U.S. Army Corps of Engineers
New York District

DRAFT

Implementation Strategy
of the
Dredged Material Management Plan
for the
Port of New York and New Jersey

Technical Appendix

September, 1999

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Abbreviations and Commonly Used Terms

AK – Arthur Kill
AKA – Also Known As
CAD – Contained Aquatic Disposal (Subaqueous Pit)
CARP – Contaminant Assessment and Reduction Program
CCMP – Comprehensive Conservation Management Plan
Cd – Cadmium
CDF – Confined Disposal Facility
CY – Cubic Yard
DDT – Dichlor diphenyl trichloroethane
DMMIWG – Dredged Material Management Integration Work Group
DMMP – Dredged Material Management Plan for the Port of New York and New Jersey
EC – Engineering Circular
e.g. – *Exampli Gratia* – For Example
EIS – Environmental Impact Statement
ESDC – Empire State Development Corporation
HARS – Historic Area Remediation Site
HEP – Harbor Estuary Program
Hg – Mercury
HMDC – Hackensack Meadowlands Development Commission
i.e. – *Id Est* – That is
IGT – Institute of Gas Technology
KVK – Kill Van Kull
MA – Massachusetts
MCY – Million Cubic Yards
MPRSA – Marine Protection, Research and Sanctuaries Act
N/A – Not Applicable or Available
NBCDF – Newark Bay Confined Disposal Facility
NEPA – National Environmental Policy Act
NJ – New Jersey
NJDIG – Conceptual Contractual Mechanism Developed by the New Jersey Dredging Inter-Agency Group
NJMR – Office of New Jersey Maritime Resources
NJPDES – New Jersey Pollutant Discharge Elimination System
NY – New York
NYCEDC – New York City Economic Development Corporation
NYD – New York District Corps of Engineers
NYSDEC – New York State Department of Environmental Conservation
PA – Pennsylvania
PAH – Polyaromatic hydrocarbons
PANY/NJ – Port Authority of New York and New Jersey
PCB – Polychlorinated biphenyl
PEIS – Programmatic Environmental Impact Statement
Port – Port of New York and New Jersey
RCRA – Resource Conservation and Recovery Act
SERG – Senior Executive Review Group
S/S – Solidification/Stabilization
TBD – To Be Determined
TEU – Twenty-foot Equivalent Unit
USACE – U.S. Army Corps of Engineers
USEPA – U.S. Environmental Protection Agency
WRDA – Water Resources Development Act
YR – Year

A DREDGED MATERIAL MANAGEMENT PLAN ECONOMIC BENEFIT ANALYSIS

A-1 EXISTING CONDITION

In 1996, more than 51 million tons of ocean-borne cargo with an estimated value in excess of $66 billion passed through the Port of New York and New Jersey. The total regional monetary impact of the Port and port-dependent industries is estimated at more than $29 billion, and the number of jobs directly and indirectly associated with the Port and port-dependent industries totals approximately 193,000. The state of New York exported $34 billion of goods to over 200 countries throughout the world in 1994, ranking it third among the 50 states. Of goods manufactured in New York, 16%, or $2.4 billion, was exported which serves to illustrate the importance of export trade in maintaining New York's manufacturing economy. The existence of the port is essential for other regional industries that are significantly dependent upon direct access to the port and waterborne shipping. These industries include: electric power generation, ready-mix concrete, sugar refining, and scrap and waste material. Of the 166,000 port-related jobs in the region, 90,000 are either located in New York or held by New York State residents, and economic activity generated by cargoes moving through the region's port facilities creates over $12 billion in sales for New York State firms.

International waterborne trade is also important to New Jersey's economy. The 12th-largest exporting state, New Jersey shipped over $13 billion of goods throughout the world. Of 500,000 manufacturing jobs in the state, 70,000, or 14 %, are dependent on exports. Chemicals and pharmaceuticals, the third largest industry in New Jersey, relies on the port as an efficient conduit for both the export of its products and the import of raw materials. The recycling industries are heavily dependent on the port for the export of material. In 1994, 1.5 million tons of iron and steel scrap were exported, and New Jersey firms shipped 95% of this total. Of the 166,000 port-related jobs in the region, 76,000 are either located in New Jersey or are held by New Jersey residents, and economic activity generated by the Port and its dependent industries creates $13.5 billion in sales for New Jersey firms.

A-2 BENEFITS FROM CONTINUED MAINTENANCE DREDGING OF THE HARBOR

New York Harbor is naturally shallow. Without artificial deepening, the average water depth would be approximately 19 feet. Since oil tankers, bulk vessels, and containerships require depths of up to and exceeding 45 feet to transit the harbor, periodic maintenance dredging of harbor channels is essential for continued use of the Port. Should the harbor become impassable, goods with origins or destinations in the New York metropolitan area currently transported via water would have to be brought to and from another port. This additional cost to transport cargoes to and from another port, which would be unnecessary if the Port of New York and New Jersey remained accessible, is a measure of the benefit continued dredging of the harbor yields. A second such measure concerns tanker traffic. Currently, modern tankers with deep drafts are often forced to lighten their cargoes to safely transit the Port's navigation channels. With the prospect of ever shallower channels in the event that maintenance dredging were discontinued, tanker operators would be forced to further lighten their cargoes. This additional cost, which would be precluded by continued maintenance dredging, is a measure of benefits yielded by continued maintenance dredging. A third source of benefits is petroleum barge traffic. Without maintenance dredging, petroleum and petroleum products currently transported via water would require transportation via road. Road transportation incurs larger costs than water transportation, and the corresponding increase in costs, precluded by continued maintenance dredging, is another source of benefits. Throughout the analysis, a 20-year project life, a 1998 price level, and a 7 1/8 % discount rate have been applied. Commercial activity in the Port is assumed in the analysis to continue at current levels.

A-3 BENEFITS FROM CONTAINER TRAFFIC[1]

Currently, general cargo is primarily moved internationally in containers. More than 60% of all deep-sea general cargo moves in containers, and, between developed countries, this total is much higher. The capacity of the world's containership fleet at the end of 1996 was 4.83 million TEUs (twenty-foot equivalent units). By 1999, this capacity is expected to increase to 5.9 million TEUs.

The vast majority of container traffic in the Port of New York and New Jersey, approximately 96%, is handled at terminals in Newark, Elizabeth, and Jersey City, NJ, as well as Staten Island, N.Y. The Port has three marine container complexes in New Jersey: (1) Port Newark, (2) the adjacent Elizabeth-Port Authority Marine Terminal, both under the jurisdiction of the Port Authority of New York and New Jersey; and (3) Global Terminal and Container Services, Inc., a privately-owned facility in Jersey City. Port Newark/Elizabeth together occupy 2,184 acres and comprise 40,534 linear feet of ship berths. 18,410 linear feet are devoted to containership operations. Berth depths range from 35-40 feet (MLW), and the combined facility has 31 dockside cranes. Global Terminal, a 100-acre facility with 1,800 feet of berthing at a depth of 40 feet (MLW), is equipped with four dockside cranes. In Staten Island, the Howland Hook Terminal spans 187 acres with 2,500 linear feet of wharf, 3 berths as deep as 37 feet, and 7 cranes. Ocean access to Port Newark/Elizabeth is gained via the 45-foot deep Ambrose and Anchorage Channels in Lower and Upper New York Bays, via the 40-foot Kill Van Kull Channel, and, finally, the Newark Bay Channel, which serves the Port Newark Channel and Elizabeth Channel, entrances. Ocean access to Global Terminal is also gained initially through the Ambrose and Anchorage Channels in Lower and Upper New York Bays and then via the Port Jersey Channel. Similarly, Howland Hook is reached from the ocean via the Ambrose and Anchorage Channels, via the Kill Van Kull Channel, and, finally, via the 35 foot Arthur Kill Channel.

Significant container traffic is also handled at the Bay Ridge / Red Hook terminal in Brooklyn, N.Y. The Bay Ridge / Red Hook Channels, maintained at various depths as great as 40 feet, provide access to the facility and are also reached from the ocean via the Ambrose and Anchorage Channels. The facility, which covers 85 acres, has 4 cranes to service ships.

If maintenance dredging were to be discontinued, the natural siltation process would render navigation channels increasingly shallower. Reductions in channel depths would require shippers to gradually divert cargoes bound for the Port of New York and New Jersey to other ports. The nearest alternative port capable of handling significant amounts of cargo is Norfolk, Va. As a result, without maintenance dredging, container cargo would eventually require diversion to the Port of Norfolk. As roughly 70% of the containers entering the Port of New York and New Jersey had final destinations in the New York metropolitan area, it would be necessary to transport many of these containers back to the New York metropolitan area. This additional transportation cost required to return these containers is a measure of the benefits provided by continued maintenance dredging of navigation channels in New York Harbor. Maintenance dredging precludes the necessity to divert containers to the nearest alternative port.

In 1997, a combined total of 1,407,857 containers were handled at Port Newark/Elizabeth, Global Terminals, and Howland Hook Terminals. As mentioned above, 70% of these containers will require transportation back to the New York metropolitan area: roughly 986,000 containers. The cost of transporting a container by truck from the Port of Norfolk to the New York metropolitan area is approximately $880.00. With 986,000 containers to be transported, the total cost is $868,000,000. This cost is a measure of the benefits provided by continued maintenance dredging. However, it may be argued that container cargoes with ultimate destinations in the New York metropolitan area, which currently arrive on containerships, already require some land-based transportation in order to reach their final destinations. Precluded transportation costs through continued maintenance dredging exist only in the form of additional costs which would be required to transport container cargoes to their final destinations beyond what is required currently. The full $880.00 cost per container would thus not be incurred. In order to measure benefits to maintenance dredging in this stricter sense, it is necessary to subtract the cost of re-

[1] At several points in the analysis, numbers are used in a deterministic manner. In every such case, the number used is, in reality, part of a range of values that the number could assume. In each instance, the number actually used is drawn from that part of the range which will produce the lowest possible estimate of the benefits yielded by maintenance dredging. This procedure recognizes that risk and uncertainty are facts of life and as such have been applied in order to establish the lower limit of the benefits attributable to maintenance dredging.

transportation to some intermediate location from the $880.00 charge for trucking containers the entire distance. The cost of trucking containers from Port Newark (a representative location within the New York metropolitan area) to Reading, Pa. was selected as a proxy for the cost to transport containers from Port Newark to the extreme limit of what may be considered the New York metropolitan area. Subtracting this cost, $470.00, from the total cost, $880.00, yields a revised cost of $410.00 per container. With a revised cost of $410.00 per container, benefits from continued maintenance dredging (the precluded cost of diversion and re-transportation) total $404,000,000 per year.

In 1997, 52,516 containers were handled at Bay Ridge / Red Hook. A larger percentage of the containers handled at Bay Ridge / Red Hook can be expected to remain in the New York metropolitan area; 90% rather than 70%. If 90% of the total require retransportation to the New York metropolitan area, an additional transportation cost of $19,300,000 would be incurred (47,000 x $410.00). This additional transportation cost, avoided by continued maintenance dredging, represents another source of benefits from container traffic.

A-4 LIGHTERING BENEFITS

In addition to container vessels, petroleum tankers also represent a source of benefits yielded by continued dredging in both the system of channels comprising the New York / New Jersey Channels and those which provide access to Newark Bay (as mentioned above). In 1996, approximately 20 million tons of petroleum and petroleum products arrived at the Port. Due to current channel depths, which are less than optimal for modern tankers, many large petroleum tankers are required to lessen their drafts to safely enter the Port's navigation channels. Drafts are lessened through a process known as lightering. Petroleum is transferred to barges, and the barges subsequently transport the excess petroleum to a storage facility at port. While records of actual vessel drafts upon entrance to the harbor have been obtained, ship drafts after lightering are not generally recorded at the terminals. For the purpose of analysis, the assumption was made that tankers minimize lightering and off-load only to the point at which they can use a channel safely. The draft at which vessels can use a channel safely has been determined by allowing 2 feet of underkeel clearance relative to channel depth. The Arthur Kill, which petroleum traffic transits, has an existing channel depth of 35 feet (MLW). With 2 feet of clearance, a controlling draft of 33 feet results. Table A-7-1 displays an estimate of total petroleum transportation costs, including lightering costs necessitated by a controlling draft of 33 feet, for tankers with drafts in excess of 33 feet. The total transportation cost is more than $242 million. Under such conditions, roughly 5.3 million tons require lightering. The cost of this lightering is displayed in Table A-7-2. If maintenance dredging were discontinued, the natural siltation process will gradually lessen navigation channel depths. With a siltation rate of roughly one foot every 5 years, Table A-7-3 displays the resulting lightering costs necessitated by a loss of one foot of channel depth. The difference between total lightering costs now, $11,834,000, and 5 years hence, $13,580,000, is $1,745,000 and represents a benefit to continued maintenance dredging. Had dredging been continued, this increase in lightering costs would have been avoided. If this process is continued over the 20-year project life, in which a reduction in channel depth of roughly 4 feet can be expected in the absence of maintenance dredging, annual benefits from avoided lightering costs of $2,900,000 result (discounted at 7 1/8%). This calculation is displayed in Table A-7-4. Benefits from both precluded container transportation costs and lightering costs for the New York / New Jersey Channels and those channels which provide access to Newark Bay total roughly $407,000,000 per year (see Table A-7-7).

A-5 BENEFITS FROM CONTINUED BARGING OF PETROLEUM

A third source of benefits from continued maintenance dredging is yielded by avoided increases to petroleum transportation costs through the continued use of barges. In addition to lightering trips, barges routinely shuttle petroleum along a variety of waterways in the region. As siltation proceeds, these channels will eventually require maintenance dredging in order to allow continued access for barges. The alternative to water transportation of petroleum and petroleum products is to deliver them by truck. The amount by which the cost of delivery via road exceeds that of delivery via water would be a cost avoided by maintenance dredging. Table A-7-5 lists various channels, which serve as a conduit for traffic bound for final destinations on other channels, as well as traffic, which will terminate at a point on the conduit channel itself. Whenever this is the case, an entry has been made in the "Total Traffic" column for the conduit channel. For any given channel, the difference between the "Total Traffic" column and the "Final Destination" column yields the amount of traffic for which the channel is a mere conduit. Table A-7-5 compares the annual cost of road transportation with the cost of water transportation for the channels whose dredging is not justifiable on the basis of container traffic alone. The results, the disposal costs per cubic yard supportable by benefits to continued maintenance dredging, are summarized in Table A-7-7.

A-6 ADDITIONAL BENEFITS

Port facilities at an alternative port would need to be expanded in order to handle the increased volume of cargo that would have been handled in the Port of New York and New Jersey had maintenance dredging been continued. The cost of expansion would be considerable. An estimate of the cost of such expansion can be determined from a study recently completed by the New York City Economic Development Corporation (NYCEDC) which examined the possibility of expanding existing port facilities in the Port of New York and New Jersey. In this study, cost estimates were developed for three locations: Brooklyn, Staten Island, and Port Newark/Elizabeth. The cost per acre in each of these three proposed project sites was estimated in considerable detail. As the three locations in question are reasonably representative of the Port's constituent facilities, an average of these individual costs per acre yields a reasonably representative cost per acre for the Port as a whole (see Table A-7-6). This average cost is roughly $1,800,000 per acre. Container handling, breakbulk, and petroleum facilities in the Port cover roughly 7,000 acres. With an estimated value of $1,800,000 per acre, these facilities have a total value of approximately $13 billion. Given a 20 year project life and the current government discount rate, 7 1/8 %, the construction of comparable facilities would cost $1.2 billion annually. The continued dredging of New York Harbor makes such an investment unnecessary. Such a large avoided cost is, in reality, attributable to specific facilities at specific locations in the Port. Further analysis of the justifiability of specific channels for continued maintenance dredging will require an apportionment of this avoided cost to specific facilities in order to gain a more accurate assessment. While the sand, gravel, and cement industries are also a significant component of the Port, their facilities were not included in this analysis.

A-7 CONCLUSION

Table A-7-7 presents a summary of the results of the analysis. This table compares the total benefits to the total quantity of dredged material expected for each channel, taken in isolation. This benefit analysis has demonstrated that benefits from continued maintenance dredging in several of the Port's waterways are present. On the basis of Table A-7-7 alone, one should not evaluate the economic justifiability of the maintenance dredging of any particular channel or segment thereof. To determine whether maintenance dredging of any particular channel is economically justified, a more complete incremental analysis must be undertaken.

Table A-7-8 presents the results of this benefit analysis given an extended time period. While benefits from containership traffic and barge traffic are assumed to remain unchanged in such an instance, benefits from petroleum lightering were calculated to reflect the passage of time. These calculations are displayed in Table A-7-4. Petroleum lightering benefits are a component of total benefits for the waterway system, which consists of both the New York / New Jersey Channels as well as the adjacent channels that provide access to Newark Bay. As a result, total benefits for this waterway system were calculated to reflect the lightering component over time. Table A-7-8 displays total benefits for years 2025 and 2050.

<u>REFERENCES</u>

Robbins, Pope, and Griffis, P.C. (1992), "Recap Island, The Decision that Cannot be Deferred, A Plan for Solid Waste and Dredge Spoil Disposal and Resource Recovery for the Metropolitan New York Area," New York, NY.

Table A-7-1 1996 Petroleum Transportation Costs at 35 Foot Channel Depth (with Lightering)

Number of Vessels 1996	Draft	Diff-erence in Draft	Feet Over-Loaded	Immersion Rate (tons/inch)	Required Lightering (tons per Vessel)	Cost of Lightering (per ton)	Cost of Lightering	Cargo	Round-Trip Distance	Speed of Vessel	Hours Required to Complete Round-Trip	Lightering Time Required	Total Time Required	Cost per Hour	Ship Cost of Round-Trip	Lightering + Ship Cost	Cost per Ton	Total Number of Tons	**Total Cost of Tonnage**
50	33	0	0	100	0	$2.20	$0	25,769	8,000	14	571	48	619	$595	$368,810	$368,810	$14.31	1,288,469	$18,440,524
24	34	1	1	106	1,272	$2.20	$2,798	28,356	8,000	14	571	48	619	$626	$387,679	$390,477	$13.77	680,551	$9,371,452
11	35	1	2	111	2,664	$2.20	$5,861	31,116	8,000	14	571	48	619	$656	$406,547	$412,408	$13.25	342,281	$4,536,487
48	36	1	3	117	4,222	$2.20	$9,289	34,056	8,000	14	571	48	619	$687	$425,415	$434,705	$12.76	1,634,694	$20,865,819
38	37	1	4	124	5,930	$2.20	$13,047	37,181	8,000	14	571	48	619	$717	$444,284	$457,330	$12.30	1,412,893	$17,378,551
41	38	1	5	130	7,800	$2.20	$17,160	40,499	8,000	14	571	48	619	$748	$463,152	$480,312	$11.86	1,660,439	$19,692,804
14	39	1	6	137	9,839	$2.20	$21,646	44,014	8,000	14	571	48	619	$778	$482,020	$503,666	$11.44	616,192	$7,051,327
105	40	1	7	144	12,054	$2.20	$26,519	47,733	8,000	14	571	48	619	$809	$500,889	$527,408	$11.05	5,012,007	$55,377,796
18	41	1	8	151	14,452	$2.20	$31,795	51,664	8,000	14	571	48	619	$839	$519,757	$551,552	$10.68	929,948	$9,927,940
50	42	1	9	158	17,041	$2.20	$37,491	55,811	8,000	14	571	48	619	$870	$538,625	$576,116	$10.32	2,790,566	$28,805,792
7	43	1	10	165	19,828	$2.20	$43,621	60,182	8,000	14	571	48	619	$900	$557,493	$601,114	$9.99	421,276	$4,207,800
17	44	1	11	173	22,819	$2.20	$50,202	64,783	8,000	14	571	48	619	$930	$576,362	$626,564	$9.67	1,101,315	$10,651,582
33	45	1	12	181	26,023	$2.20	$57,250	69,621	8,000	14	571	48	619	$961	$595,230	$652,480	$9.37	2,297,479	$21,531,829
13	46	1	13	189	29,446	$2.20	$64,780	74,701	8,000	14	571	48	619	$991	$614,098	$678,879	$9.09	971,110	$8,825,421
2	47	1	14	197	33,095	$2.20	$72,810	80,030	8,000	14	571	48	619	$1,022	$632,967	$705,776	$8.82	160,061	$1,411,553
6	48	1	15	205	36,979	$2.20	$81,354	85,616	8,000	14	571	48	619	$1,052	$651,835	$733,189	$8.56	513,695	$4,399,135
																Total Tonnage:		21,832,978	
																		TOTAL COST:	**$242,475,810**

Sources: Coast Guard, Corps of Engineers, and Sandy Hook Pilots data and experiences.

