addition, as suggested in the NJDEP guidelines for the management and regulation of dredging activities in New Jersey's tidal waters (NJDEP 1996), the proposed NBCDF will be located in an area impacted by similar levels of existing sediment contamination as the dredged material proposed for disposal. Based on the existing level of sediment contamination in the immediate vicinity of the proposed NBCDF, there is no reason to propose any short-term or long-term permit conditions for surficial sediment or water column chemistry monitoring or tissue bioaccumulation testing, as it will not be possible to separate out the influence of the disposed sediments from the existing sediments.

The overall emphasis of the monitoring and management plan is to monitor the cap of the closed CDF to determine its effectiveness at containing/isolating the contaminated sediments placed in the CDF, and if necessary, to rectify any problems (most probably through the addition of cap material). The second area emphasized in the monitoring plan is the health of the biotic community through periodic sampling of the benthic community, and comparing the results to previously collected data including baseline data to establish recolonization patterns/trends and the return and continued use of the area by higher trophic level populations. Monitoring will be conducted during disposal events to ensure turbidity levels in the surrounding water do not exceed permitted levels. This will help to ensure that unacceptable negative impacts to water quality does not occur.

The monitoring plan covers the establishment of predredging baseline conditions through long-term monitoring following capping. This plan incorporates the experience gained through other dredging and disposal monitoring programs at both open- water and confined disposal sites. However, no attempt has been made to directly relate this

program to other monitoring programs because this program is very specific, while the others were generally broader in scope.

The following assumptions have been made during the development of this monitoring and management plan:

- The results of the environmental assessment indicate that there is no need for non-water (sediment, air) related monitoring.

- Monitoring will be conducted for NBCDF dredging and dredged material disposal activities only.

- Monitoring at source dredging sites will be performed by the site owner according to the terms of the permit for the site. This is assumed to include loading of the barges and transport of the dredged material to the CDF. Floatables and petroleum by-products will not be permitted for disposal at the CDF.

- Monitoring for the CDF begins with the collection of physical, chemical and biological samples to establish baseline conditions. (NOTE: The baseline sampling program was conducted during the period April 1995 through March 1996 (LMS 1996).)

The purpose of setting these objectives is to develop and implement a monitoring plan that inspects the site, documents conformance to design standards, and provides remedial action options if design standards/permit conditions are contravened.

The objectives of this plan are to:

- Establish an organizational framework for management of the NBCDF.

- Provide baseline information for physical, chemical, and biological conditions at the NBCDF and at reference/control stations, which will be used during operational and postcapping monitoring. The baseline data base will include both existing information and data obtained during the NBCDF project. (Ample preconstruction baseline information is available.)

- Provide a general sampling protocol for the data and information needed for operational management and long-term monitoring of the proposed NBCDF. The final monitoring plan, quality assurance/quality control procedures, and reporting requirements will be specified in the project specific Federal and state permits.

5.07.1 MANAGEMENT PLAN

The management plan is dependent on a functioning organizational framework that includes all involved agencies and the responsible organization (RO) (site owner/ operator). The Port Authority of New York and New Jersey will be the RO for the proposed NBCDF. The RO will assign a project manager(s), who will be responsible for the execution of the monitoring program specified in the Federal and state permits, including the pre-operational, operational, and post-operational phases of the program. If an outside contractor is required to conduct the technical monitoring program, the RO will be responsible for preparing a request for proposal, selecting and managing a contractor, and sponsoring (funding) the contract.

5.07.2 PROPOSED MONITORING PROGRAM

The proposed monitoring program is planned as a series of monitoring tasks conducted during four stages of the project. The final NBCDF monitoring program will be based on agreements among the regulatory agencies. The tasks considered for inclusion in the monitoring program will be conducted at the CDF to ascertain the following:

- Confirmation that design criteria are satisfied prior to disposal of dredged material;
- Assurance that dredged material disposal operations proceed in accordance with protocol and contaminated sediments are contained within the CDF; and
- Assurance that the cap functions as designed to contain the contaminated sediments for the long-term.

The project is divided into the following stages:

- Predredging (baseline) (Phase complete)
- CDF construction dredging/predisposal
- Disposal of contaminated dredged material and capping
- Postcapping.