(1998 Price Level)

Table A-7-2 Lightering Costs – Existing Condition

Number of Vessels	Draft	Difference in Draft	Feet Over-Loaded	Immersion Rate (tons/inch)	Required Lightering (tons per vessel)	Total Tons Lightered	Cost of Lightering (per ton)	Cost of Lightering (per vessel)	Total Cost of Lightering
50	33	0	0	100	0	0	$2.20	$0	$0
24	34	1	1	105	1,264	30,341	$2.20	$2,781	$66,750
11	35	1	2	111	2,669	29,363	$2.20	$5,873	$64,598
48	36	1	3	117	4,222	202,673	$2.20	$9,289	$445,880
38	37	1	4	124	5,930	225,350	$2.20	$13,047	$495,771
41	38	1	5	130	7,800	319,806	$2.20	$17,160	$703,573
14	39	1	6	137	9,839	137,747	$2.20	$21,646	$303,043
105	40	1	7	144	12,054	1,265,679	$2.20	$26,519	$2,784,494
18	41	1	8	151	14,452	260,143	$2.20	$31,795	$572,315
50	42	1	9	158	17,041	852,060	$2.20	$37,491	$1,874,532
7	43	1	10	165	19,828	138,794	$2.20	$43,621	$305,346
17	44	1	11	173	22,819	387,923	$2.20	$50,202	$853,431
33	45	1	12	181	26,023	858,744	$2.20	$57,250	$1,889,236
13	46	1	13	189	29,446	382,792	$2.20	$64,780	$842,142
2	47	1	14	197	33,095	66,191	$2.20	$72,810	$145,619
6	48	1	15	205	36,979	221,875	$2.20	$81,354	$488,125
								TOTAL	**$11,834,854**

Table A-7-3 **Lightering Costs – 1 Foot Reduction**

Number of Vessels	Draft	Difference in Draft	Feet Over-Loaded	Immersion Rate (tons/inch)	Required Lightering (tons per vessel)	Total Tons Lightered	Cost of Lightering (per ton)	Cost of Lightering (per vessel)	Total Cost of Lightering
44	32	0	0	94	0	0	$2.20	$0	$0
50	33	1	1	100	1,196	59,803	$2.20	$2,631	$131,567
24	34	1	2	105	2,528	60,682	$2.20	$5,563	$133,500
11	35	1	3	111	4,004	44,044	$2.20	$8,809	$96,897
48	36	1	4	117	5,630	270,231	$2.20	$12,386	$594,507
38	37	1	5	124	7,413	281,688	$2.20	$16,308	$619,714
41	38	1	6	130	9,360	383,767	$2.20	$20,592	$844,288
14	39	1	7	137	11,479	160,704	$2.20	$25,254	$353,550
105	40	1	8	144	13,776	1,446,490	$2.20	$30,307	$3,182,278
18	41	1	9	151	16,259	292,661	$2.20	$35,770	$643,855
50	42	1	10	158	18,935	946,733	$2.20	$41,656	$2,082,813
7	43	1	11	165	21,810	152,673	$2.20	$47,983	$335,880
17	44	1	12	173	24,893	423,189	$2.20	$54,766	$931,016
33	45	1	13	181	28,191	930,306	$2.20	$62,020	$2,046,672
13	46	1	14	189	31,711	412,237	$2.20	$69,763	$906,922
2	47	1	15	197	35,459	70,918	$2.20	$78,010	$156,021
6	48	1	16	205	39,444	236,667	$2.20	$86,778	$520,667
									-
								TOTAL	**$13,580,146**

Table A-7-4 Lightering Benefits

YEAR		TOTAL LIGHTERING COSTS	INCREASE IN COSTS	INTERPOLATED BENEFITS	DISCOUNTED BENEFITS
1998	0	$11,835,000		$0	$0
1999	1			$349,000	$326,000
2000	2			$698,000	$608,000
2001	3			$1,047,000	$852,000
2002	4			$1,396,000	$1,060,000
2003	5	$13,580,000	**$1,745,000**	**$1,745,000**	$1,237,000
2004	6			$2,094,000	$1,386,000
2005	7			$2,443,000	$1,509,000
2006	8			$2,792,000	$1,610,000
2007	9			$3,141,000	$1,691,000
2008	10	$15,325,000	**$3,490,000**	**$3,490,000**	$1,754,000
2009	11			$3,839,000	$1,801,000
2010	12			$4,188,200	$1,834,000
2011	13			$4,537,400	$1,854,000
2012	14			$4,886,600	$1,864,000
2013	15	$17,071,000	**$5,236,000**	**$5,236,000**	$1,865,000
2014	16			$5,585,000	$1,857,000
2015	17			$5,934,000	$1,842,000
2016	18			$6,283,000	$1,820,000
2017	19			$6,632,000	$1,794,000
2018	20	$18,816,000	**$6,981,000**	**$6,981,000**	$1,762,000
2019	21			$7,330,000	$1,727,000
2020	22			$7,679,000	$1,689,000
2021	23			$8,028,000	$1,649,000
2022	24			$8,377,000	$1,606,000
2023	25	$20,561,000	**$8,726,000**	**$8,726,000**	$1,562,000
2024	26			$9,075,000	$1,516,000
2025	27			$9,424,000	$1,470,000
2026	28			$9,773,000	$1,423,000
2027	29			$10,122,000	$1,375,000
2028	30	$22,307,000	**$10,472,000**	**$10,472,000**	$1,328,000
2029	31			$10,821,000	$1,281,000
2030	32			$11,170,000	$1,235,000
2031	33			$11,519,000	$1,189,000
2032	34			$11,868,000	$1,143,000
2033	35	$24,052,000	**$12,217,000**	**$12,217,000**	$1,098,000
2034	36			$12,566,000	$1,055,000
2035	37			$12,915,000	$1,012,000
2036	38			$13,264,000	$970,000
2037	39			$13,613,000	$929,000

		TOTAL LIGHTERING COSTS	INCREASE IN COSTS	INTERPOLATED BENEFITS	DISCOUNTED BENEFITS
2038	40	$25,797,000	**$13,962,000**	**$13,962,000**	$890,000
2039	41			$14,311,000	$851,000
2040	42			$14,660,000	$814,000
2041	43			$15,009,000	$778,000
2042	44			$15,358,000	$743,000
2043	45	$27,542,000	**$15,707,000**	**$15,707,000**	$710,000
2044	46			$16,056,000	$677,000
2045	47			$16,405,000	$646,000
2046	48			$16,754,000	$616,000
2047	49			$17,103,000	$587,000
2048	50	$29,288,000	**$17,453,000**	**$17,453,000**	$559,000
2049	51			$17,802,000	$532,000
2050	52			$18,151,000	$506,000
2044	53			$18,500,000	$482,000
2045	54			$18,849,000	$458,000
2046	55	$31,033,000	**$19,198,000**	**$19,198,000**	$436,000
				SUM OF DISCOUNTED BENEFITS (YEARS 1-20):	$30,326,000
				ANNUALIZED BENEFITS - 20 YEARS (2018):	**$2,890,000**
				SUM OF DISCOUNTED BENEFITS (YEARS 1-27):	$41,545,000
				ANNUALIZED BENEFITS - 27 YEARS (2025):	**$3,960,000**
				SUM OF DISCOUNTED BENEFITS (YEARS 1-52):	$64,492,000
				ANNUALIZED BENEFITS - 52 YEARS (2050):	**$6,147,000**

(1998 price level, 7 1/8% discount rate, rounded to nearest thousand)

Table A-7-5 Benefits from Avoided Truck Transportation Costs

CHANNEL	FINAL DESTINATION: TONS (x1000)	FINAL DESTINATION: TON MILES (X1000)	TOTAL TRAFFIC: TONS (x1000)	TOTAL TRAFFIC: TON MILES (x1000)	COST PER TON MILE VIA ROAD	COST PER TON MILE VIA WATER	TOTAL COST VIA ROAD	TOTAL COST VIA WATER	COST AVOIDED (Total Cost Via Road Less Total Cost Via Water)	ESTIMATED DREDGING REQUIRED (CY/YR)	PRICE PER CY SUPPORTED BY YEARLY TRAFFIC
Bay Ridge & Red Hook	1,014	3,232	3,656	11,157	$0.20	$0.04	$2,231,400	$446,280	$1,785,120	677,421	$2.64
Buttermilk Channel	288	577	29,605	88,528	$0.20	$0.04	$17,705,600	$3,541,120	$14,164,480	39,343	$360.03
East River	4,560	35,386	31,409	464,113	$0.20	$0.04	$92,822,600	$18,564,520	$74,258,080	387,328	$191.72
East Rockaway Inlet	834	834			$0.20	$0.04	$166,800	$33,360	$133,440	2,111	$63.21
Flushing Bay & Creek	1,720	3,897			$0.20	$0.04	$779,400	$155,880	$623,520	101,541	$6.14
Gowanus Canal	2,081	2,078	2,649	2,647	$0.20	$0.04	$529,400	$105,880	$423,520	10,796	$39.23
Hackensack River	1,254	7,755			$0.20	$0.04	$1,551,000	$310,200	$1,240,800	47,166	$26.31
Hudson River Channel	1,945	11,241	17,226	209,892	$0.20	$0.04	$41,978,400	$8,395,680	$33,582,720	453,418	$74.07
Hudson River, Lower Section	576	2,514	15,285	193,733	$0.20	$0.04	$38,746,600	$7,749,320	$30,997,280	437,233	$70.89
Jamaica Bay	992	11,437	993	11,441	$0.20	$0.04	$2,288,200	$457,640	$1,830,560	57,187	$32.01
Newtown Creek	1,522	2,442			$0.20	$0.04	$488,400	$97,680	$390,720	14,699	$26.58
Passaic River	3,386	4,790			$0.20	$0.04	$958,000	$191,600	$766,400	92,081	$8.32
Port Chester Harbor	223	223			$0.20	$0.04	$44,600	$8,920	$35,680	6,112	$5.84
Raritan River	2,348	2,254			$0.20	$0.04	$450,800	$90,160	$360,640	111,638	$3.23

This table compares the annual cost of road transportation with the cost of water transportation for the channels whose dredging is not justifiable on the basis of container traffic alone. The traffic on these channels is primarily petroleum and petroleum products. The source of the annual statistics is: "Waterborne Commerce of the United States", 1996, Part 1, pp. 43-89. The sources for the prices of transportation per ton-mile are "FY 1997 Planning Guidance, Shallow Draft Vessel Costs", HQUSACE, for the "Via Water" price and the New Jersey Department of Transportation for the "Via Road" price.

Table A-7-6 Valuation of Port Facilities

BROOKLYN		NEWARK / ELIZABETH		STATEN ISLAND	
Cost of Proposed Project:	$ 2,406,000,000	Cost of Proposed Project:	$ 1,369,000,000	Cost of Proposed Project:	$ 1,169,000,000
Acres:	1,100	Acres:	1,825	Acres:	467
Cost Per Acre:	$ 2,187,273	Cost Per Acre:	$ 750,137	Cost Per Acre:	$ 2,503,212

BROOKLYN	$ 2,187,273
NEWARK / ELIZABETH	$ 750,137
STATEN ISLAND	$ 2,503,212
	$ 5,440,622

$ 5,440,622 / 3 = **$ 1,813,541 Average Value Per Acre**

BROOKLYN — Cost Components

$ 327,000,000	Land Acquisition
$ 392,000,000	Demolition
$ 1,381,000,000	Construction – General
$ 15,000,000	Construction – Improvements
$ 291,000 000	Cranes
$ 2,406,000,000	

NEWARK/ ELIZABETH — Cost Components

$ 5,000,000	Land Acquisition
$ 25,000,000	Demolition
$ 677,000,000	Construction – General
$ 44,000,000	Construction – Improvements
$ 192,000,000	Cranes
$ 426,000,000	Warehouse Construction
$ 1,369,000,000	

STATEN ISLAND — Cost Components

$ 69,000,000	Land Acquisition
$ 67,000,000	Demolition
$ 906,000,000	Construction – General
$ 7,000,000	Construction – Improvements
$ 120,000,000	Cranes
$ 1,169,000,000	

Source: “Feasibility Report of Hub Port Development”, NYCEDC, prepared by Booz-Allen & Hamilton Inc., 3/20/97, pp. IV-4 to IV-22.

Table A-7-7 Dredged Material Management Plan Study - Benefit Analysis

DREDGING VOLUMES AND BENEFITS *

Channel Segments		Benefits	Source of Benefits	Long-Term Projected Maintenance Dredging Rate (cubic yards per year)**	Benefits per Cubic Yard
Anchorage	NY / NJ Channels and Newark Bay			240,000	
Bayonne				19,000	
Kill Van Kull				530,000	
Newark Bay				1,300,000	
N. Arthur Kill				260,000	
Sandy Hook				600,000	
Shooters Island		$404,000,000	Containerships	69,000	
S. Arthur Kill		$2,900,000	Tankers	880,000	
		$407,000,000	TOTAL	3,900,000	$104
		$19,300,000	Containerships		
Bay Ridge/Red Hook		$1,800,000	Barges		
		$21,000,000	TOTAL	680,000	$31
Buttermilk		$14,000,000	Barges	39,000	$359
East River		$74,000,000	Barges	390,000	$190
E. Rockaway Inlet		$130,000	Barges	2,100	$62
Flushing Bay and Creek		$620,000	Barges	100,000	$6
Gowanus Canal		$420,000	Barges	11,000	$38
Hackensack River		$1,200,000	Barges	47,000	$26
Hudson River Channel		$34,000,000	Barges	450,000	$76
Hudson River (Lower Section)		$31,000,000	Barges	440,000	$70
Jamaica Bay		$1,800,000	Barges	57,000	$32
Newtown Creek		$390,000	Barges	15,000	$26
Passaic River		$770,000	Barges	92,000	$8
Port Chester Harbor		$36,000	Barges	6,100	$6
Raritan River		$360,000	Barges	110,000	$3

* 1998 Price Level
Numbers rounded so total may not add.
** Dredging volumes are both Federal and non-Federal combined.

Table A-7-8 Dredged Material Management Plan Study - Phase 2 Benefit Analysis

DREDGING VOLUMES AND BENEFITS *
WITH AN EXTENDED PERIOD OF ANALYSIS

YEAR 2025

Channel Segments		Benefits	Source of Benefits	Long-Term Projected Maintenance Dredging Rate (cubic yards per year)**	Benefits per Cubic Yard
Anchorage	NY / NJ Channels and Newark Bay			240,000	
Bayonne				19,000	
Kill Van Kull				530,000	
Newark Bay				1,300,000	
N. Arthur Kill				260,000	
Sandy Hook				600,000	
Shooters Island		$404,000,000	Containerships	69,000	
S. Arthur Kill		$4,000,000	Tankers	880,000	
		$408,000,000	TOTAL	3,900,000	$105

YEAR 2050

Channel Segments		Benefits	Source of Benefits	Long-Term Projected Maintenance Dredging Rate (cubic yards per year)	Benefits per Cubic Yard
Anchorage	NY / NJ Channels and Newark Bay			240,000	
Bayonne				19,000	
Kill Van Kull				530,000	
Newark Bay				1,300,000	
N. Arthur Kill				260,000	
Sandy Hook				600,000	
Shooters Island		$404,000,000	Containerships	69,000	
S. Arthur Kill		$6,100,000	Tankers	880,000	
		$410,000,000	TOTAL	3,900,000	$105

* 1998 Price Level
Numbers rounded so total may not add.
** Dredging volumes are both Federal and non-Federal combined.

B MANAGEMENT OPTION ANALYSIS & DETAIL

B-1 CONTAMINANT REDUCTION

DESCRIPTION

Contaminant Reduction is an initiative focused on lowering contaminant levels in the sediments and biota of NY/NJ Harbor. This simply stated goal involves complex scientific, management and political issues.

The NY District has estimated that as little as one-third of maintenance dredged material is suitable for ocean placement as remediation material at the HARS or other currently defined beneficial uses. The remaining material is estimated at approximately 2.7 MCY/YR. Recent (since 1992) sediment analysis of both private and federal navigation projects reveals contamination patterns in the proposed dredged materials. Dredged materials in the Arthur Kill, Hackensack River, the Brooklyn and Bayonne waterfronts of the upper Bay, the tributaries of the East River have consistently been found to fail toxicity criteria for ocean placement. In many of these same areas, the potential for adverse impacts due to bioaccumulation of contaminants has also been indicated: Arthur Kill-Hackensack River (PCBs, DDT, dioxin, dieldrin); upper Bay (PCBs, DDT, dioxin (especially at Bayonne waterfront project areas)); East River tributaries (PCBs, DDT). Although acute toxicity has not been indicated in Newark Bay and the lower Hudson, bioaccumulation of dioxin in Newark Bay and bioaccumulation of PCBs and DDT in portions of the lower Hudson have occurred at levels that preclude unrestricted beneficial use. Testing results indicate that sediments of projects located in most areas of the main stem of the upper East River and the Lower Bay are currently suitable for beneficial use.

There is evidence that sediments in the Harbor are getting cleaner. In general, older (deeper) sediments have higher contaminant levels than the more recently deposited material. Dramatic decreases in sediment contamination from 1960s levels have been documented in certain areas of the harbor, while studies conducted in other areas have proved inconclusive (Bopp *et al*, 1997, EPA, 1993, NOAA, 1995). If trends toward cleaner sediments were to continue throughout the Harbor, significant reductions in the amount of contaminated dredged material would be realized. This in turn would have profound effects on the long-term dredging budgets, port planning decisions and the overall restoration efforts in the estuary.

Currently, there is insufficient data to accurately quantify sediment contamination for the entire Harbor area. The Harbor Estuary Program (HEP) is coordinating a regional Contaminant Assessment and Reduction Program (CARP) designed, in part, to assist dredged material managers in quantifying these contamination trends (see Implementation section below). Large uncertainties regarding the projections of contaminant levels in future dredged sediments is an unavoidable aspect of the Contaminant Reduction program in its current phase. A focal point of the Corps role in the program is obtaining greater certainty in these predictions, which are expected to continue to evolve over the next few years. Accordingly, the Contaminant Reduction and DMMP programs should be flexible enough to incorporate and respond to new information, as it becomes available. Significant dredged material disposal costs savings and habitat restoration benefits are all within the reach of a successful program, therefore the Corps is a direct beneficiary and key component of the program. The Corps commitment to the Contaminant Reduction initiative must coincide with a similar commitment from the other regional stakeholders.