The most comprehensive physical, chemical, and biological sampling will be conducted during the predredging (baseline) phase. Information gathered during this effort will be used as the baseline for monitoring efforts at both the control and disturbed sites for the remainder of the program.

The following monitoring program components are proposed in accordance with the specified schedule.

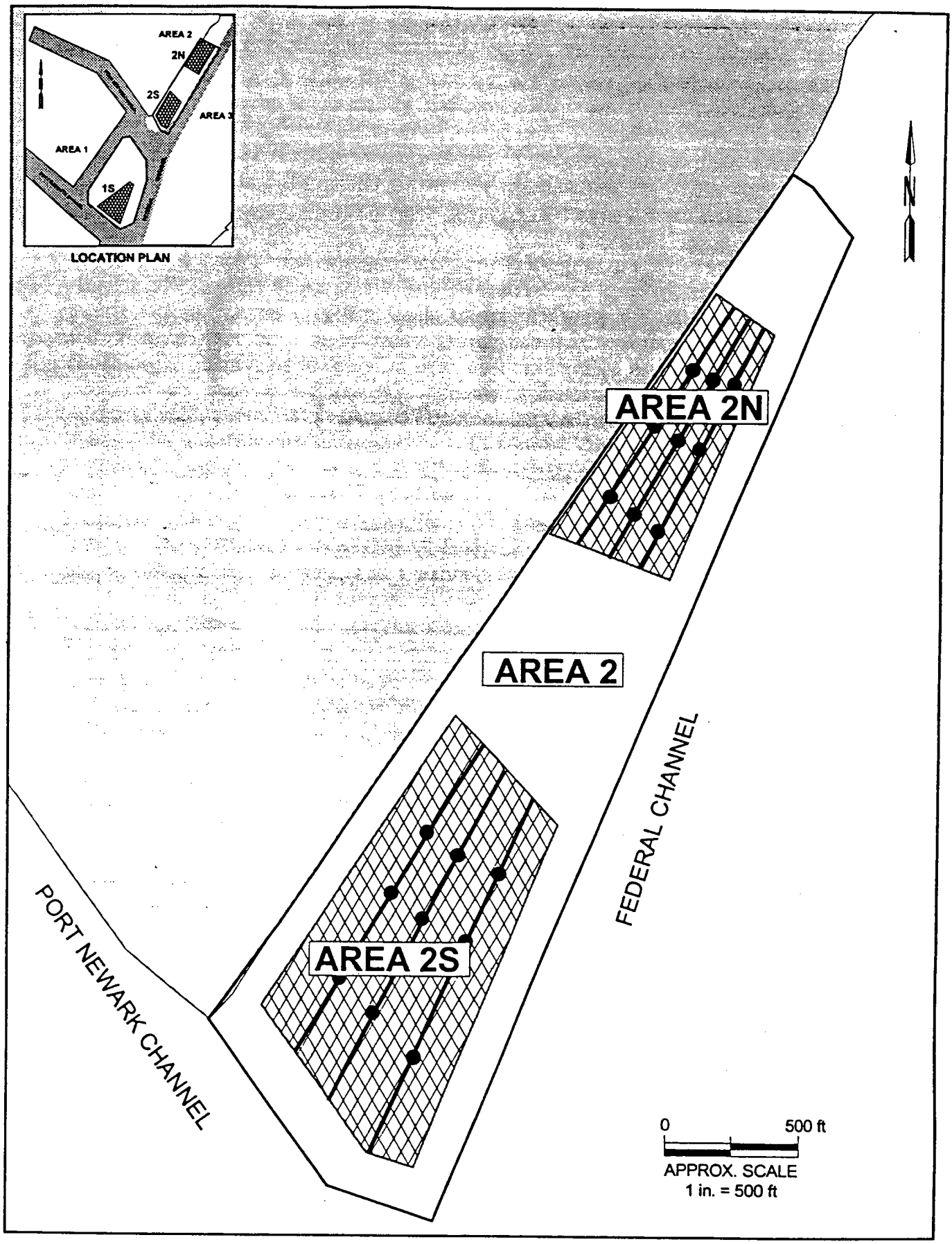
Bathymetry. Bathymetric surveys will be conducted at the proposed CDF sites along transects, with transect spacing sufficient to obtain detailed bottom contour profiles. Differential global positioning system (DGPS) or equivalent technology should be employed to accurately position the boat (± 5 ft [±1.5 m]). Tidal corrections will be made with respect to a known datum with real-time water level information.