TECHNIQUES

The data available at this early stage of program development, is extremely limited and therefore the assessment of potential impacts uncertain. Existing project information and estimates for specific future projects are used to predict dredged material volumes and contaminant levels until year 2005.

Two methods are used in this chapter to generate a first order estimate of the quality of dredged material beyond 2005. In making predictions, emphasis was placed on the bioaccumulating contaminants that are currently problematic for full beneficial use of NY/NJ Harbor dredged material (*i.e.,* DDT, PCBs, dioxins and furans). It must be recognized that non-bioaccumulating contaminants (*e.g.,* PAHs, metals) can contribute significantly to the toxicity of dredged material, therefore, their importance should not be minimized.

The first method to predict the quality of post-2005 dredged material uses the assumption that contaminant concentrations measured in surficial harbor sediments during three recent sediment assessment efforts: R-EMAP (1993-4); NOAA Status and Trends (1995); and MAXUS (1991-95) is representative of the level of sediment contamination present in material that will require dredging in years 2005-15. Post-2005 material is projected to be suitable for beneficial use in those areas of the harbor with sediments that have recently (since 1992) been tested for ocean disposal and been determined to be HARS suitable material and/or in areas where the surficial sediments meet current bioaccumulation and toxicity criteria. The analysis is further described in section A, below.

The second method used to predict sediment suitability for beneficial use establishes temporal trends for important contaminants using radionuclide data and contaminant levels reported by Bopp et al. (1997). These trends were then extrapolated to estimate contaminant levels and suitability for beneficial use in future dredged material. The analysis is further described in section B, below.

A. Prediction of Dredged Material Quality through 2015: Use of surficial sediment data as a surrogate for post-2005 dredged material.

Dredged material suitable for ocean placement as remediation material at the HARS must meet current HARS remediation standards. These standards are based on biological criteria; specifically, exposure of benthic organisms to the material must not result in adverse effects due to toxicity or to bioaccumulation of contaminants. Projections of post-2005 dredged material quality were based upon 10-day exposures of the marine amphipod *Ampelisca abdita* to surficial harbor sediments during the R-EMAP and NOAA studies. The potential for adverse effects due to bioaccumulation was assessed by calculating the theoretical bioaccumulation potential (TBP) of nonpolar organic contaminants (DDT, PCBs, and dioxin (2,3,7,8-TCDD)) in the sediments using the following relationship:

$$Ct\text{-}28d = (BSAF28d * \%L * C_s)/TOC.$$

where:

Ct-28d = estimated tissue concentration resulting in an organism exposed to the sediment for 28 days;
BSAF28d = biota-sediment accumulation factor;
%L = lipid concentration of organism (wet wt.), expressed as decimal;
C_s = concentration of nonpolar organic compound in sediment;
TOC = organic carbon content of sediment, expressed as decimal.

TBPs were calculated assuming the mean lipid concentrations of test animals were as reported in federal dredged material testing projects since 1992 and using BSAFs reported by Rosman *et al*. (1997). The results of the toxicity and the TBP calculations were then compared to current HARS criteria to determine the suitability of the sediment for beneficial use.

B. Projections of future quality of dredged material: Extrapolation of temporal trends in sediment contaminant concentrations to predict long term trends in dredged material quality.

In a previous study by Bopp *et al*. (1997) sediment samples were taken from different depths of cores collected throughout NY/NJ Harbor and analyzed for PCBs, DDD (an anaerobic breakdown product of DDT) and dioxin levels. Dates of deposition of these samples were estimated using radioisotopes. These data showed that concentrations of these contaminants have decreased dramatically in certain parts of the harbor since the 1960s; results were inconclusive in other areas. The rates of decline of contaminant concentrations revealed by these cores were extrapolated in the present study to predict future levels of contaminants in dredged material and to forecast harbor sediments suitable for beneficial use. Since total DDT, not DDD, is used in making beneficial use suitability determinations under the current evaluative framework- a suitable target sediment concentration had to be developed for this compound. Using the TBP equation, it was determined that the NOAA ER-M value (the median sediment concentration observed or predicted by different methods to be associated with biological effects) for PCBs approximated the appropriate target sediment concentration for determining the potential for exceedances due to bioaccumulation of this contaminant. Therefore, targets for beneficial use sediment concentrations of contaminants were set to NOAA ER-Ms for both DDD and PCBs. Following a review of bioaccumulation data from recent federal dredging projects, the target sediment concentration for dioxin was set at 10 parts per trillion.

POTENTIAL IMPACTS

A. Prediction of Dredged Material Quality through 2015: Use of surficial sediment data as a surrogate for post-2005 dredged material.

The amphipod test results conducted on surficial harbor sediments show that dredged material throughout the Newark Bay-Kills-Hackensack and Passaic Rivers complex is likely to continue to be toxic to amphipods and therefore unsuitable for beneficial use through 2015. Significant potential for toxicity is also predicted for Jamaica Bay and areas of the Upper Bay and the East River. The distribution of toxic surficial sediments is shown in Figure B-1-1.

TBP results predict that, as anticipated, exceedances of criteria due to bioaccumulation of PAHs are limited to a few select areas in the Passaic River, Hudson River, Bay Ridge and a tributary of Jamaica Bay (Figure B-1-2). PCBs, DDT and 2,3,7,8-TCDD will continue to be problem contaminants in the Passaic and Hackensack Rivers, Newark Bay and the Kills through year 2015 (Figures B-1-3 - B-1-6). Scattered exceedances for PCBs are also predicted in the upper Bay and the East River through 2015. (TBPs predict similar patterns in bioaccumulation criteria exceedances in both *Macoma nasuta* and *Nereis virens* (compare the results for PCBs in Figures B-1-3 & B-1-4), so only TBP results for one species (*i.e., M. nasuta*) are depicted on the Figures.)

Patterns revealed by analysis of surface sediments in NY/NJ Harbor indicate that little or no increase in the volume of dredged material that is suitable for ocean placement or other beneficial use is anticipated by 2015. Areas that presently yield the remaining material are predicted to continue to be problematic.

B. Projections of future quality of dredged material: Extrapolation of temporal trends in sediment contaminant concentrations to predict long term trends in dredged material quality.

Extrapolation of the trends in sediment contaminant levels predicts that PCBs will continue to be a problem in Newark Bay dredged sediments through 2045 and in the Passaic River beyond 2100. PCB levels in upper Bay and Jamaica Bay sediments are predicted to be presently at or nearing beneficial use target concentrations. PCB extrapolations are shown in Figure B-1-7. The extrapolations predict that DDD will continue to be problematic in the Passaic River, Newark Bay and the Kills until at least 2025; upper Bay sediments are not predicted to have criteria exceedances related to DDD after 2000 (Figure B-1-8). Dioxin was only analyzed in Newark Bay and the Passaic River. Dioxin concentrations are predicted to continue to be problematic through 2045 in these areas (Figure B-1-9). Projected dates for HARS suitability in the waterways considered are summarized in Table B-1-1.

The projections using surficial sediments and the dated sediment cores generally agree in predicting that dredged material from Newark Bay, Arthur Kill, Kill Van Kull and portions of the upper Bay will remain unsuitable for beneficial use for at least the next 15 years. Most of the Lower Bay and portions of upper Bay and Jamaica Bay are expected to meet the criteria for beneficial use by 2010. The forecasts of dredged material suitability from the sediment core data are based on extrapolations from very few observations at a single location within a given waterway and must be viewed as highly uncertain predictions.

Table B-1-1 Projected Timelines for Improvement of Dredged Material Quality in Various NY/NJ Harbor Waterways to Levels that Allow Beneficial Use

Year was extrapolated from chemical and radioisotope data reported for sediment cores by Bopp et al. (1997).

Waterway/Contaminant	Dioxin	DDD	PCBs
lower Passaic River	2040	Post-2100	Post-2100
Newark Bay	2045	2035	2045
Kill van Kull	NA	2025	NA
Arthur Kill	NA	2025	NA
Upper Bay	NA	2000	2010
Jamaica Bay	NA	NA	1995

NA = Not Analyzed

Recent dredged material testing data suggests that the conclusion that upper Bay sediments are nearing target levels for PCBs may only be true for certain areas (*e.g.*, Buttermilk and Red Hook Channels, Red Hook Flats Anchorage) and recent data and modeling results reported by Thomann and Farley (1998) indicate that the projections appear overly optimistic for the upper Bay-lower Hudson River areas of the Harbor.

<u>IMPLEMENTATION</u>

The above analyses have two important conclusions: there is a continuing contaminated dredged material problem in NY/NJ Harbor and there are large uncertainties surrounding the prediction of future contaminant levels. Despite these uncertainties, the data are clear in their identification of the Newark Bay-Kills complex and the upper Bay as problem areas. The analyses suggest that the quality of dredged material in portions of the upper Bay may improve to levels permitting beneficial uses within the next 20 to 40 years; however, the uncertainty surrounding these predictions limits the usefulness of these projections for planning purposes.

Given the uncertainties associated with these predictions, the DMMP does not attempt to predict the amount of contaminant reduction expected over the next 40 years but rather sets a goal for the regionally based Contaminant Reduction program. The target is to reduce the annual amount of dredged material unsuitable for HARS placement to 0.5 MCY by the year 2040. Attaining this goal would require a total volume reduction of non-HARS suitable material of approximately 34 MCY (Figure B-1-10). At a typical placement cost for non-HARS material of $29/CY the potential cost savings is almost 1 billion dollars over the next 40 years. If starting in 2015 the following reductions in contaminated material were realized, the goal could be attained: a logarithmic 3% decline in volume from Newark Bay and the Kills, a 5% decline in the Upper Bay, Hudson & East Rivers and a 10% decline from the Lower Bay and Jamaica Bay.

These goals may be within the reach of a cooperative and aggressive contaminant reduction program. The Harbor Estuary Program (HEP) is coordinating a regional Contaminant Assessment and Reduction Program (CARP). The primary objective of the approximately $30 million dollar CARP effort is to assist dredged material managers by:

(1) identifying and evaluating sources of contaminants that need to be reduced or eliminated to ensure that in the future, newly deposited sediments in navigational waterways will be clean enough for ocean remediation activities
(2) defining what actions will be the most effective in abating the sources; and
(3) determining how long it will take for sediments to achieve “cleanliness”.

The NYSDEC work plan “Sources and Loadings of Toxic Substances to New York Harbor” and NJDEP’s “NJ Toxics Reduction Work plan” describe the majority of the monitoring actives associated with the program. Some of the monitoring/track down programs have already begun collecting data and most are scheduled to begin by the fall 1999. The majority of the CARP data collection and track down efforts are currently scheduled for completion in fall 2002. Close coordination with stakeholders and the public will ensure the continued commitment to the success of the program. Meeting the currently outlined goals will require the participation of all concerned parties in developing and implementing the program. The program's goals, if deemed appropriate by all stakeholders, must be actively pursued and monitored.

The State of NJ and the Port Authority of NY and NJ (PANY/NJ) have appropriated $2.9 million dollars for the development of a harbor-wide contaminant fate and transport model. The scope and detailed work plan for the modeling are currently in development but it is expected that the model would take into account the complex hydrodynamics, sediment fate and transport and contaminant fate and transport of the NY/NJ Harbor. The model is expected to be usable by regulatory and policy personnel in both States, the NYD and the USEPA.

The states of New York and NJ are funding a Quality Assurance/Quality Assessment and Data Validation component for the CARP. The quality control activities and procedures will be implemented to ensure that the all CARP environmental data collection activities are scientifically valid, and that the data so collected are complete, representative, comparable, and of a known and documented quality. The purpose of data validation component is to assess data quality as it relates to "usability". Data of very poor quality may be faithfully reported but may be of little validity if the quality control data are unacceptable. Data validation encompasses two broad categories: the assessment of data for contractual compliance, and an assessment of data usability. The former activity is primarily the responsibility of the laboratory although the CARP QA Officer will independently validate compliance through audits and inspections; the latter is the direct responsibility of the appointed CARP Program QA Officer.

The NYD is providing data management support as part of the CARP effort. The data management program focuses on building data sets and data evaluation tools to further the understanding of the distribution and sources of sediment contaminants in the harbor. Data analysis and mapping tools, including geographic information systems and three dimensional spatial interpolation programs will be geared toward facilitating the interpretation and communication of the variable and complex data sets. The database will be readily available to the workgroup and public for use in identifying contaminant sources and prioritizing clean up strategies. The information maintained in the database will be used by the NYD to more accurately predict and plan for future dredging needs and quantify the associated costs.

An accurate assessment of the contaminant levels in future dredged material is an essential element of a successful dredged material management and planning program. The collection and analysis of additional data would provide the basis for generation of more reliable estimates and could enable more optimistic projections to be made. These projections would in turn facilitate the consideration and possible implementation of shorter term and lower capital dredged material management scenarios. As new information on contaminant sources and distributions become available, they will be incorporated into the contaminant reduction and DMMP programs. These programs are designed with considerable flexibility to accommodate and react to increasingly reliable estimates of future dredging volumes. The NYD is a direct beneficiary of the lower dredged material disposal costs associated with a successful contaminant reduction program. Other programs of the NYD, such as habitat restoration will also benefit from the cleaner sediments, water, and biota. As such, the NYD will continue to participate in partnerships designed to reduce both the volume of contaminated dredged material and the scientific uncertainty associated with dredged material management.

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Figure B-1-1 Bulk Sediment Toxicity Results for *Ampelisca abdita*

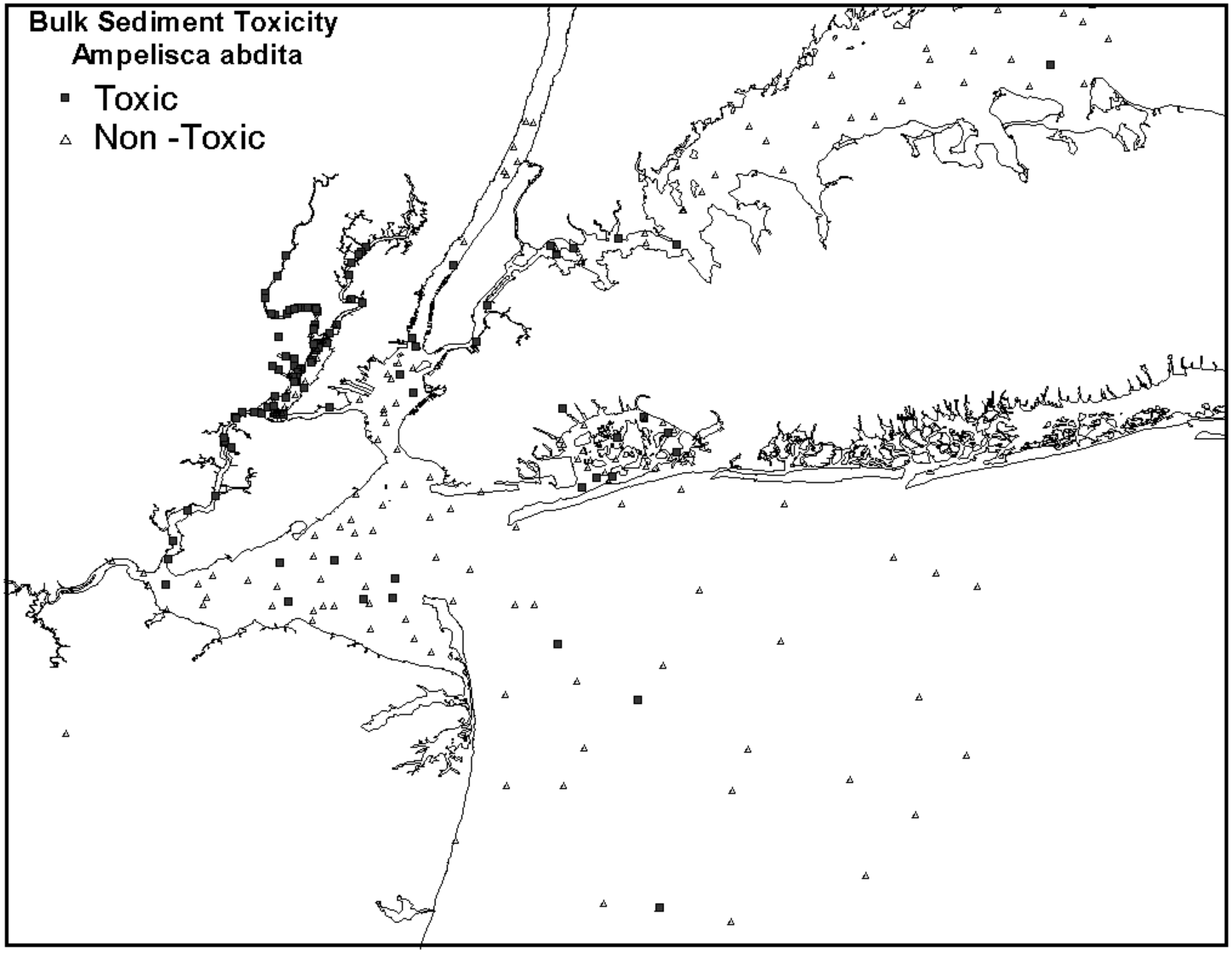


Figure B-1-2 Theoretical Bioacumulation Potentials for Total PAHs *in Macoma nasuta*

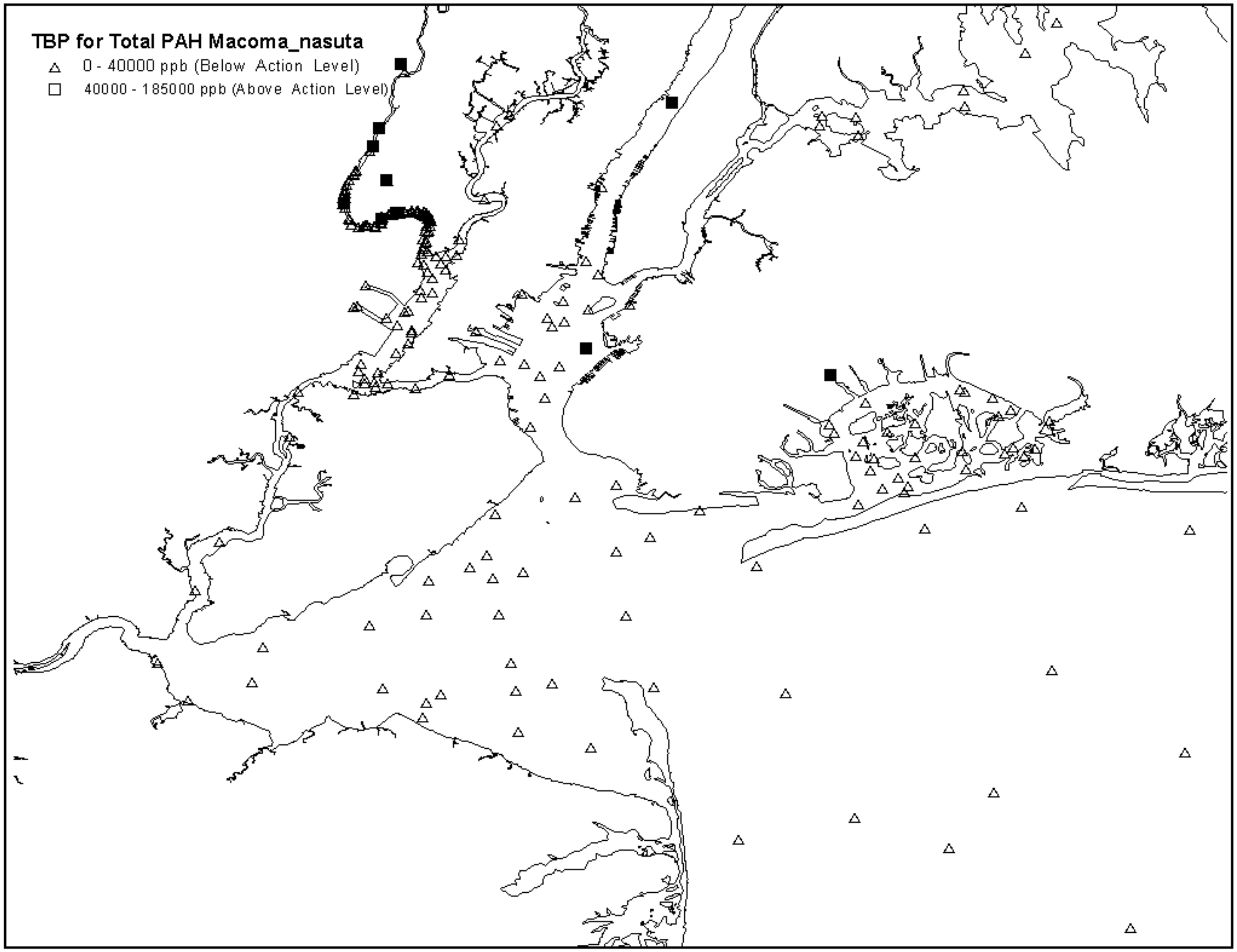


Figure B-1-3 Theoretical Bioacumulation Potentials for Total PCBs *in Macoma nasuta*

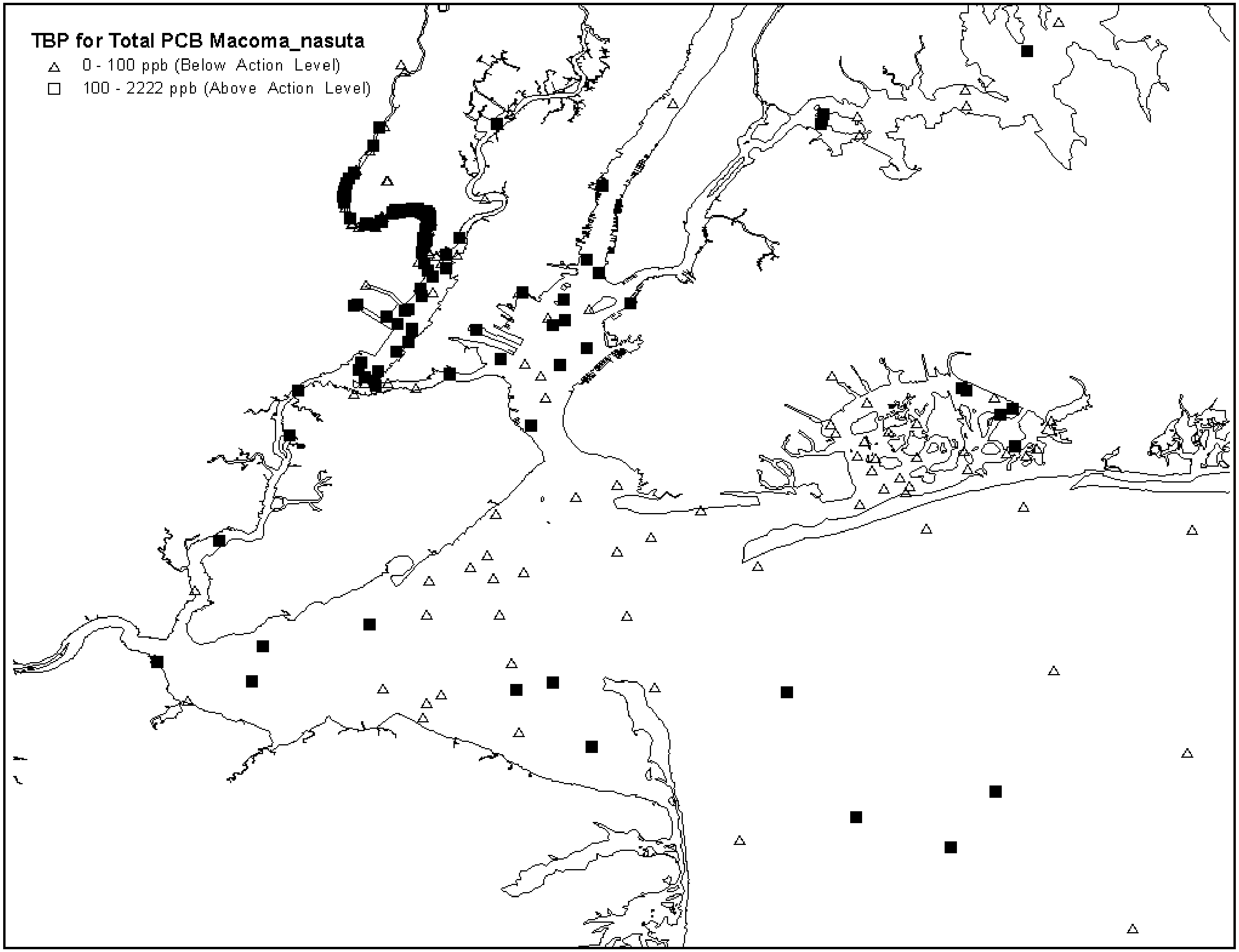


Figure B-1-4 Theoretical Bioacumulation Potentials for Total PCBs in *Neries virens*

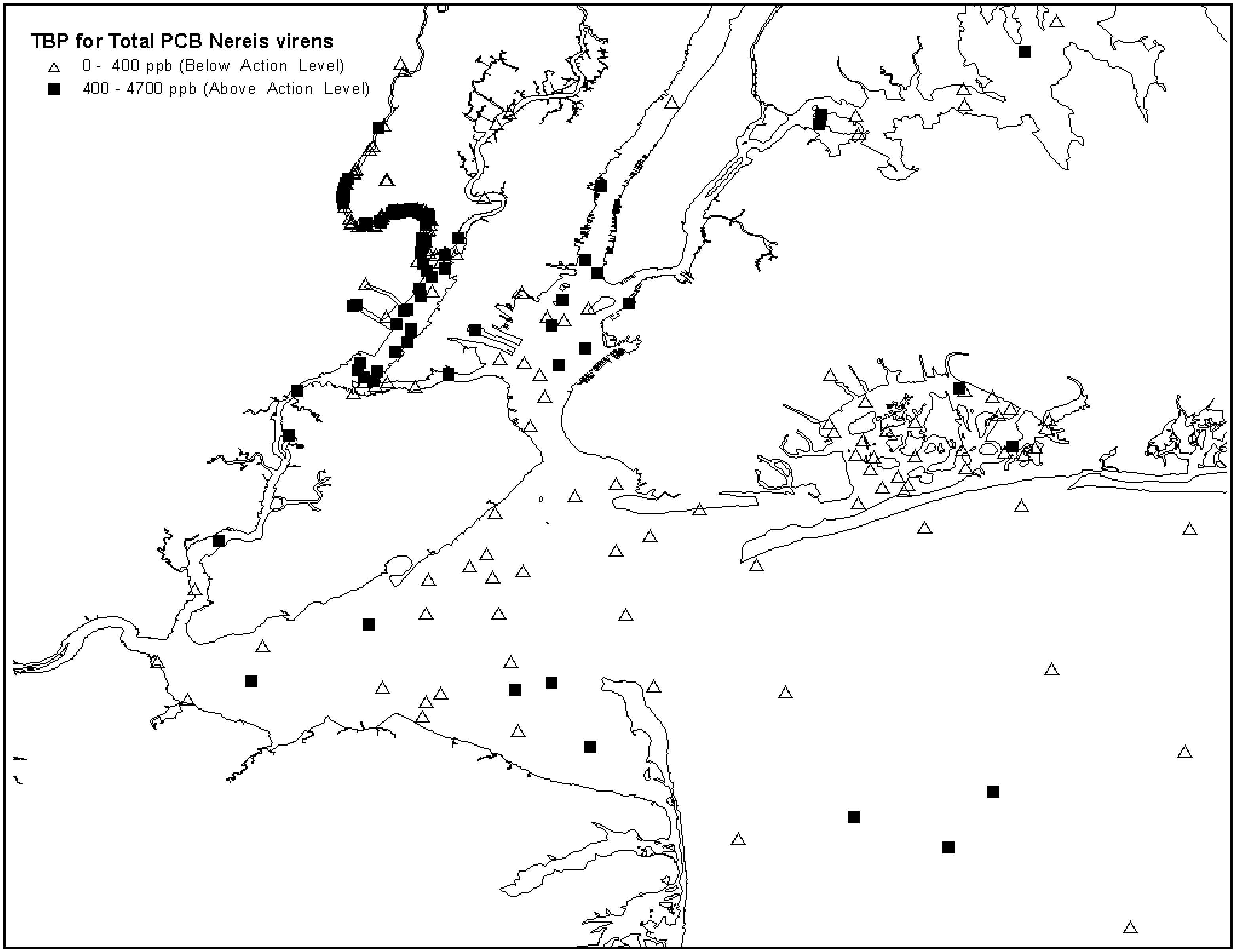


Figure B-1-5 Theoretical Bioacumulation Potentials for 2378 TCDD (Dioxin) in *Macoma nasuta*

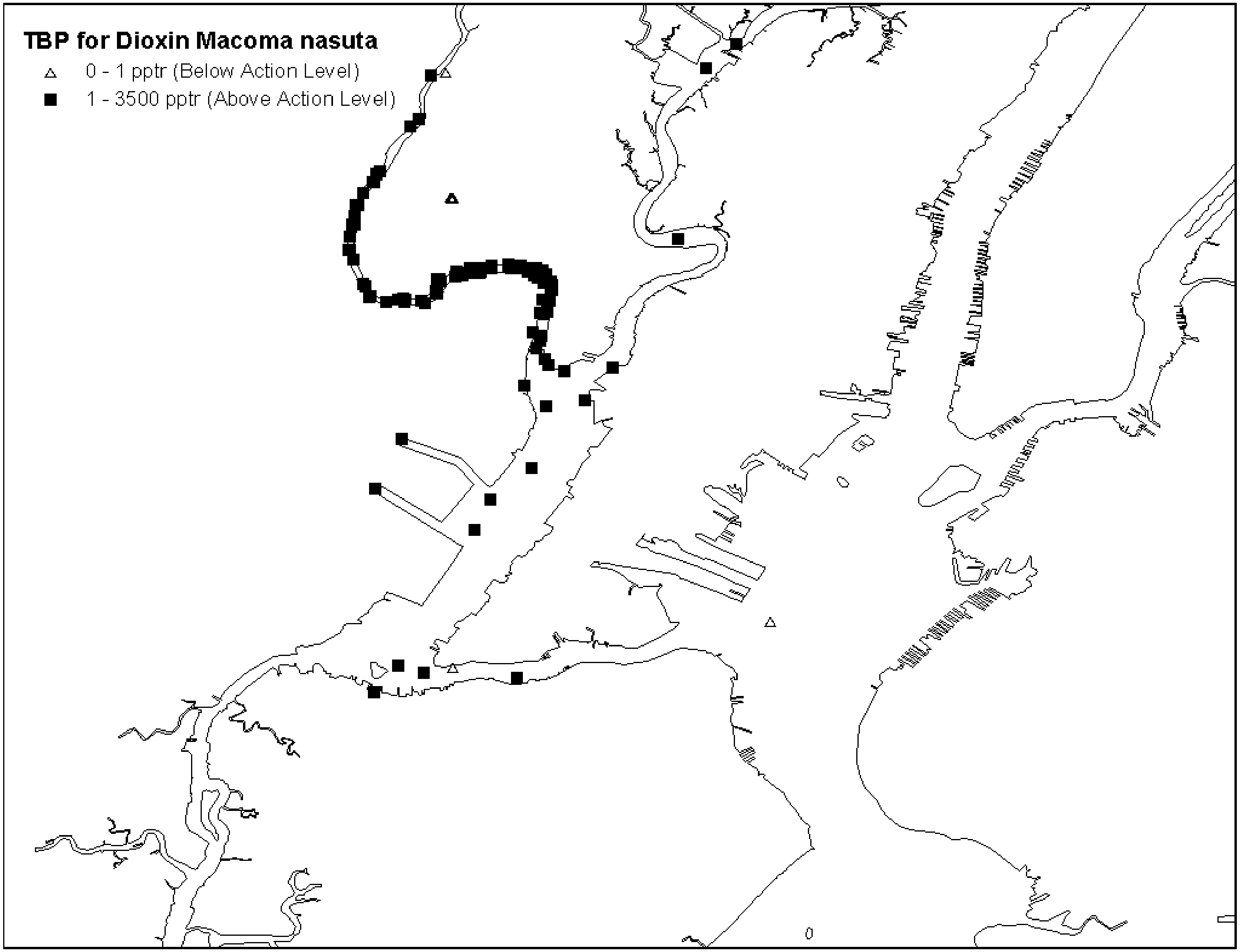


Figure B-1-6 Theoretical Bioacumulation Potentials for Total DDT *in* Macoma nasuta

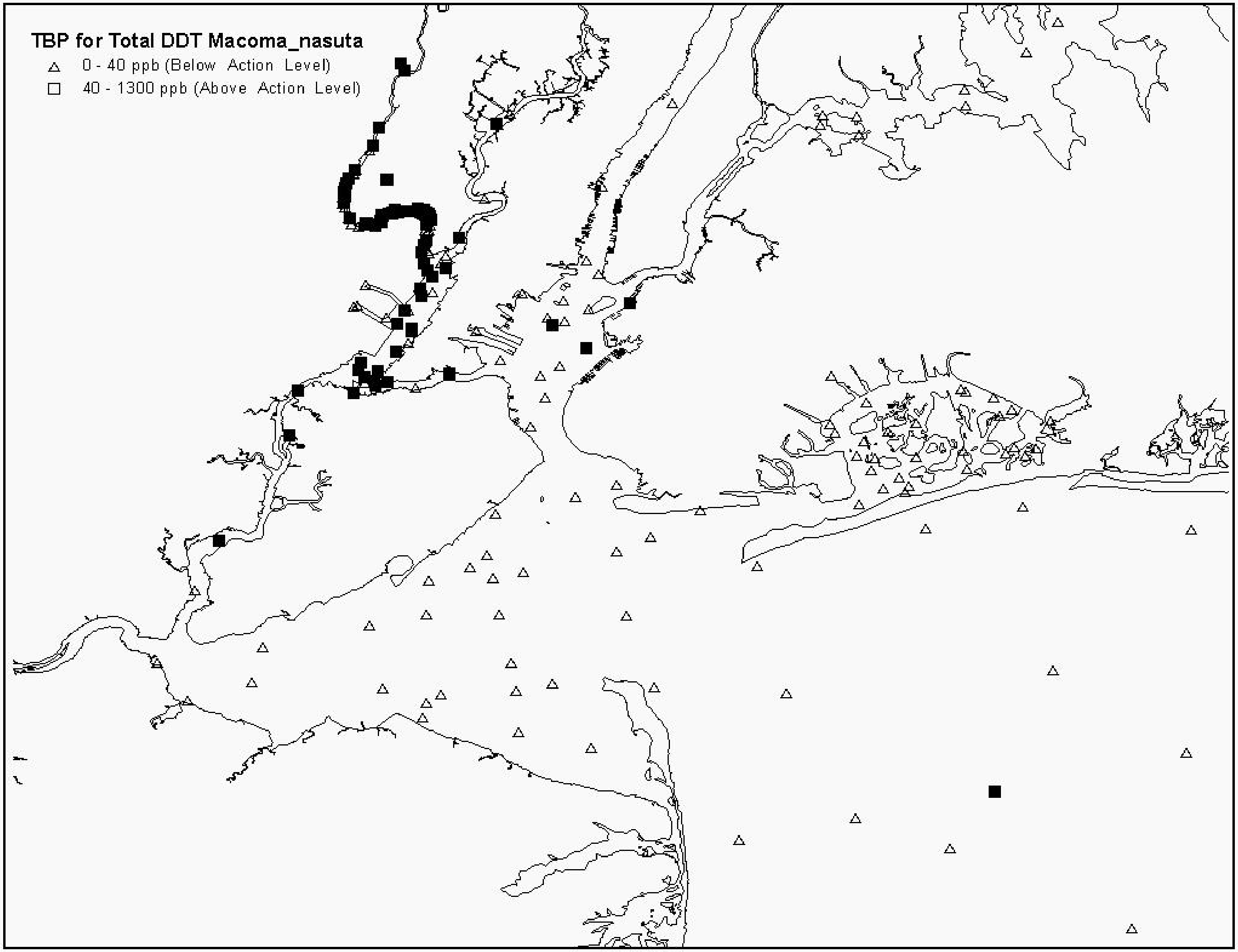


Figure B-1-7 Prediction of Long Term Dredged Material Quality for Total PCBs Based on Historic Trends

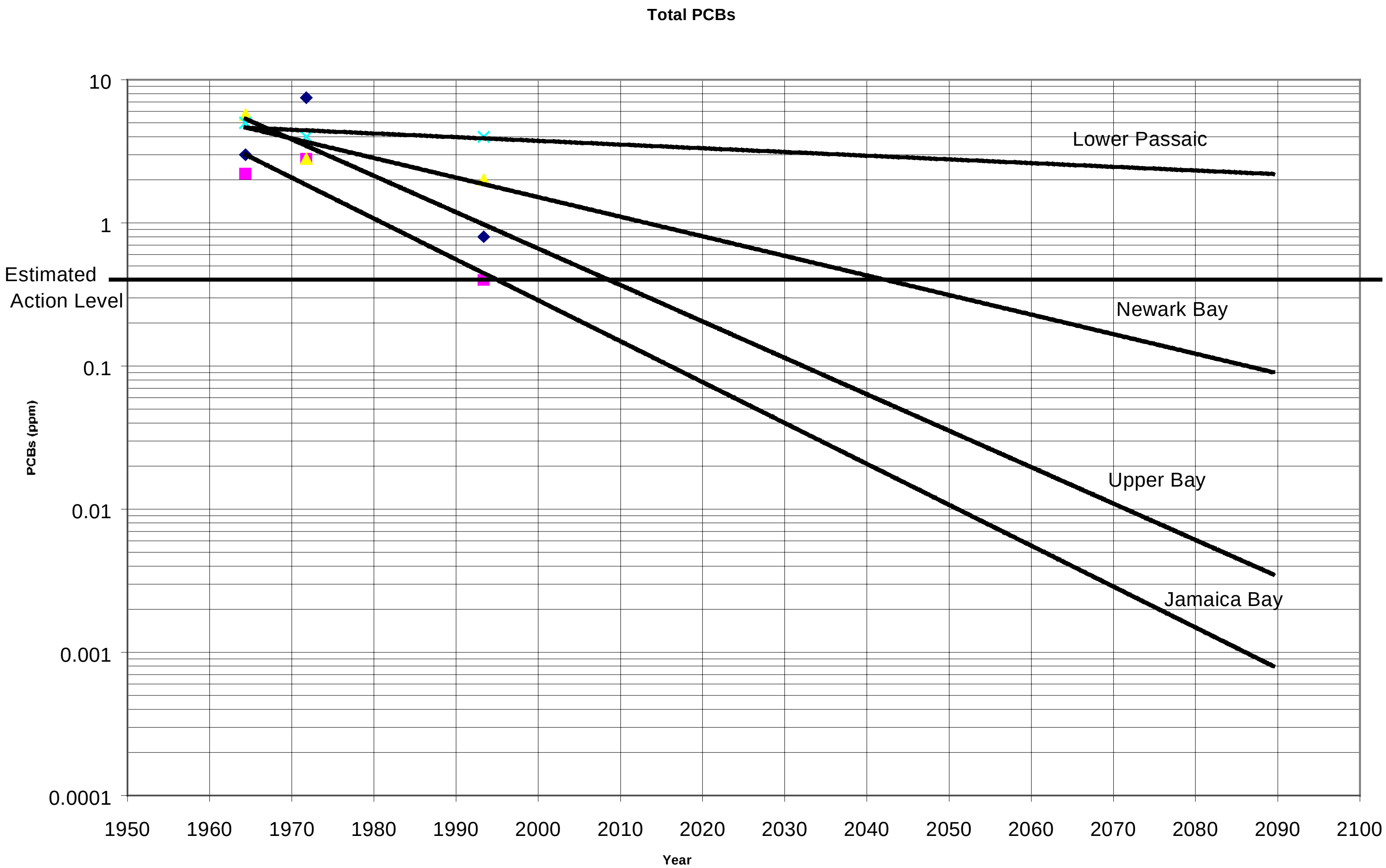


Figure B-1-8 Prediction of Long Term Dredged Material Quality for DDD Based on Historic Trends