Predredging bathymetric surveys will be conducted to establish the existing bottom contours for the purpose of restoring the Bay bottom to its original configuration following disposal operations and capping. Bathymetry may be used during the dredging operations to ensure adherence to design drawings and establish the bottom depth/profile. During disposal of dredged material in the CDF, bathymetry will help to determine dredged material placement, and to monitor depth or available volume. CDF capping procedures will result in bottom profiles similar to predredging bottom contours, with the bottom contours confirmed through the use of bathymetry. Bathymetry may also be used during the postcapping/long-term monitoring phase of the program. Side-scan sonar used to validate bathymetric traces and to provide more complete images of project site elevations is not applicable to the proposed NBCDF due to shallow water depths.

Surficial Sediments. Sediment sampling was conducted at the proposed NBCDF and at other Newark Bay sites during 1995 and 1996. The 1995 and 1996 sediment sampling programs established the baseline conditions for the NBCDF sediments. Since the baseline sediment sampling program established that the sediments in the immediate vicinity of the proposed NBCDF are as contaminated as the sediments proposed for disposal in the CDF, no sediment sampling is projected for the dredging, disposal, or postclosure phases of the NBCDF project.

Biological Monitoring. Biological monitoring should consist of sampling to determine benthic infaunal species composition and density (baseline, and postcapping/long-term monitoring phases). The information gathered during this portion of the program will be used to characterize the predisturbance conditions at the CDF sites and at control/ reference locations. Biological data will be used to establish the recolonization rate of the disturbed areas and functional use of the area by higher trophic level populations. Information will be obtained on the successional pattern of benthic populations related to colonization of different substrates (clean cap material (sand) and fine sediments deposited in the area through natural sedimentation), and changes noted in species composition over time.

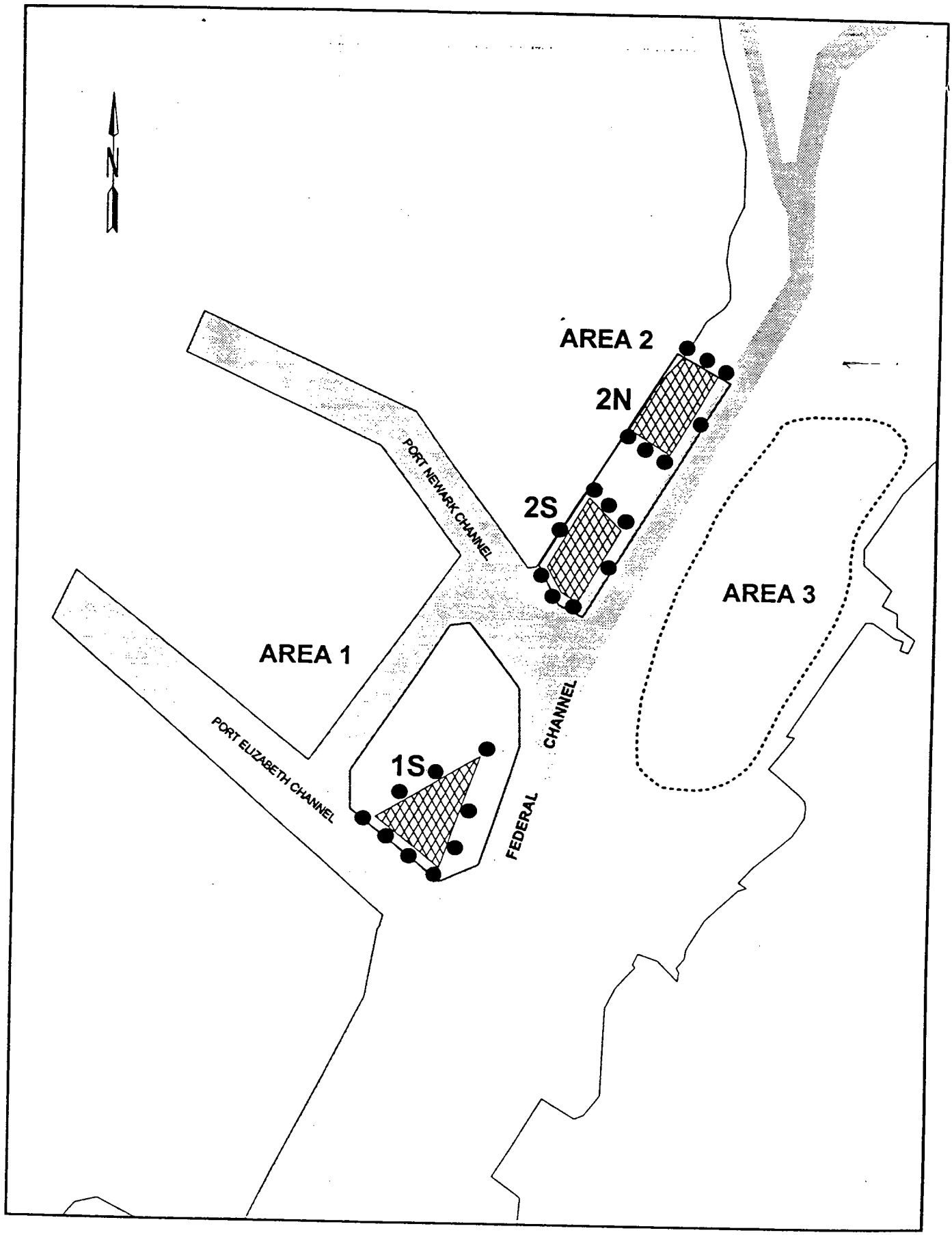
Monitoring of the Cap. The 3-ft (1-m) sand cap (cap thickness recommended by NJDEP [NJDEP 1996]) that will be placed on the CDF must be monitored to assure that it is functioning as designed. Based on studies conducted at other disposal sites where sand was used to cap contaminated soft sediments, it is expected that the cap will prevent contaminated sediments from escaping the CDF. It is also expected that the dredged