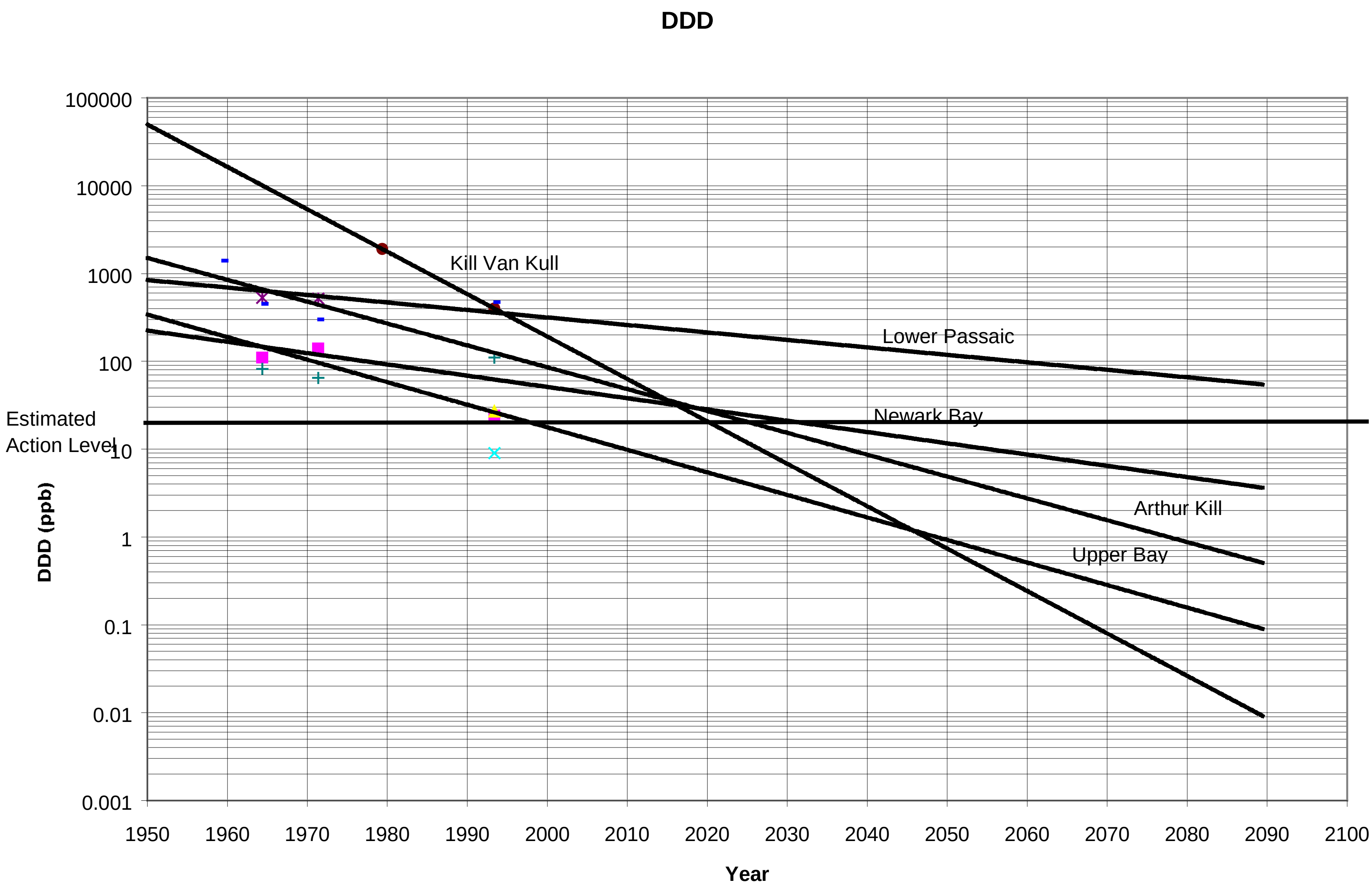


Figure B-1-9 Prediction of Long Term Dredged Material Quality for Dioxin Based on Historic Trends

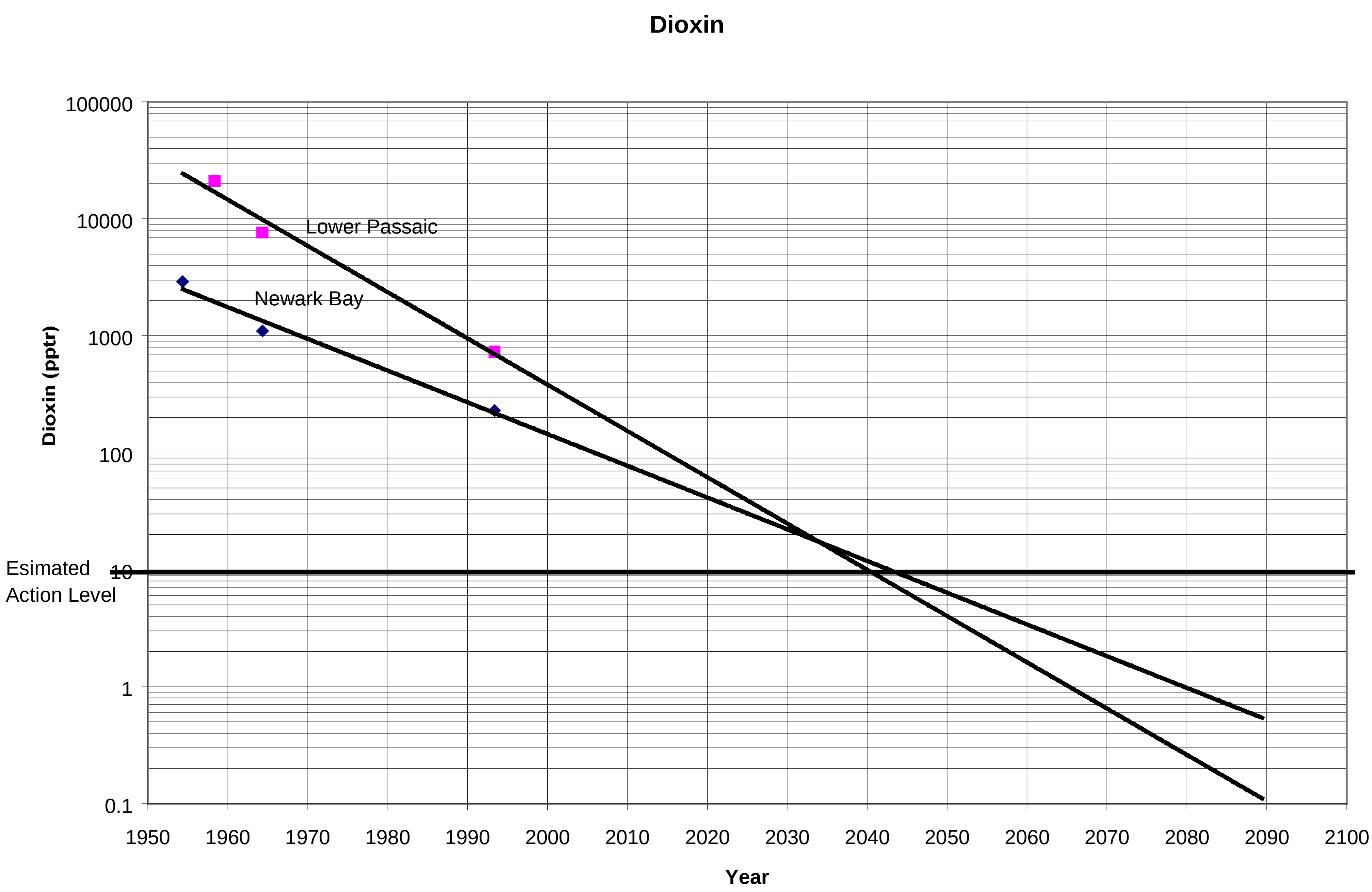
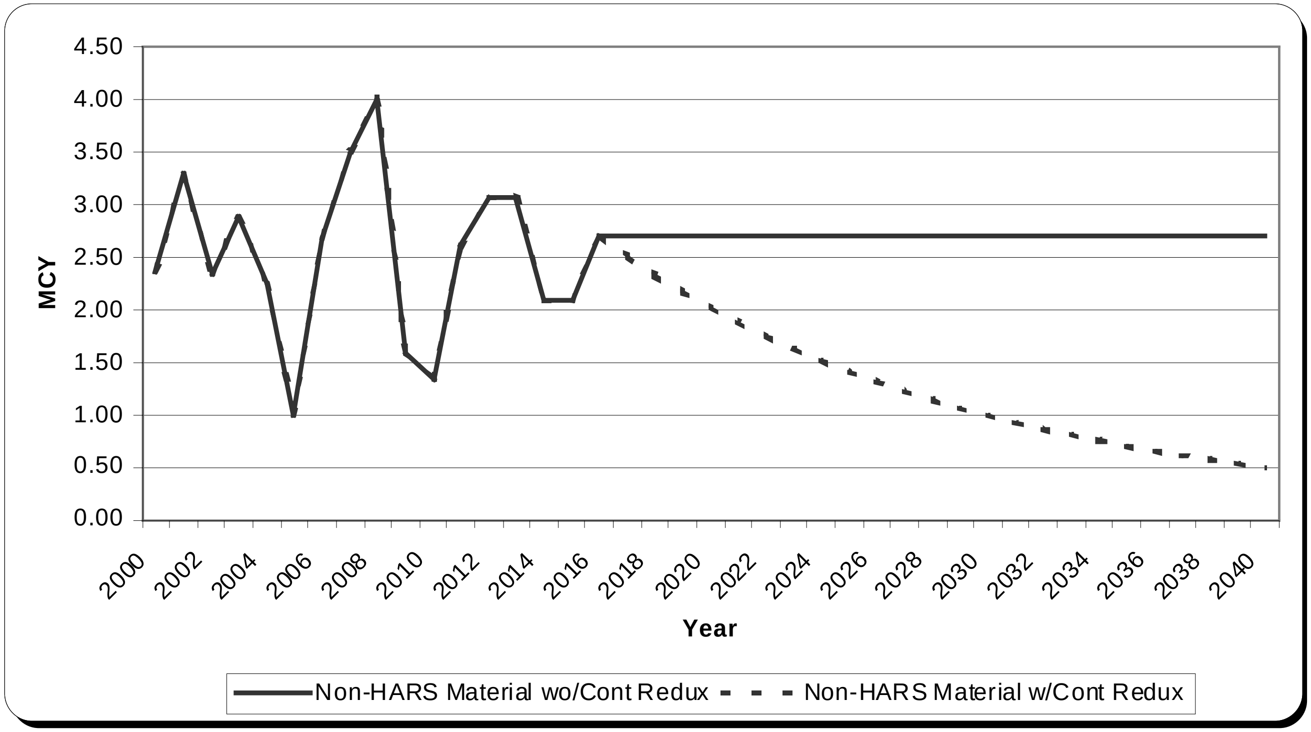


Figure B-1-10 Contaminant Reduction Target Goals



B-2 SEDIMENT REDUCTION

DESCRIPTION

The navigation channels of NY/NJ Harbor are part of a dynamic and complex system. High sedimentation rates within some of the channel areas necessitate frequent dredging to keep the channels open. Sediment reduction focuses on reducing the amount of sediment settling within the navigation channels. The sedimentation / minimization strategies can be classified into three main types: Watershed Sediment Reduction Controls, Channel Design Optimization, Advanced Maintenance Dredging and Structural Modification.

TECHNIQUES

Watershed Sediment Reduction Controls are specific strategies to reduce the amount of sediment reaching a waterbody. Techniques include the implementation of Best Management Practices (BMP's) and Total Maximum Daily Loads (TMDLs) which are designed to the reduce the volume of sediment laden runoff from agricultural lands, redirecting runoff to collection basins or other pervious surfaces where infiltration to the ground water can occur and protecting and reinforcing steep slopes and stream banks.

Channel Design Optimization is a term used to describe both a method for decreasing the sedimentation rate within the channel by straightening the channel as well as determining the economic need to maintain the channel. Straightening channels, termed channel realignment, tends to cause the water velocity within the channel to increase. The higher water velocity maintains a larger percent of material suspended in the water column and therefore decreases the amount of material settling out of the water column and accumulating in the channel. In the channel design optimization process, the Corps also examines the economic need to dredge the channel. The channel must have sufficient economic value to warrant the use of federal funds for the channel's maintenance. Channel design optimization strategies are examined during initial project design and as part of the routine maintenance procedures.

Advanced Maintenance Dredging has been used as a short-term means of reducing both dredging cost and dredging frequency by dredging below the desired channel depth. Sediment settling in the channel will fill the channel to the authorized channel depth but the time between maintenance dredging operations will increase. This does not reduce the volume of material removed but can lower dredging cost by avoiding several mobilization and demobilization cycles and reduces the frequency of disturbances.

Structural Modifications are physical constructions designed to keep sediment moving through (instead of settling in) a channel area or preventing sediment from entering the channel area. Typical structures include flow training dikes and sills, scour and propeller jets, gates and curtains, pneumatic barriers and sedimentation basins. Numerical models of hydrodynamics, salinity and sedimentation are used to assess the feasibility of generic and specific structural modification plans.

POTENTIAL IMPACTS

Watershed Sediment Reduction Controls are designed to reduce runoff and the impacts associated with erosion and habitat loss. If a stream or channel bank reinforcement were proposed, the potential impacts would be evaluated in a separate EIS. The major elements for impact assessment include habitat disturbance, ecologically important species, wetlands and mudflats disturbance and water quality.

Channel Design Optimization strategies are investigated during channel design and before maintenance dredging projects are initiated. The potential impacts are examined under the EIS for these projects. If a significant channel realignment were proposed, the potential impacts would be evaluated in a separate EIS. The major elements for impact assessment include habitat disturbance, ecologically important species, wetlands and mudflats disturbance and water quality.

Each component of the NY/NJ Harbor navigation system was examined to identify areas that were suitable for sedimentation reduction/ minimization measures. Specific structural modification plans were developed for the four sites identified in the Interim Report: North of Shooters Island, Port Newark/Port Elizabeth, Military Ocean Terminal at Bayonne, and Claremont Terminal. These projects are being further investigated as part of the NYD's Harbor Navigation Study. If one of the structural modification projects were suggested for implementation, the project EIS would evaluate the potential impacts. Physical Sediment Reduction measures have the possibility of impacting the benthic and fish communities. Impact concerns include the habitat loss from the project "foot-print" and alterations of the water velocity and water quality. There may also be positive impacts associated with the pneumatic sediment suspension systems including increased aeration, increased fish habitat and reduced dredging frequency. There is a potential to encounter both prehistoric and historic cultural resources if proposed structural work is not limited to previously disturbed areas.

IMPLEMENTATION

The New Jersey Division of Watershed Management has established a watershed-based program to develop TMDLs (Total Maximum Daily Loads) for impaired waterbodies in New Jersey. The impairments (as listed on the federal 303d list) are defined by exceedences of NJ Surface Water Quality Standards. The development of TMDLs will provide a basis for the development of Watershed Management Plans by region (20 in NJ) to reduce point and non-point sources of pollution so that these water bodies will no longer be impaired. NYSDEC has a similar TMDL based program.

The on-going New York and New Jersey Harbor Navigation Study (HNS) is a comprehensive study of the Port. Channel design optimization strategies including examining the economic value of individual reaches and the possibility for realigning reaches to the dominant flow direction are being evaluated as part of the study. The study also includes further evaluation of possible structural modification projects.

Several technologies have been proposed for reduction of sedimentation in berthing areas. While some of these systems have been used elsewhere in the country with some success, there is no data on their efficacy in the NY/NJ Harbor. Preliminary technical designs and economic evaluations of four proposed structural modification projects were completed in 1997. The North of Shooters Island project proposed the construction of a flow training dike to narrow the channel to a width similar to that which currently exists in the Arthur Kill and KVK. Sedimentation Modeling indicates that the proposed flow-training dike would reduce shoaling within the project boundary by 50,000 CY/YR. The cost of the dike is $18,000,000 and economic analyses indicate that the plan would be cost effective for dredging costs exceeding $36 per CY. Option plans for flow training dikes and pneumatic barriers, were developed for sites within Port Newark/Port Elizabeth. Modeling results indicate the options could reduce sedimentation by between 25,000 CY/YR. and 150,000 CY/YR. Economic evaluations indicate that plans are cost effective for dredging costs from $30 to $52 per CY. The larger reduction in dredged material volumes is associated with the high project cost. The project plans for MOTBY and Claremont Terminal both proposed narrowing the entrance to the reach through the construction of a pneumatic barrier. Both the MOTBY and the Claremont Terminal project could reduce shoaling by approximately 20,000 CY/YR. at an estimated project cost of $23 per cubic yard.

While some of these systems have been used elsewhere in the country with some success, there is no data on their efficacy in the NY/NJ Harbor. Before recommending or permitting the widespread use of these technologies, the NJDEP has requested that demonstration projects be conducted with concurrent modeling of sediment loading and ecological effects. NJMR has contracted Air Guard, Inc. of Trumbull, CT to design, install and monitor the efficacy of a pneumatic sediment suspension system at two locations in New Jersey. The first system, installed earlier this year, demonstrates pneumatic suspension in an inter-pier area of the Kill van Kull. IMTT, Inc. of Bayonne, NJ is hosting the demonstration. The second system, to be installed in summer of 1999 will demonstrate the efficacy of the technology in an open berth area in the Arthur Kill. TOSCO, INC. of Linden, NJ will host the second system demonstration. In addition, CITGO Petroleum of Pennsauken, NJ has begun discussions with NJMR and NJDEP on the demonstration of a turbo resuspension system at its facility on the Arthur Kill. The SCOUR technology utilizes high volume low velocity water jets to maintain movement of water across the berth bottom during slack tide. Multiple heads are installed across a bulkhead and are designed to operate in sequence to "push" sediment-laden water along and out of the berthing area. The system does not, however, resuspend already deposited sediment but rather prevents settling.

The preliminary evaluations and demonstration projects described above indicate that there may be opportunities for feasible sediment reduction projects in the NY/NJ watershed and Harbor. The two state sponsored watershed programs and the HNS will further evaluate the feasibility of Sediment Reduction options in the Harbor as well as the potential for further cost reductions from channel alignments, during its study of navigation improvements

REFERENCES

U.S. Army Corps of Engineers. 1997. Dredged Material Management Plan (DMMP) for New York Harbor, Sediment Reduction/Minimization Methods Final Report.