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Newark Bay Confined Disposal Facility

Figure 5.07-2
Possible Core Sampling Locations for CDF 2S and 2N

outside of the project area and will provide background data for the daily evaluation (Figure 5.07-3). Turbidity monitoring as a means of monitoring the disposal operation must take into consideration other sources of turbidity that may occur at the same time as dredged material disposal operation. Other turbidity sources include shipping traffic, combined sewer overflows, storm water outfalls, and storm events disturbing the shallow-water sediments. No water quality monitoring is projected as part of the long-term monitoring plan.



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Figure 5.07-3
Possible Location of In Situ Turbidity Meters

5.08 MITIGATION MEASURES

The intent of developing mitigation measures is to avoid, minimize, or compensate for identified impacts determined to be adverse to the environment within or adjacent to a project area. Avoidance and minimization of adverse effects are mitigation techniques that are developed as the project is designed and are incorporated into the final design of the project. Adverse effects that may require compensatory mitigation are evaluated to characterize their magnitude, importance, and persistence. The critical part of the evaluation is the determination of importance and persistence. If the effect is deemed important, an assessment is made to determine whether it is short term and naturally reversible or long term and/or irreversible. Those impacts found to be long term and/or irreversible require development of mitigation measures to compensate for the environmental loss.

The NBCDF project is intended to be an interim, short-term solution for disposal during the period in which the Federal and state agencies identify a long-term disposal site for contaminated sediments within the NY/NJ Harbor region. The urgency of this project is underscored by the fact that the MDS will be closed for disposal dredged material by 1 September 1997 (following closure a Historical Area Remediation Site [HARS] consisting of the MDS and historical surrounding areas impacted by precious dredged material will be designated); loss of revenue to the ports located on Newark Bay because sedimentation has filled both the channel and berthing areas to a point where fully loaded ships cannot use the port; and the priority put on this project by Governor Whitman of New Jersey. Combined, these elements have given this project a very high priority.