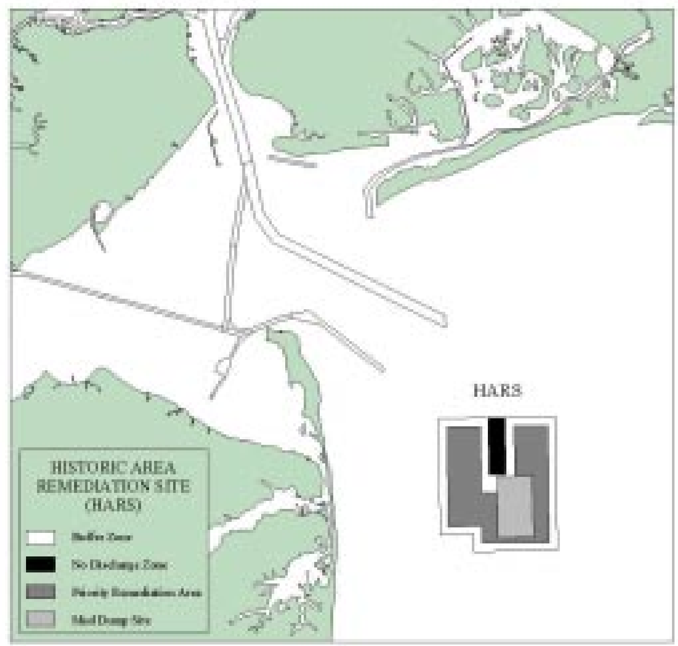
U.S. Army Corps of Engineers. 1998. New York and New Jersey Harbor Navigation Study, Without-Project Condition Report

U.S. Army Corps of Engineers. (in Press). New York and New Jersey Harbor Navigation Study, With-Project Condition Report

B-3 BENEFICIAL USES

B.3.1 HISTORIC AREA REMEDIATION SITE

Figure B-3-1 Historic Area Remediation Site



On August 28, 1997, the USEPA promulgated a final rule that de-designated and terminated the use of the New York Bight-Dredged Material Disposal Site (also known as the Mud Dump Site) and simultaneously designated it as the Historic Area Remediation Site (HARS) (Figure B-3-1).

The HARS is being remediated with suitable dredged material that meets current Category I standards and will not cause significant undesirable effects including through bioaccumulation. According to EPA Region 2, this is the first time in U.S. history that dredged material is being used to remediate contaminated areas of the ocean floor. Based on current projections, remediation of the HARS is expected to require at least 40 MCY (based upon a one meter cap) and will utilize HARS suitable dredged material for at least the next decade or more.

The USEPA is now performing a public and scientific peer review process of the HARS dredged material testing evaluation framework. This may result in a change of standards for determining if dredged material is suitable for placement in the HARS. For the purposes of the DMMP planning efforts, it is assumed that current standards for remediating the HARS will not change.

B.3.2 HABITAT CREATION, ENHANCEMENT AND RESTORATION

BACKGROUND

The successful use of dredged material for habitat creation, enhancement and restoration in highly urbanized areas like New York/New Jersey Harbor requires the implementation of non-traditional and innovative approaches, as well as commonly used applications such as beach nourishment. Further, as much of the New York Harbor navigation channel sediment is non-HARS suitable, it cannot be exposed to the environment over the long term without modification and/or spatial buffering. On the other hand, it is also recognized that leaving contaminated sediments in navigation channels over the long term poses a risk of continued exposure and uptake by various aquatic organisms.

Both HARS and non-HARS suitable dredged material from NY/NJ Harbor have many habitat creation applications. These include wetland creation, enhancement and restoration for habitat, aesthetic, water quality, shoreline erosion control and other functional improvement, the filling of existing degraded borrow pits and degraded dead-end basins for habitat and water circulation improvement and upland habitat creation on landfill cover made from dredged material. Section 2.2 of the DMMP summarizes these applications, which are discussed in more detail below and in Table B-3-1.

The US Army Corps of Engineers is the sole agency in the country responsible for the creation, enhancement and restoration of aquatic, wetland and upland habitat using dredged sediments. Implementation of the beneficial use of dredged material, carefully considered, can provide opportunities for habitat and water quality restoration in areas where restoration might not be possible without the use of dredged material. Use of both HARS and non-HARS suitable (as appropriate) dredged material offers a unique opportunity to use a resource which has historically been treated as waste, and at the same time restore and improve degraded habitats in estuaries, the ocean and adjacent uplands. In addition to supporting one of the DMMP goals, the beneficial use of dredged material in the New York/New Jersey area also supports one of the primary goals of EPA's Harbor Estuary Program (HEP).

Habitat development and restoration cannot be pursued in a vacuum. It needs to be pursued within a regional restoration plan (RRP) framework. RRP's are classes of site-specific recommendations based on assessments of resource conditions or trends on a large watershed or ecosystem basis. The basic premise of regional restoration planning is that the relative combinations of types of habitats, as well as their individual amounts, determine the ecological viability of an area. Habitat restoration efforts should target re-establishment of the habitat ratios (to the extent practical in urban areas) present when the area's ecosystem was considered healthy. Any plans to use dredged material for habitat creation or restoration needs to follow an approach to restoration that balances the needs of the resources in question with coordination among the various interest groups pursuing restoration opportunities. Furthermore, it needs to consider less obtrusive ways of accomplishing goals (e.g., hydrologic restoration of intertidal wetlands may be preferred over the creation of new marshes from uplands, which in turn would generally be preferred to creation of new marshes from shallow sub-tidal areas).

Towards that end, such a Regional Restoration Plan for the NY/NJ Harbor has been started. Extensive public and agency participation in the planning, construction and monitoring of beneficial use projects will be essential to addressing the concerns involved in the implementation of some of these applications within the regional plan concept. Although current dredging technology can be used to build many types of estuarine habitat, the use of dredged material in estuaries always involves trade-offs in natural resource values. For example, creation of nesting islands for birds may eliminate benthic foraging habitat for fish. In some cases this trade off makes good ecological sense for an area, in others it does not. Inclusion of the public and natural resource agencies in the examination of the many habitat trade-offs involved is necessary to ensure support for these projects.

Work accomplished on the DMMP was reported in the DMMP Interim (December 1996) and Progress (June 1997) Reports. The present DMMP report describes the development of the various applications in considerably more detail. The reader's attention is directed to the DMMP technical support document that describes beneficial-use applications in the Harbor: Beneficial Use of Dredged Material for Habitat Creation, Enhancement and Restoration in the New York/New Jersey Harbor Area, Draft, February 1999.

Description of Applications
Applications for the beneficial use of dredged material for habitat creation, enhancement and restoration in the Harbor fall into two categories: proven and potential. Proven applications are wetland creation/enhancement, creating reefs with dredged rock, establishing oyster beds and, in some cases, creating bird habitat. All of these are possibly feasible in the harbor and are included in the DMMP. The other applications require varying levels of planning and data collection and demonstration before implementation. Of these, those that have support or interest by individual sponsors (e.g., filling degraded pits) are included for consideration in the DMMP.

Creation, enhancement and restoration of wetlands can be accomplished with Non-HARS suitable dredged material as long as the physical and chemical characteristics of the sediment and the overlying water columns can support the wetland. In highly urbanized areas such as the New York/New Jersey area where thousands of acres of wetland have been lost to filling and erosion or degraded by pollution and colonization by invasive plants, it is incumbent upon the responsible agencies to examine the feasibility of beneficially using contaminated sediments as a substrate for wetland creation or restoration for a variety of purposes providing said material can be quickly and permanently isolated from animals and plants. These purposes include the stabilization of eroding shorelines, the improvement of water quality in inter-pier and other enclosed areas, the filtering of landfill leachate and habitat and aesthetic improvements.

Care must be taken to insure that contaminants are not made available to the food web. This could be accomplished either by capping, diking and/or mixing of the non-HARS sediments with cleaner sediments and/or additives to attain acceptable contaminant levels or reduce mobilization potential. A preliminary comparison of acres of lost tidal wetland in the New York metropolitan area with potential areas for wetland creation and restoration indicates that there is a substantial amount of inter-tidal and sub-tidal acreage available for this option.

The wetland creation/restoration beneficial use application (and any other application that involves converting inter-tidal or shallow sub-tidal habitat to another type of habitat) remains a point of controversy in the regulatory community because of the habitat trade-off issue. Any significant implementation of this option, especially with non-HARS sediment would have to demonstrate that the value of the habitat created is greater than what is lost. However, the concept is potentially valid, and worth pursuing, particularly since implementation of this beneficial use application may represent a significant contribution to solving the dredged material management problem and help restore lost habitat in the highly urbanized New York area.

Mudflat Creation, Enhancement and Restoration
Like wetlands, inter-tidal mudflats have been lost in the New York Harbor area since early Colonial times. Mudflats often contain highly productive algae communities, benthic communities, and are bird and fish feeding areas. Some are valuable commercially, e.g., bait worms, soft clams, mussels.

Since mudflats are often (but not necessarily) associated with adjacent wetlands, they will be treated in generally the same way as wetlands under the DMMP, and would have similar impacts and concerns, although they are located lower in elevation than wetlands.

Submerged Aquatic Vegetation (SAV) Bed Creation, Enhancement and Restoration
The major SAV species in the New York Harbor area is *Zostera marina* (eelgrass). This species has suffered devastating loses in this century, and the causes of this decline are still not clear. Disease, reduction in water quality (particularly nitrogen eutrophication), changes in bottom topography, increased resuspension of sediments and decreased light penetration of the water column have all been implicated. It seems likely that a combination of these factors is to blame. Attempts to reestablish eelgrass beds in the New York Harbor area have so far met with failure. Thus, the District does not consider the investigation of the use of dredged material as a substrate for establishing eelgrass beds a wise investment at this time. Future studies and potential improvement in water quality may allow a reconsideration of this position. Other attempts, outside the DMMP, that do not rely solely on using dredged material to restore eelgrass beds will likely continue (e.g., Jamaica Bay Ecosystem Restoration Project), and progress will be carefully monitored to see if dredged material may play a role later on.

Oyster Reef Creation, Enhancement and Restoration
The use of sand/clean silt covered with oyster shell (as a hard substrate for settlement of planktonic stage oysters) for oyster bed establishment has been done for many years. Certain maintenance projects could contribute the necessary substrate on a dredging cycle basis. As in other fill projects, the habitat trade-off issue needs to be resolved. However, there seems to be an interest in this type of cooperation that is encouraging. The Baykeeper (American Littoral Society) is currently conducting an experiment involving the placement of oyster shell in the Upper Bay of New York Harbor on the New Jersey flats near the Statue of Liberty. The shells will be monitored for oyster larval attachment and growth. This is a promising application in the New York/New Jersey area, particularly since oysters are thought by some to be increasing in number, indicating an improvement in water quality. Unfortunately, the amount of appropriate dredged material for this application would be relatively small, although the ecological and public relations benefits could be quite substantial. The Raritan Bay Baymen's Association in re-starting an oyster fishery, which historically was a thriving business in parts of Raritan Bay, has also expressed interest.

A significant issue that needs resolution before the USACE can engage in or even support oyster restoration activities in the NY/NJ Harbor area is the potential negative impact on human health and the existing shellfish industry. This issue comes from restoring oyster populations in areas where water quality is still too poor to allow harvesting. The newly created beds could become an attractive nuisance that could foster illegal harvesting. This issue is discussed in detail in the oyster restoration chapter of the Habitat Beneficial Use Report (Barry Vittor & Associates, Draft, February 1999)

Shellfish Bed Creation, Enhancement and Restoration
The target species would most likely be soft clams (*Mya arenaria*). Initial discussions have taken place between National Marine Fisheries Service and New York District staff concerning the placement of clean sand from the Shrewsbury River maintenance dredging project (Sandy Hook, NJ) into an eroded area in Sandy Hook Bay. The purpose would be to restore the bottom topography so as to enhance benthic habitat and thus promote soft clam colonization. Again, the habitat trade-off issue comes into play.

Although less likely, improvement of hard clam habitat by adjusting the fine/coarse composition of the sediments more suitable for hard clams is also a possibility. Only appropriate grain size, HARS suitable material would be considered. Suitable sediments could be obtained from local Raritan Bay/Sandy Hook Bay maintenance projects.

Fish Reef Creation and Enhancement
Reef creation using dredged rock has been routinely placed at reef sites for many years. Locally, rock blasted from the Kill van Kull/Arthur Kill navigation projects has been placed at one of New Jersey's State artificial reef sites over the course of several months. Although very little systematic monitoring of these artificial reefs has occurred, environmental regulatory agencies and fishing groups prefer rock over other types of materials (e.g., tires, fly ash blocks, cars, trains, mud, sand, clay, silt, gravel, etc.). Cleaned military surplus vehicles (e.g., tanks, personnel carriers, etc.) have been successfully used in some cases and are more resistant to deterioration than other vehicles. Additional rock from the Kill van Kull/Newark Bay/Arthur Kill deepening projects in the New York/New Jersey Harbor may generate significant amounts of reef building material (as detailed in the Comprehensive Port Study, NYD, 1999).

Hard glacial clay (possibly mixed with Pleistocene gravel and other coarse glacial material) from areas in the New York /New Jersey Harbor, which may be part of the overall Harbor deepening project (to potentially 50+ feet), could also be used productively as fill for borrow pits and capping material (if approved by EPA). However, this material is not considered appropriate reef building material either by the Atlantic States Marine Fisheries Council, environmental regulatory agencies or local fishing groups. Since this Pleistocene material is essentially uncontaminated, there may be competitive uses for it (i.e., HARS remediation site, borrow pit and landfill cover, and/or intermediate fill). It is the USACE's understanding that USEPA needs to determine the acceptability of this material for habitat creation, borrow pit fill, capping and other uses. It may be suitable, subject to further demonstration, to build underwater "berms" with this material, but these should not be referred to as "reefs". Of course, appropriate fine sediments can be used in remediation projects on a case by case basis.

Bird Habitat Creation, Enhancement and Restoration

Several potential applications for bird habitat enhancement with dredged material have been identified in the New York/New Jersey area. These are the creation of upland habitat creation at Floyd Bennett Field, Brooklyn, Mudflat/marsh restoration at South Brother Island (East River) for colonial water bird feeding habitat, and nesting/feeding applications at Prall's Island (Arthur Kill) and Shooters Island (Kill van Kull). Also being considered by the District is the deposition of dredged material on Hoffman-Swinburne Islands to create upland bird habitat for species such as least terns. Permission from the National Park Service is required for some of these projects (e.g., Hoffman-Swinburne Islands and Floyd Bennett Field). All these potential applications are described in more detail in the bird habitat restoration chapter of the Beneficial Use report (Barry Vittor & Assoc., Draft, February 1999).

It is potentially possible that moderately contaminated dredged material could be considered for base material for this application, although it would have to be contained and/or rendered harmless, because the intent is for birds to feed directly in the inter-tidal sediment in some cases. Capping with clean sediment would be necessary.

Filling of Dead-end Basins

Although difficult to quantify, sediments in some poorly flushed urban waterways may be contributing significantly to bioaccumulation of contaminants in benthos and fish. Many parts of greater New York Harbor, particularly the Brooklyn waterfront, parts of Jamaica Bay and industrialized parts of New Jersey, suffer from this type of condition, which is caused primarily by imperfect shoreline geometry.

Some of these waterways, because of their location in the estuary, their shoreline geometry and proximity to sources of contaminants (such as street runoff, stormwater outfalls and Combined Sewer Outfalls (CSO), which are often located at the headwaters of these tributaries), can be considered essentially "unrestorable". It is recognized by many that this is a controversial point. Further, some urban waterways, although grossly polluted, serve as *de facto* settling basins for organics and toxins, which might otherwise migrate out into the outer waterways and affect more valuable areas. This must be considered in selecting sites for filling. In some cases, stormwater outfalls would need to be extended or rerouted.

In the most degraded urban areas where quality habitat is considered essentially impossible to restore, it seems reasonable to consider a management strategy that not only encapsulates similar contaminated sediments from other parts of the same waterway, but also results in some relative improvement of habitat quality in the dredged area and surrounding waters. These, "hot spots" of contaminated sediment could be dredged and contained in these potentially "unrestorable" waterways, such as the headwaters of the highly industrialized Newtown Creek and the Gowanus Canal and Bergen and Thurston Basins.

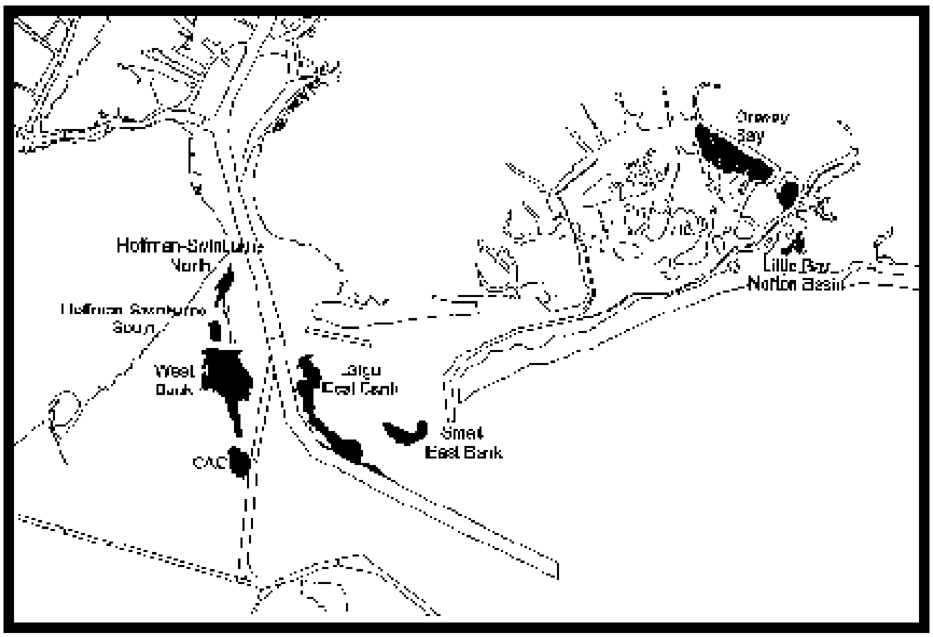
Creation of Treatment Wetlands

This involves creating wetlands with dredged material in inter-pier or similar moderately flushed areas, not primarily to create habitat, but to act as a natural water purification system. These might be particularly useful in close proximity to CSO's or other high organic load outfalls, especially where other clean-up or abatement efforts are planned or underway. Wetlands also trap sediments under certain conditions and can potentially be utilized to reduce sediment flux to the estuary, along with sediment-associated contaminants. Possible locations are the Brooklyn waterfront inter-pier areas, Bowery Bay (Queens) and Thurston and Bergen Basins (Jamaica Bay).

This application requires engineering evaluation to determine critical minimum sizes for the wetland to be of value in filtering contaminants. Further, although the science of utilizing constructed wetlands for water treatment is well developed for controlled freshwater situations (such as where the wetland treatment is associated with a sewage treatment facility), little work has been done with the use of tidal areas for this application. Implementation of this application would require an initial project action to determine its long-term value and feasibility in New York Harbor. Barry Vittor & Associates, Draft, February, 1999 discusses the assets and liabilities of this application in detail.

<u>Borrow Pit Restoration</u>
A "borrow pit" is a man-made depression in the bottom of a waterway, typically dredged to acquire construction grade sand. New York Harbor contains several dozen of these anthropomorphic depressions, the largest of which are located in Jamaica and Lower Bays (Figure B-3-2). Some of these basins have remained viable habitat for fish and other estuarine organisms, and others have not. Several have become traps for fine-grained, contaminated sediments. In extreme cases, these same degraded pits exhibit seasonal hypoxia/anoxic events and subsequent diminished benthic communities.