The immediate need for this project has caused the project design and the environmental assessment to proceed on concurrent, parallel paths. This has permitted evaluation of environmental effects of the various components of the project to be completed before the project design was finalized. As a result, the opportunity has been afforded to incorporate mitigation measures to avoid or minimize impacts into the final project design, to the extent practicable. The most significant change was effected after field testing identified contaminated sediments within a sizable portion of the original area to be dredged for the CDFs. This information led to a downsizing of the project and altered the plan of operation of the facility to avoid/minimize the disturbance of these sediments and to contain those that are to be moved during the creation of the facility. The choice of location both minimizes distances dredged material will need to be transported for disposal and avoids transporting these materials across the shipping channel, thus minimizing chances for accidental spills. Other examples of mitigation techniques that will be incorporated into the operating procedures include possible use of an environmental clamshell bucket during excavation of the disposal facilities and possible installation of a silt curtain around the areas being dredged. If necessary, these will minimize/avoid the movement of resuspended sediments from the areas of excavation to adjacent areas within Newark Bay.

Even with this opportunity to incorporate mitigation into the project design, certain adverse effects are unavoidable. These effects, which are identified in Chapter 4 of this document, have been evaluated for the purpose of requiring mitigation in the context of short-term vs long-term and naturally reversible vs irreversible impacts. All adverse effects that have been deemed short term and naturally reversible, irrespective of magnitude, are considered to be transitory; thus no mitigation is required. Examples of this type of impact are the loss of individuals and habitat for both the infaunal benthic community and the fish community during the excavation and operation of these facilities. However, after proper capping of the facilities, both communities will begin to re-establish themselves in the disturbed area after soft sediments are naturally deposited on the cap. Evaluation of the remainder of the adverse effects identified several potential long-term adverse impacts that would require mitigation. These effects could include escape of sediments from the sites during dredging and the possible erosion of contaminated dredge spoils from the facilities during the operational phase of the project or after the facilities are capped.

The management and monitoring plan presented in Section 5.07 includes the mitigation plan with corrective actions to be taken if and when sediments (contaminated or otherwise) escape from the defined areas of each CDF.

It is assumed that these facilities will operate throughout the year to meet the critical dredging needs of the port. However, if severe winter weather curtails dredging before a CDF is filled and capped, an interim cap approximately 1 ft (0.3 m) thick will be placed over the dredged material to prevent movement of contaminated material from the CDF and minimize exposure of bottom-dwelling organisms to the contaminated sediments.

5.09 REFERENCES

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6.0 SECTION 404(b)(1) GUIDELINES EVALUATION

6.01 INTRODUCTION

This section of the NBCDF FEIS presents a Section 404(b)(1) guidelines evaluation for disposal at the NBCDF of dredged material that is determined to be unacceptable for ocean disposal. The evaluation is based on the regulations found at 40 CFR 230, Section 404(b)(1) Guidelines for Specification of Disposal Sites for Dredged or Fill Material. Those regulations implement Sections 404(b) and 501(a) of the Clean Water Act, which govern the disposal of dredged and fill material inside the territorial sea baseline (§230.2(b)). The evaluation addresses the proposed disposal of dredged material deemed unsuitable for ocean disposal in the proposed NBCDF from a draw area defined as waters in New York-New Jersey Harbor contiguous to the State of New Jersey, including Newark Bay, the Arthur Kill, and the Kill Van Kull. The evaluation covers both the disposal of dredged material from the defined draw area at the NBCDF and the relocation of dredged material unacceptable for ocean disposal from one part of the facility to another for disposal during construction (but it does not cover disposal of that material elsewhere).

This final site-specific 404 (b)(1) Guidelines Evaluation is based on the selection of Alternative 2 as the Port Authority of New York and New Jersey's (applicant) preferred alternative. USACE will evaluate the preferred alternative to determine whether it results in the least acceptable adverse effects.

6.02 FINAL 404(b)(1) EVALUATION

The following Section 404(b)(1) evaluation is presented in a format consistent with typical evaluations in the NY/NJ Harbor area and addresses all required elements of the evaluation.

I. Project Description

a. Location: West side of Newark Bay, Essex County, New Jersey, between the Newark Bay Federal Navigation Channel and Port Elizabeth and Port Newark (see FEIS Section 1.02, Project Description).

b. General Description: Disposal of dredged materials at any one of three subaqueous confined disposal facilities (CDFs) to be constructed by dredging in shoal areas at Areas 1S, 2S, and 2N; pits to be capped with clean sand when filled (see FEIS Section 1.02, Project Description).

c. Authority and Purpose: Provide for the safe disposal, under provisions of the River and Harbors Act of 1899 and the Clean Water Act of 1972, of

dredged material generated in New Jersey waters that is determined to be unacceptable for ocean disposal (see FEIS Section 1.01.1, Regulatory Authority).

d. Dredged Material: Sediments from unspecified sites located in waters in New York-New Jersey Harbor contiguous to the State of New Jersey, including Newark Bay, the Arthur Kill, and the Kill Van Kull (see FEIS Figure 1.04-1), found unacceptable for ocean disposal (see FEIS Section 1.04, Objectives of the Project; and Section 5.01), and meeting any state/Federal testing requirements for disposal in the CDF.

e. Proposed Discharge Site: The proposed discharge sites include three CDFs located on the west side of Newark Bay. FEIS Section 2.03.3, Alternative CDFs, considers various combinations of these sites (also see FEIS Figure 1.02-1).

f. Disposal Methods: Controlled bottom-dumping scow discharge to within 10 ft (3.0 m) MLW; clamshell dredge underwater placement of dredged material thereafter to base of cap; pumped placement of cap material (see FEIS Sections 5.05.4, 5.05.5, and 5.05.6).

II. Factual Determinations

a. Physical Substrate

(1) Substrate elevation and slope: Three CDFs would be created, then filled to restore the original bathymetry. The original bathymetry elevations are typically between 0.5 and 5.0 ft (0.2-1.5 m) below MLW. The maximum depth of the CDFs prior to filling would be about 75 ft (23 m) below MLW. During construction and prior to filling, side slopes would be determined by the natural angle of repose of the in situ sediments, typically not more than 3:1 in surficial layer and 1.5:1 in underlying layer. Setbacks of 40 ft (12 m) would be used to assure that uncharacterized material from beyond the site perimeter does not slump into the pit (see FEIS Sections 1.02.4, Construction Concept and Costs; and 5.02.1, Capacity of the Facility).

(2) Sediment type: Existing sandy and silty clay soils of underlying layer would be replaced by various types of soils from sites within the Newark Bay complex; existing surficial silty sediments would be replaced by clean sand (see FEIS Sections 1.02.2, Geotechnical

Information; 3.04, Sediment Quality; and 5.05, Equipment and Construction Techniques).

(3) Dredged material movement: None; the dredged material will be contained within the CDFs (see FEIS Section 5.05.4, Filling NBCDF With Contaminated Maintenance Materials With Dump Scows, and 5.05.5, Placement of Contaminated Maintenance Materials into NBCDF).

(4) Physical effect on benthos: Temporary loss of existing, contaminated habitat (see FEIS Sections 3.04, Sediment Quality, and 5.05.6, Capping Contaminated Maintenance Materials in NBCDF) supporting a benthic community with low species diversity, dominated by polychaete worms (see FEIS Section 3.08, Benthos). Replacement of substrate by clean, fine to medium sand (see FEIS Section 5.04.2, Available Capping Materials), with subsequent deposition of fine, silty sediments and reestablishment of stable, low-diversity community (see FEIS Sections 4.06.1, Habitat Disturbance; and 4.08, Benthos).

(5) Other effects: None identified.

(6) Actions to minimize impacts: Use of dredging setbacks to minimize slumping of uncharacterized sediment outside the CDF footprint. Closure of access channel during terminal placement of dredged materials. Use of performance criteria to minimize dredging errors. Use of monitoring during and after disposal operations to control short-term escape of sediments and long-term integrity of site (see FEIS Sections 5.06, Best Management Practices; and 5.07, Monitoring and Management Plan).

b. Water Circulation, Fluctuations, and Salinity Determinations

(1) Water

(a) Salinity: The NBCDF will have no effect on salinity in Newark Bay because the project does not influence the water mass movements (tidal flow and river discharge) that control salinity (see FEIS Sections 4.02, Physical Oceanography; and 4.05, Water Quality).