Figure B-3-1 Proposed borrow pits for restoration of shallow water habitat



The report entitled *"Beneficial Uses of Dredged Material for Habitat Creation, Enhancement and Restoration in NY/NJ Harbor"* (Barry Vittor & Associates, Draft, February 1999) estimated that approximately 85 million cubic yards of capacity exists for dredged material in the borrow pits located in Figure A-3-2. Because of the potentially degraded condition of these pits and their ability to contain large volumes of dredged material to restore the bottom over the pits to more natural contours, this option was pursued further. The CAC pit in the Lower Bay and the Jamaica Bay pits were studied for several physical, chemical and biological aspects from April, 1997 to January, 1998 (Clarke, in preparation). Also, benthic data from all the pits (as part of the overall harbor benthic survey) was collected and analyzed from October 1994 to 1997 (Wilber, in preparation). The surveys were intended to serve as a preliminary assessment of potential use and value to benthic and fish communities in the two bays. Data collected included sediment texture and percent organics, benthic grabs, underwater photography, fish hydroacoustics (sediment profiling imagery), dissolved oxygen, temperature, salinity and fish trawls. The results suggest that the Jamaica Bay pits and the West Bank pits to be poor environments for most marine life. This is possibly due to the accumulation of oxygen demanding sediments, geometry (relatively deep holes with steep sides in a naturally shallow estuary) and the lack of sufficient hydrodynamic flux resulting in high residence times (particularly the Jamaica Bay pits).

Hydrodynamic and water quality monitoring of Jamaica Bay is currently underway as part of the USACE/NYCDEP Jamaica Bay Ecosystem Restoration Project. Preliminary results show that recontouring specific channels (in part by filling in several of the pits) could improve water quality in the bay. Consequently, the filling of pits such as Grassy Bay could play an important part in Jamaica Bay restoration. Conflicting policy issues (as well as several technical issues relating to existing habitat use of the pits and the effects of contaminant loss during placement) need to be addressed before this controversial issue can be resolved. It is important to point out that most of the water quality studies done thus far in Jamaica Bay have concentrated on the application to improvements in general circulation and meeting state water quality use standards. This is quite different from the goal of habitat restoration, which might have much stricter goals (e.g., prevention of summer time DO levels falling below 2 mg/l for extended periods).

A preliminary estimate of the total volume of dredged material that could be used to fill those pits still under consideration (all Jamaica Bay pits, the Hoffman-Swinburne Island pits and the large West bank pit) is approximately 56 million cubic yards (Barry Vittor & Associates, Draft, February 1999). This figure assumes that each pit is filled to ambient adjacent bottom. The use of these pits potentially represents up to two decades worth of dredged material placement options. Equally important, the environmental benefits of helping to restore Jamaica and Lower Bays, although un-quantified at this point in time, are potentially substantial.

POTENTIAL IMPACTS

Assumes the use of all clean or contaminated sediments isolated from the environment by capping with clean sediments for all applications except reef construction (which assumes only rock to be used) and oyster, other shellfish and SAV habitat enhancement and restoration (which assumes only all clean sediments will be used).

Wetland Creation, Enhancement and Restoration
Beneficial Impacts:
-- Replace/enhance lost wetland
-- Erosion control
-- Make use of current bio-technology
-- Eliminate/reduce use of more structurally dependent/less environmentally friendly erosion control technologies
-- Enhance most other Clean Water Act wetland values

Adverse Impacts:
-- Loss of existing habitat under the new wetland footprint
-- Potential physical and chemical effects of contaminants leaching from the sediments, i.e., smothering and acute toxic, bioaccumulative and sublethal effects (can be controlled)
-- Uptake of contaminants into the food web through the ingestion of marsh plants and animals
-- Cost
-- Cultural resources

Mudflat Creation, Enhancement and Restoration
Essentially the same potential impacts as for wetlands.

Oyster Habitat Creation, Enhancement and Restoration
Beneficial Impacts:
-- Contribute to the resurgence of the local oyster population and oyster industry
-- Provide more ecological edge effect around oyster reefs.

Adverse Impacts:
-- Loss of existing habitat under footprint of reef
-- Indirectly contributes to the attractive nuisance problem from illegal harvesting
-- Competition with other uses of the estuary (which can be completely eliminated through good planning)
-- Cultural resources

Shellfish Habitat Creation, Enhancement and Restoration
Similar potential impacts as to oyster habitat.

SAV Habitat Creation, Enhancement and Restoration

The habitat trade-off is the only potential concern. (NOTE: The District at this time is eliminating this application from further consideration).

Fish Reef Creation, Enhancement and Restoration
Beneficial Impacts:
-- Increase local marine species habitat and populations that utilize artificial reefs
-- Provide better fishing opportunities

Adverse Impacts:
-- The habitat trade-off issue; depending on the target species, location and many other factors, the concentration of fish resources may result in deleterious increased harvest (presumably offset by the fact that only state approved reef enhancement sites would be used)
-- Cultural resources

Bird Habitat Creation, Enhancement and Restoration
Essentially the same potential impacts as wetlands.

Filling Basins
Beneficial Impacts:
-- Removal of contaminated sediments from the estuary and reduction of contaminant uptake
-- Replacement of existing bottom sediments with cleaner sediments
-- Improvement of water circulation

Adverse Impacts:
-- Loss of existing habitat (which must be minimal value)
-- Temporary release of contaminants at the dredging and placement site, which should also be short term and of very limited spatial extent
-- Long-term maintenance of the disposal site
-- Cost
-- Cultural resources.

Construction of Treatment Wetlands
Potential impacts essentially similar to creating habitat wetlands.

Borrow Pit Restoration
Beneficial Impacts:
-- Restoration of historic natural bottom topography (to the extent possible)
-- Improved water circulation and water quality
-- Improved benthic and fish habitat
-- Improved recreational opportunities
-- Creation of synergistic environmental improvement opportunities (complementing CSO abatement and wetland/upland restoration)
-- Elimination of contaminant uptake from the bottom of the pit
-- Elimination of seasonal hypoxia/anoxia generated by oxygen demanding sediments accumulating at the bottom of these pits and lack of water circulation at depth

Adverse Impacts:
-- Loss of existing habitat
-- Temporary resuspension of sediments at dredging site
-- Temporary loss of some contaminants at the placement site
-- Small loss over time of dissolved contaminants in pore water squeezed out of consolidating sediments in he pit

IMPLEMENTATION

1. Wetland Habitat Creation, Enhancement and Restoration
   - Step 1 – Survey the New York Harbor area for potential sites
   - Step 2 – Identify potential volumes, engineering requirements, costs and all other pertinent requirements for each site to be implemented
   - Step 3 – Screen and prioritize sites
   - Step 4 – Implement selected projects, including acquisition of all permits, site specific engineering design and construction costs, etc
   - Step 5 – Analyze the results of the initial projects, and use those results and conclusions to finalize sites for further implementation, final volumes, identify precise source of sediments, etc
   - Step 6 – Implement remaining projects as appropriate, including acquisition of all necessary permits

2. Mudflat Habitat Creation, Enhancement and Restoration

   Similar implementation process to wetlands.

3. Oyster Habitat Creation, Enhancement and Restoration

   Similar implementation process to wetlands.

4. Shellfish Habitat Creation, Enhancement and Restoration

   Similar implementation process to wetlands.

5. SAV Habitat Creation, Enhancement and Restoration

   Eliminated from further consideration. No implementation steps planned at this time.

6. Fish Reef Creation and Enhancement

   Already part of on-going projects. Continued coordination with the states needed.

7. Bird habitat Creation, Enhancement and Restoration.

   Step 1 – Analyze results of previous surveys

   Proceed as with wetlands, starting with Step 3.

8. Filling Basins.

   Similar process to wetlands, except that, at already identified sites (e.g., Newtown Creek and Gowanus Canal), proceed straight to implementation of demonstration projects, after initial data collection and analysis, if possible.

9. Creation of Treatment Wetlands

   Similar implementation process to wetlands.

10. Borrow Pit Restoration
    - Step 1 – Study each pit to determine level of habitat use
    - Step 2 – Monitor placement of dredged material to insure no water quality impacts
    - Step 3 – Conduct post-construction monitoring to determine level of restoration
    - Step 4 – Apply knowledge gained from each project on the next one until all the pits are filled that are amenable to restoration

Table B-3-1 Summary of Habitat Beneficial Use Applications

Note: Please reference footnotes below and refer to the full Beneficial Use report to avoid misinterpretation of this table. Assumptions and level of confidence differ widely with each application.

Application	**Potential Volume (MCY)**	**Generic Dredging Cost ($/CY)**	**Year Potentially Available**	**Type of Dredged Material Used***
Landfill Cover**	100+***	10 – 20	2000	H,T, G, C
Wetlands (habitat)**	1 – 5	20 – 40	2002	H, T, G, C
Wetlands (treatment)**	7 – 10	30 – 40	2002	H, T, G, C
Fish Reefs	10+	24	On-going	R
Filling Basins**	3 – 5	40	2003	H, T, G, C
Landfill Leachate**	1 – 4	30 – 40	2002	H, T, G, C
Birds**	1 – 3	12 – 15	2002	H, T, G,C
Mudflats**	0.5	20 – 30	2002	H, T, G,C
Oysters	0.5	8	2002	H
Shellfish	0.1	5 – 10	2002	H
Degraded Borrow Pits**	85	5 – 15	2001	H, T, G, C

* C – Unsuitable material isolated by clean dredged material
H – Clean (HARS suitable) material
R – Rock
T– Treated
G – Glacial clay (if acceptable to EPA)

** - Most of these applications are unlikely to use non-HARS material. However if non-HARS material were used for the underlying base, these applications would require capping (covering) with HARS remediation material in order to isolate the overlying environment from the potential harmful effects of contaminants. The appropriateness of using treated dredged material as a cap is undetermined at this time, but is potentially feasible if the applicable testing criterion indicates no significant potential for harm.

*** Assuming all available upland fill areas (including sanitary landfills) are capped.

**** Assuming adequate funding is available to implement needed research and demonstration, where applicable

<u>REFERENCES</u>

Barry A. Vittor and Associates, Inc. (draft, February 1999), “Beneficial Uses of Dredged Material for Habitat Creation, Enhancement, and Restoration in NY/NJ Harbor,” Kingston, NY.

Barry A. Vittor and Associates, Inc. (1998), “Characterization of Benthic Assemblages in the New York Bight Apex,” Kingston, NY.

U.S. Environmental Protection Agency (1996), “Summary of the Comprehensive Conservation & Management Plan – The NY/NJ Harbor Estuary Program Including the Bight Restoration Plan,” New York, NY.

B.3.3 LAND REMEDIATION

DESCRIPTION

This option combines the beneficial use of dredged with the environmental and economic restoration of degraded lands. Degraded lands include, but are not limited to, active & inactive landfills, brownfields, quarry sites, and abandoned coal mines. All these sites have disturbed environments and limited natural resource value in their present condition. Many also generate substantial leachate and surface runoff that contaminate surrounding soils, aquifers, and surface water.

Landfills and brownfields offer unique opportunities for the beneficial use of stabilized dredged material, because these sites often have environmental safeguards incorporated into the site's design, such as liners and leachate collection systems in the case of landfills and groundwater containment and monitoring on brownfields sites. These safeguards, together with institutional controls would be required on these sites regardless of whether dredged material is beneficially used on these sites or not. Capping these sites with dredged material may be an economical and safe means to help remediate these sites. After being properly restored, many of these sites, especially in urban areas, can be developed for industrial, commercial, or recreational use. In this way, environmental restoration could be linked with economic development and community revitalization. Alternatively, a restored site can be used for wildlife habitat (Section B.3.2).

Dredged material used for land remediation under properly controlled conditions should not result in additional deterioration of the environment. The soils and any waste materials present on these sites are generally much more contaminated than the dredged material that would be used for capping. For example, most dredged material would likely meet the NJDEP Nonresidential Soil Cleanup Criteria guidance levels for most contaminants (NJDEP, 1997). Once placement is completed, the dredged material is usually capped with clean material, further containing and isolating the contaminants from the ecosystem. A site-monitoring program during and after use would ensure that the remediation is successful and poses no significant risk to the environment or public health. The use of dredged material would be one component, albeit a key one, in the complete restoration of a site. For example, an inactive solid-waste landfill may also require a landfill-gas venting system and a leachate-collection system as part of its closure/remediation plan.

Prior to use, dredged material is typically amended or processed with additives (*a.k.a.* binding agents) to reduce the water content, improve structural/geotechnical properties, and better immobilize the contaminants within the material. Binders include Portland cement, fly ash, lime, and cement kiln dust. Proprietary additives may also be used. After blending, the material is allowed to "set" into a hardened, granular soil-like condition, with a lower water content and improved structural/geotechnical properties (e.g., shear strength, compactability). The right types and proportions of admixtures are tailored to meet the engineering specifications and standards for a generally-accepted and similarly-manufactured product. Beneficial uses for a soil-like product include structural or nonstructural fill, grading material, daily/intermediate landfill cover, and final landfill cover. Being predominately fine-grained, dredged material has the low hydraulic conductivity (typically 10^{-6} cm/sec or less) desirable for cover/capping material. In the NY/NJ region, earthen material used for such purposes typically sell for $5-12/ton as delivered. However, quality control and quality acceptance requirements need to be established to ensure acceptable uniform quality.

The process of blending in binding agents is referred to as solidification/stabilization (S/S). S/S is considered a decontamination technology (see Sections 2.4 and B.4) because it enhances the immobilization of contaminants in the material. Contaminants generally become more tightly bound to the matrix, preventing significant levels from leaching into aquifers and water bodies or otherwise becoming biologically available. The high alkalinity found in commonly used binders further aids in reducing the leaching potential of most toxic metals. Material that has undergone S/S is sometimes referred to as "stabilized" material.

Two other ways to process dredged material to make it suitable for land remediation is dewatering and manufactured soil production. Previous studies (Malcolm Pirnie, 1982, 1983 & 1987) have indicated that de-watered dredged material without using any admixtures should generally have structural/geotechnical properties suitable for landfill cover and similar applications.

Dewatering could be accomplished by passive dewatering (e.g., spreading it on open land to dry) or mechanical dewatering (*e.g.*, centrifuge, belt-filter press). However, passive dewatering is not considered practical for large volumes in this region due to the colder climate and lack of large open tracts of land along the waterfront. Mechanical dewatering is a possibility, but may be as costly as S/S without matching the latter's benefits. S/S does a better job in improving structural/geotechnical properties further immobilizing any contaminants, as well as reducing the water content. More contaminated sediments may need to be decontaminated prior to processing into manufactured soil (See Section 2.4 B.4).

For remediation sites located in remote or restricted areas, dredged material could be used to make a manufactured topsoil to support a vegetative cover. This may be an economical alternative for those sites that need to import topsoil cover. In the NY/NJ region, topsoil from commercial suppliers typically sells for $15-20/ton as delivered. To make a fertile topsoil in this process, dredged material is blended with a cellulose waste (e.g., yardwaste compost, wood chips) and biosolids (*e.g.*, sewage sludge, cow manure). A greater proportion of these organic admixtures would be used than that of binders in S/S, resulting in less dredged material needed to make a given volume of end product. These organic admixtures would also enhance immobilization of the contaminants and, over time, promote microbial degradation of many organic contaminants. (Fertile soils harbor immense populations of microorganisms.) The topsoil-production process can also be combined with phytoremediation (growing select plant species to stabilize or clean up contaminants). For these reasons, manufactured-topsoil production is considered a decontamination technology (Sections 2.4 and B.4). Using the end product as a topsoil cover would be limited to remote or restricted sites, such as abandoned coal mines in rural areas, to minimize any potential public exposure to contaminants present in the material.

The NYD is preparing a user's manual entitled "A Manual for Using Dredged Material for Remediating Contaminated Upland Sites" (LMS, draft 1999). The purpose of this manual is to educate and encourage local communities and private enterprises in this type of beneficial use. In addition, WES has prepared several technical documents on the subject over the past decade. These include a general guidance manual on various beneficial uses of dredged material, including land remediation (USACE, 1987); a report on the feasibility of passive dewatering in the NY/NJ region (USACE, 1987); and technical manuals for using dredged material for landfill cover in the NY/NJ region (USACE, draft 1999) and remediation of waterfront brownfields (USACE, in preparation).

The Office of New Jersey Maritime Resources (NJMR) is currently working on a GIS-based database of degraded sites located in New Jersey that may be suitable candidates for using dredged material for capping and remediation. While initial screening of the NJDEP databases has yielded encouraging results, additional work is necessary before additional sites can be recommended as part of the DMMP. The databases currently do not include extensive site-specific information, such as site status, acreage availability, and the nature and extent of site contamination.

For upland use in New Jersey, NJDEP would issue an Acceptable Use Determination (AUD) on a case-by-case basis. The AUD would be issued in conjunction with a Waterfront Development Permit for a specific dredging project provided the acceptable use project is designed and managed in a manner consistent with all the environmental statutes applicable to the project. This is addressed in NJDEP's guidance manual entitled "The Management and Regulation of Dredging Activities and Dredged Material in New Jersey Tidal Waters" (NJDEP, 1997). For an upland project in New York State, the NYSDEC would issue a Beneficial Use Determination (BUD) on a case-by-case basis. The BUD process will be addressed in NYSDEC's upcoming guidance manual on upland placement of estuarine dredged material.

In Pennsylvania, efforts in using dredged material are currently focused on reclaiming abandoned coal mines. Upon passing engineering and environmental criteria, the Pennsylvania Department of Environmental Protection (PADEP) would classify processed dredged material as clean fill material and issue a Beneficial Use approval. The PADEP would then perform a Class III unlined landfill analysis to evaluate use of the material for coal mine reclamation.

TECHNIQUES

A. Daily & Intermediate Cover at Active Solid-Waste Landfills

Instead of disposing of dredged material at active solid-waste landfills intended for other wastes (and incurring a high tipping fee), this option would use processed dredged material as daily or intermediate cover. Other possible uses at these landfills are constructing levees and lining disposal areas. Active landfills have an extra benefit over other degraded lands by being designed to contain contaminants and manage runoff. Past studies for this region (Malcolm Pirnie, 1982, 1983 & 1988) have shown that this alternative is feasible.

B. Final Cover at Abandoned/Inactive Solid-Waste Landfills

Many abandoned or otherwise inactive solid-waste landfills in this region have never been formally closed. Such an action would require a state-approved closure plan and post-closure plan. Processed dredged material could be used for capping these landfills. One inactive landfill site, the Jersey Gardens Mall Site in Elizabeth, NJ (formerly called the OENJ Orion Site), has already taken in processed dredged material. The site was developed into a retail shopping mall. Approximately 0.6 MCY of processed dredged material was placed as structural fill for a parking lot. The last load of dredged material was placed in November 1998.

The OENJ Site in Bayonne, NJ encompasses an inactive municipal landfill and a brownfield. The site underwent a remedial investigation and an approved remedial action work-plan was developed. The beneficial use of dredged material on this site was incorporated into that remedial action work-plan by using dredged material as a low permeability cap and structural fill. It is estimated that 4.5 MCY of amended dredged material may be accommodated on this site. The use of dredged material on this site offers several environmental benefits. Uncapped landfills in the region are estimated to generate approximately 400,000 gallons of leachate per acre per year. The low permeability of the dredged material cap will reduce the amount of precipitation infiltrating contaminated historic fill on the property. This results in a substantial reduction of contaminants leaching into the Upper Bay. In addition, the use of dredged material as structural fill allows the site's developer to fund the more expensive elements of the remedial action work-plan, including a groundwater barrier system and a leachate collection system. Once the fill has been placed a three foot thick clean fill cap will be placed over the dredged material. This cap not only provides a growing medium for plants to be established on the site but also eliminates any potential environmental exposure to the dredged material or the existing contaminants on the site. Once closed, the site will be developed into a recreational facility including a golf course.