(b) Water chemistry: The NBCDF will have small, localized effects on water chemistry during the disposal operations. These effects would be similar to typical dredged material disposal operations, but lesser in magnitude, because the

disposal takes place into a pit, which will reduce the interaction between the dredged material and the open water of Newark Bay (see FEIS Section 4.05, Water Quality). The localized effects will be limited to the period of time that disposal takes place (approximately one year), after which capping will prevent interaction between the dredged material and the waters of the Bay.

(c) Clarity: Changes in clarity of the water will be limited to a small turbidity plume when the dredged material is discharged from the scow. The plume will be localized, because the material will be discharged into a pit in a shoal area. The confinement of the CDF and the surrounding shallow water will inhibit the spread of the turbidity plume. Between scow dumps, the tidal currents will dissipate the dredged material that does not immediately settle to the bottom of the pit (see FEIS Section 4.05, Water Quality). There will be no long-term effect on clarity because the cap will isolate the dredged material from interaction with the waters of the Bay.

(d) Color: Not applicable.

(e) Odor: Odors typical of dredging operations will be created in the disposal area during construction and disposal operations. Because the site is remote from residential areas, the potential for odor problems is minimal. In addition, the open scows carrying the dredged material will be at the disposal site for brief periods before the material is discharged into the pit (see FEIS Section 4.15, Air Quality).

(f) Taste: Not applicable.

(g) Dissolved gas levels: Potential for short-term reduction in dissolved oxygen levels within the CDFs until they are filled, which will minimize the release of particle-bound metals and organic compounds (see FEIS Section 4.05, Water Quality). Short-term release of hydrogen sulfide and methane gases during disposal of dredged material (see FEIS Section 4.05, Water Quality). There will be no long-term effects on dissolved oxygen because the cap will isolate the dredged material from contact with the waters of the Bay.

(h) Nutrients: A short-term, localized increase in nutrients, which could contribute to an increase in algal growth, may occur. However, the method of disposal will limit the release of nutrients and the short periods during which disposal will take place will limit the potential for eutrophication. After the cap is placed, the dredged material cannot interact with the waters of Newark Bay, so there will be no long-term increase in nutrients and eutrophication will not result (see FEIS Section 4.05, Water Quality).

(i) Eutrophication: A short-term, localized increase in nutrients, which could contribute to an increase in algal growth, may occur. However, the method of disposal will limit the release of nutrients and the short periods during which disposal will take place will limit the potential for eutrophication. After the cap is placed, the dredged material cannot interact with the waters of Newark Bay, so there will be no long-term increase in nutrients and eutrophication will not result (see FEIS Section 4.05, Water Quality).

(j) Other: None

(2) Current patterns and circulation: Potential short-term, localized reduction in current velocities at the site of the CDFs; no short-term changes in current velocities or circulation elsewhere in Newark Bay; restoration of existing currents once CDFs are filled and capped (see FEIS Section 4.02.1.3, Impacts of Dredging and Disposal Operations).

(3) Normal water level fluctuations: The existence of the CDFs will not have a significant effect on normal water level fluctuations in Newark Bay. Restoration of the original bathymetric contours with capping assures no long-term effects on normal water level fluctuations (see FEIS Section 4.02, Physical Oceanography).

(4) Salinity gradients: The NBCDF will have no effect on salinity in Newark Bay, because the project does not influence the water mass movements (tidal flow and river discharge) that control salinity (see FEIS Sections 4.02, Physical Oceanography; and 4.05, Water Quality).

(5) Actions to minimize impacts: The design of the NBCDF inherently assures that there will be minimal short-term and no long-term effects on water circulation, fluctuations, and salinity.

c. Suspended Particulate/Turbidity Determination

(1) Change at disposal site: There will be short-term, localized increases in suspended particulates/turbidity during disposal operations but no long-term changes; there will be minimal changes away from the site (see FEIS Section 4.04.2, Constructed CDFs).

(2) Effects on chemical and physical properties of the water column: There will be minimal short-term effects on the chemical and physical properties of the water column due to suspended particulates/turbidity and no long-term effects (see FEIS Section 4.05, Water Quality).

(3) Effects on biota: In the short term, increased exposure to some contaminants, but no long-term effects (see FEIS Sections 4.06, Fish and Shellfish; and 4.08, Benthos).

(4) Actions to minimize impacts: Use of the Best Management Practices specified by NJDEP in the draft guidance on The Management and Regulation of Dredging Activities and Dredged Material in New Jersey's Tidal Waters (see FEIS Section 5.06, Best Management Practices).

d. Contaminant Determination

Specific dredging projects have not been identified for disposal at the NBCDF, so the degree of contamination in the materials to be deposited at the site is not known. However, the intent of the NBCDF is that its use be restricted to disposal of dredged material determined to be unacceptable for ocean disposal. This implies that the material deposited will be contaminated to some degree. FEIS Section 5.01 discusses how dredged material will be qualified for disposal at the NBCDF. By dredging and filling the NBCDF, relatively uncontaminated subsurface sediments will be replaced by contaminated dredged materials, and contaminated surface sediments will be replaced by uncontaminated cap material. On completion of the capping, all contaminated dredged material disposed of at the NBCDF will be isolated under the cap.

e. Aquatic Ecosystems and Organisms Determination: In the short term, disposal of dredged material at the NBCDF will result in loss of about

1.3% of the bottom area of Newark Bay and about 2% of the shoal habitat in the Bay (see Section FEIS 4.06.1, Habitat Disturbance). That habitat is currently used by a low-diversity community composed principally of polychaete worms (see FEIS Section 3.08, Benthos). Following placement of the sand cap, the site is expected to be repopulated and there will be no long-term impairment of the benthic community (see FEIS Section 4.06.1, Habitat Disturbance; and Section 4.08, Benthos).

f. Proposed Disposal Site Determination: Based on the screening criteria developed (see FEIS Section 2.01, Criteria for Alternative Selection), nine classes of disposal alternatives were evaluated and the confined disposal facility was selected as the best alternative class (see FEIS Sections 2.02, Alternative Dredged Material Disposal Strategies). Five feasible confined disposal alternatives were evaluated and one selected (see FEIS Section 2.03, Alternative Locations Within Newark Bay). Factors considered in the evaluation of the feasible alternatives include duration of disposal operations, cost, erosive properties, sediment resuspension, sediment chemistry, water quality impacts, effects on finfish and shellfish communities, effects on wildlife communities, effects on benthic community, proximity to hazardous waste sites, effects on wetlands, effects on endangered and threatened species, effects on critical habitats and marine sanctuaries, aesthetics, cultural resources, air quality, floodplain values and hydrology, human health, socioeconomics, navigation, land use, noise, sole-source aquifers, traffic, and indirect and cumulative impacts.

g. Determination of Cumulative Impacts: Short-term negative impacts associated with increased dredging activity encouraged by availability of a site for disposal of dredged material determined to be not suitable for ocean disposal. Long-term positive impact resulting from isolation of contaminated sediments under the NBCDF cap (see FEIS Section 4.24.2, Cumulative Impacts).

h. Determination of Secondary Impacts: Long-term positive impacts on sites contributing dredged material to the NBCDF due to removal and isolation of contaminated sediments under the NBCDF cap (see FEIS Section 4.24.1, Indirect Impacts).

III. Findings of Compliance or Noncompliance

a. No significant adaptations of the guidelines were made relative to this evaluation.

b. There are no practicable alternatives for the proposed action under the jurisdiction of Section 404(b)(1) Guidelines (see FEIS Section 2).

c. The proposed action does not appear to violate applicable state water quality standards, effluent standards, or NJDEP's guidance manual entitled The Management and Regulation of Dredging Activities and Dredged Material in New Jersey's Tidal Waters.

d. No threatened or endangered species and no marine sanctuaries will be affected by the proposed action (see FEIS Sections 4.11, Endangered and Threatened Species; and 4.12, Critical Habitats and Marine Sanctuaries).

e. The proposed action will not result in significant adverse impacts on human health or welfare, including municipal and private water supplies, recreational and commercial fishing, plankton, fish, shellfish, wildlife and special aquatic sites.

f. All appropriate steps to minimize adverse impacts have been taken.

IV. Conclusions

Based on all of the above, the proposed action is determined to be in compliance with the Section 404(b)(1) Guidelines, subject to appropriate and reasonable conditions, to be determined on a case-by-case basis, to protect the public interest.

7.0. LIST OF PREPARERS

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