Without the beneficial use of dredged material, it is not likely that this site would have been remediated at any time within the foreseeable future. Existing contamination at the site would continue to leach into the Upper Bay, wildlife would continue to be exposed to surficial contaminants, and the site would have no public utility. Consequently, the use of dredged material at this site will have both environmental and socio-economic benefits. The site was fully permitted in October 1998 and is awaiting its first dredging contracts with an estimated tipping fee cost of $29/CY.

The NJDEP has identified approximately 600 landfill sites, which may require final closure and remediation. Of these, the Hackensack Meadowlands Development Commission (HMDC) has identified eleven major abandoned landfills within their jurisdiction. The NJDEP is working in conjunction with the HMDC and NJMR to develop closure plans for these landfills using clean clay to be excavated during the deepening of navigation channels in the Kill Van Kull and Newark Bay. At a minimum, the projects will require 5 MCY of clean clay. It is estimated that the transfer and placement of the clay will cost $12/CY. However, little is know about the workability of the performance of the clay underlying the Bay. The PANY/NJ plans to undertake a 2,000 CY pilot project at the Koppers Coke site during 1999 to assess the suitability of the clay as a liner for a stormwater retention basin. Provided the results of the project are favorable, the NJDEP and NJMR will perform a 0.5 MCY demonstration project to a cap a landfill in the Meadowlands during 2000.

New York is investigating the use of processed dredged material as grading and cap material at municipal landfills in the State. The Pennsylvania and Fountain Avenue Landfills are inactive waterfront landfills located on Jamaica Bay in Brooklyn, NY. Both landfills leach contaminants into the Bay and are under consent decrees with the NYSDEC for final closure. Final closure material is estimated at 0.8 MCY for the Pennsylvania Landfill and 1.4 MCY for the Fountain Avenue Landfill. At both sites NY City is planning a pilot demonstration of the processing and placement of approximately 100,000 CY of HARS unsuitable material for use as grading material. Pending positive results, additional processed dredged material may be accommodated on these and other landfill in NY. The Fresh Kills Landfill in the Borough of Staten Island is scheduled to close by end of 2001, several MCY of final closure and grading material will be required. Should the State or City of New York be interested, the feasibility of using processed dredged material in the closure operations may be investigated.

C. Brownfield Remediation

As defined by USEPA, brownfields are abandoned, idled, or under-used industrial and commercial facilities where expansion or redevelopment is complicated by environmental contamination (though typically with contaminant levels too low to be considered hazardous-waste sites). Many of these sites are located in urban areas, where they could be restored to productive use. Due to the heavy historic industrial development in this region, there are numerous brownfields that could potentially benefit. Recently, USEPA and the states of New Jersey and New York have developed programs to expedite the investigation, cleanup, and restoration of brownfields. As part of this effort, they're promoting the use of non-conventional material, including dredged material, as an economic alternative to cap suitable brownfields.

In this region, one brownfield, the Koppers Coke site in Kearny, NJ has a potential capacity of 4.5 MCY (pending Corps of Engineers' approval). Under a permit obtained and managed by SK Services of Newark, NJ 2.1 MCY of dredged material is being used in the remediation of a brownfields site for reuse as a manufacturing or warehousing facility. To date 1.1 MCY of material has been placed. The NJDEP approved remedial actions are designed to prevent exposure of surface soils, mitigate the migration of dissolved-phase constituents to the Hackensack River and prevent the migration of dense non-aqueous phase liquids (DNAPL) to the Hackensack River. Amended dredged material, with a permeability of $1x\ 10^{-6}$ cm/sec. is proposed for use as a low permeability cap. Additional amended dredged material is proposed to be used on site as structural fill to bring the site to final proposed grade for redevelopment. The use of dredged material at this site will help to offset the cost of other remedial activities that have been implemented at the site including a slurry wall, a secondary groundwater barrier, and a pump-and-treat groundwater program. The advantages of the beneficial use of dredged material at this site go beyond those of traditional dredged material disposal. These added benefits include the elimination of groundwater and surface water contamination, the elimination of direct contact with existing surficial contamination and the return of an abandoned urban site to productive use. The Phase 1 project, (not requiring Corps' approval) has a remaining capacity of 1 MCY. It is estimated that 2.4 MCY of additional material could be accommodated in Phase 2 of the project, pending Corps' approval. The estimated cost of processing and transporting dredged material to the site is $29/CY.

The previously mentioned OENJ Bayonne Site in Bayonne, NJ encompasses a brownfield (as well as an inactive landfill). It is estimated that 4.5 MCY of amended dredged material may be accommodated on this site as structural fill material. The site was fully permitted in October 1998 and is awaiting its first dredging contracts.

The Port Liberte site is brownfield site located in Jersey City, NJ. The site has been identified as a potential repository for 0.8 MCY of dredged material at a cost of $17/CY. Dredged material would be amended at the Consolidated Technologies Inc.(CTI) processing facility, located on the adjacent Claremont Terminal, and transported by truck to the Port Liberte site for use as structural fill for a proposed golf course.

The Office of New Jersey Maritime Resources (NJMR) and the NJDEP are currently evaluating additional degraded sites in NJ for their suitability in using up to several MCY each. Several other brownfields in this region have already been identified, including OENJ Sayreville, NJ, OENJ Port Reading, NJ and Allied Signal, Elizabeth NJ are being proposed to process and place dredged material with a total capacity of 11 MCY at a tipping fee cost of $29/CY (Table 2 – 2). NJMR has estimated that project costs (excluding dredging and transportation) for the majority of the Land Remediation projects including treatment and transport to the site will be $29/CY.

D. Quarry Reclamation

Quarries are open excavations for extracting aggregate, limestone, slate, or similar materials. Benefits of Quarry reclamation include habitat restoration and economic development opportunities. The Upland Confined Disposal Siting Study (Dames & Moore, 1996) identified six potential quarry sites in the region, all located along the Hudson River waterfront in upstate New York. Preliminary estimates indicate that the total potential capacity exceeds 17

MCY. Currently, there is a lack of local sponsorship or support for the use of amended dredged material at these sites. In NJ Hunterdon Quarry has been identified as a possible placement site for clean, sandy dredged material with a capacity of 30 MCY at a total placement cost of $7/CY. This cost is largely associated with the washing of the dredged material to remove any salt prior to placement at the quarry. This beneficial use of dredged material would restore contours at this quarry, thereby eliminating safety hazards associated with the cut face of the quarry.

E. Abandoned Coal Mine Reclamation

Using dredged material to reclaim abandoned coal mines offers the potential of vast disposal volume. Both strip mines and deep mines can benefit from the placement of dredged material. Thousands of abandoned mines dot the eastern U.S. in relative proximity to the Port of NY/NJ, many with capacities in excess of 100 MCY each. These abandoned mine sites cause a variety of serious environmental problems, including land subsidence, underground mine fires, dangerous high-walls, and most significantly, acid mine drainage (AMD). AMD is the major cause of water pollution in every Appalachian coal-mining state, and impacts over 3,000 miles of Pennsylvania's rivers and streams alone.

The Pennsylvania Department of Environmental Protection, in coordination with the BI-State NY/NJ Clean Ocean And Shore Trust (COAST), permitted a demonstration project in June 1997 for using treated, non-HARS dredged material for abandoned coal mine reclamation. The mine site chosen for the demonstration project is the Bark Camp Mine Reclamation Laboratory located in Houston Township in Clearfield County, PA. In 1998, NJMR contracted with CTI of Blue Bell, PA to dredge, transport and place 20,000 CY of amended dredged material from the Perth Amboy Municipal Marina at the demonstration site. An additional 480,000 CY of material from the Harbor is expected to be placed by summer of 2000. Water run-off and well samples from the Bark Camp test site after placement of the initial 20,000 cubic yards of material have shown no difference in contaminant levels from background levels tested prior to placement. Using established leachate procedures, all contaminants passed the state standards, with most contaminants below the detection limit. Based on these preliminary results the use of dredged material for acid mine reclamation appears promising.

The Bark Camp demonstration uses an S/S process involving coal ash and lime as binding agents to dry and harden the dredged material. Coal ash is a highly alkaline mineral residue from the burning of coal, with Pennsylvania and New Jersey producing more than 10 million tons annually. If this demonstration proves environmentally sound and cost-effective, it would provide a beneficial use of dredged material and coal ash to remediate a major environmental problem. Upon successful completion of the Bark Camp demonstration project, the Commonwealth of Pennsylvania may issue a Statewide or Regional Permit, which would allow the beneficial use of dredged material at other mines. To date, project costs have ranged from $42 - $86/CY, following successful completion of the demonstration project and issuance of a general permit cost are expected to be $26-29/CY.

The Lehigh Anthracite Mine, in Pennsylvania has been identified as a possible site, due to its favorable location in eastern Pennsylvania with a capacity of 20 MCY. The cost of this option is projected to be about at $29/CY. However, economies of scale through reduced railroad transport and the contribution of mine reclamation funding, along with a contribution from funds for use of fly ash, lime, and cement kiln (which also constitute waste streams that require management) to offset costs, may result in a net cost to the Port of $20-26/CY for this application.

Using dredged material for mine reclamation is not unprecedented. Back in 1978, for example, contaminated dredged material from the Calumet River was used to restore an acid coal mine tailing area at Ottawa, Illinois (WES, 1998).

POTENTIAL IMPACTS

Land-remediation projects, by definition, take place only in degraded lands with low natural resource value. Many of these sites have been abandoned with the subsequent return of limited vegetation and wildlife species. Species present are typically those most adaptable to human activity and disturbed habitat. Impacts associated with a site that has revegetated would be the loss of habitat at the facility footprint. These impacts are not expected to be significant, however, since these sites rarely have the return of substantial species diversity without active management.

Wastewater from any de-watering process would be either discharged to a sewage treatment plant or discharged directly to surface water. This effluent could impact the water column of the receiving water body by causing increased turbidity, salinity, and/or inflow of small amounts of contaminants. Procedures imposed by the presiding state's permitting process would reduce the risk.

Direct impacts on aquatic resources are not anticipated, but indirect impacts could be associated with spillage and surface runoff to waterways. Reasonable, prudent measures would be used to prevent spillage and surface runoff.

There's also a concern of the dispersal of contaminants from the processed dredged material, especially leaching of contaminants due to percolation and stormwater runoff. Once placement of dredged material is completed, an additional layer of clean material would typically be placed on top, thus reducing long-term impacts.

Upland animals are highly unlikely to be directly impacted by the use of a developed site. If the site were to be used as habitat, the site would be capped with clean cover. As for endangered species, the potential threat would be minimal because it is most likely that any site chosen would be disturbed as a result of the past/present activities of humans. Coordination on a case by case basis with federal and state resources agencies would be conducted for this option.

Air quality impacts would be largely due to transport of contaminants associated with particulate emission and volatilization from staging and placement sites. NJMR is funding a research project to assess the volatility of contaminants from processing sites. With respect to specific volatilization of PCBs and dioxins, it is unclear how laboratory experiments translate to large-scale dredging and materials-handling operations. If any, these impacts would be minimized by proper handling and management techniques during operation. Long-term impacts would be minimized by capping the dredged material with clean material.

There's potential human exposure to contaminants in dredged material, particularly to workers involved in the handling the material. NJMR is currently conducting a study on the risk of exposure to contaminants resulting from working with dredged materials in an upland setting. Should this option be selected for the long-term DMMP, a risk assessment would be conducted for human health as well as the environment.

The potential for cultural resources on landfill sites is low due to disturbance associated with the construction and operation of landfill structures. Brownfields, quarries, and abandoned mines, however, may have cultural resources associated with them if there were any historic operations.

<u>IMPLEMENTATION</u>

The private sector has taken the lead in implementing land-remediation projects in this region using processed dredged material. Projects are summarized in Table 2-2. Taken together, the private sector has processed more than 1.5 MCY of dredged material by end of 1998 for beneficial use in regional land remediation projects.

The NYD will continue to support ongoing efforts, maintain coordination with the lead agencies and private firms proposing such uses, and facilitate the beneficial use of dredged material. NYD will provide assistance in locating and evaluating suitable sites requiring remediation, and provide technical support in handling, transport, placement, and monitoring at a given site.

<u>A. Rehandling / Processing Facilities</u>
For the land-remediation options in general, the development of a regional bi-State rehandling facility for low-end processing and shipment of amended dredged material could help ensure continued full-scale use of this option. Such a facility could accept material from many dredging sites throughout the Harbor and export processed material to various remediation sites as needed. The NYD will continue working with the States of New York and New Jersey in siting and developing a rehandling facility that would accept material from both states. Toward this end, the NYD is developing a conceptual design of a generic dredged material rehandling facility (LMS, draft 1998). This will complement a previous report (A.D. Little, 1998) on a conceptual design of a 0.5 MCY/year treatment facility. The rehandling-facility design will address the following: 1) regulatory review, 2) site selection, 3) engineering design criteria, 4) environmental enhancement and beneficial use elements, 5) alternative layouts, 6)

facility management and operation, 7) construction methods, schedule, and costs, and 8) a summary and analysis of alternatives.

The NJMR is proposing a state-owned, privately operated facility capable of processing 0.5 MCY per year. The facility will be designed to accept a variety of additives, and volumes of additives, to create the desired material types. The processing facility is proposed to be operational in 2002. NJMR estimates handling costs of $12/CY, processing costs of $12-17/CY, and sale of the manufactured-soil product at $8-11/CY.

Currently there are six independent dredged material processing facilities permitted in New Jersey. They are: SK Services (operational), Construction and Marine Equipment Corporation (operational), Consolidated Technologies (permitted), OENJ (permitted), S & W Waste (permitted), South Harbor Improvement Processing facility (pending NJPDES permits). The OENJ and SK Services processing facilities are tied to their respective land remediation projects, (OENJ Bayonne and Koppers). Conceivably, material processed by these facilities could go to other beneficial use projects, but new Acceptable Use Determinations would be required. The processing capacity of these facilities is estimated at between 1 and 1.5 MCY/YR each. Both the Consolidated Technologies (CTI) facility and the South Harbor Improvements Processing facility (SHIP) in South Amboy, NJ have received Acceptable Use Determinations from the NJDEP to blend and use dredged material for a variety of beneficial uses ranging from landfill cover to structural fill or topsoil, provided that the blended material meets predetermined characteristics. SHIP is a private handling facility designed to process 0.4 MCY/YR of dredged material. The CTI facility is designed to process from 1 to 1.5 MCY / YR. Both facilities have applied for NJ Pollutant Discharge Elimination System Permits and should be available for use by 2002 at an estimated $29/CY. The NJPDES permits will eliminate the need to transport decant water back to the dredging site, which will increase the cost effectiveness of these facilities.

The NJMR, the PANY/NJ and the NYD are currently negotiating a project called the NJDIG. In the NJDIG project the NJMR would act as a broker of dredged material, agreeing to accept dredged material at a negotiated price. The NJMR would then steer dredged material to various land remediation options depending on the existing need. Benefits of this arrangement will include the ability to guarantee private enterprises a sufficient volume of dredged material to allow them to efficiently scale the processing facilities and ensure that multiple technologies are able to remain feasible during their initial development. In addition, the dredging would be given the assurance that processing and placement are able to meet dredging project schedules at a predetermined price.

B. Cost Estimates

As in all options that have passed the environmentally acceptable criterion, price is the overriding factor on whether this option will be widely implemented in this region. Development of costs for land remediation include capital, operating, environmental protection, and transportation costs for both the processing/rehandling facility and the placement site. Costs are site-specific and depend on the location, capacity, method of transportation, site preparation, types of equipment used, site topography, prevailing labor wage rates, and land costs. Transport costs, in particular, should be given close attention because it can account for a disproportionately large share of the costs. For recent activities (including dredging, processing, transport, and placement) taking place at the Jersey Gardens Mall Site and the Seaboard Site, costs were running $40-50/CY. The NJMR estimates current processing facility costs of $12/CY for handling, a processing cost of $12-17/CY, and sale of the manufactured-soil product at $8-11/CY.

Other economic concerns include the USACE policy of selecting the lowest-cost disposal options with little regard for the possibilities of beneficial use (33 CFR Section 335.4); and disputes over whether the incremental expense of beneficial use should be borne by the project sponsor or the beneficiary of the restored site. The benefits of beneficial use often accrue to third parties, whereas the added expense is generally borne by the project sponsor, which is typically the federal or state government (NRC, 1997).

C. Timeline

Major activities leading to startup of a land remediation project include identification of a suitable processing/rehandling site and placement site (these could be one and the same site), public & political acceptance, site investigations, NEPA documentation, site-usage agreement, permitting, design, site preparation, and construction. The permitting process may vary from nine months to several years, depending on the nature of the project. Contracting engineering studies, conducting the studies, and preparing the required documentation could take an additional year. Use of an owner-sponsored site may facilitate the early developmental stages of the project, but not shorten design and permit needs nor necessarily allay public opposition.

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B-4 DECONTAMINATION

DESCRIPTION

Decontamination technologies reduce the harmful effects of contaminated dredged material by destroying contaminants; separating and removing contaminants from sediments; and/or immobilizing contaminants to minimize release to the environment. The objective is to have the treated material meet established environmental criteria for a designated beneficial use. Technologies could involve physical, chemical, thermal, biological processes or any combination thereof. Material undergoing treatment would have less restricted and more varied beneficial uses than untreated material. Depending on the process used, some end products have measurable market value to help offset processing costs.

For the Port of New York and New Jersey, the formidable challenge posed for this management approach is to process, in a environmentally protective and cost-effective manner, relatively large volumes of contaminated dredged material with high fine-grained fractions, estuarine salinity, and high water content. Most of these sediments contain a wide range of organic and inorganic contaminants at low concentrations relative to those typically found on state and federally regulated hazardous waste sites. However, it should be noted that several sediment “hot spots” exist in areas outside navigational channels with significantly higher contaminant levels. These hot spots could also serve as potential candidates for treatment through an environmental dredging program.

To be used beneficially, the treated material must meet applicable state and federal environmental and health & safety guidelines. Processed material must also meet the material and engineering specifications for its proposed end-use. Since the states, and not the federal government, have jurisdiction of upland management of dredged material, the presiding state determines the end-use testing criteria and issues the acceptable/beneficial-use determination for the end product of any treatment process. The NJDEP has a guidance manual entitled “The Management and Regulation of Dredging Activities and Dredged Material in New Jersey Tidal Waters” (NJDEP, 1997). The NYSDEC is in the process of finalizing its guidance manual. The acceptability, and therefore the success, of treated dredged material will be based on the ability of a given process to meet these standards at an affordable price.

Section 405 of the Water Resources Development Act (WRDA) of 1992 and Section 226 of WRDA of 1996 authorized the USEPA and the USACE to jointly conduct an investigation and demonstration of decontamination and treatment technologies applied to contaminated dredged material from NY/NJ Harbor. USEPA-Region 2 leads this effort in cooperation with the NYD. The U.S. Department of Energy Brookhaven National Laboratory, USACE Waterways Experiment Station (WES) and Rensselaer Polytechnic Institute (RPI) provide technical program support. Several previous investigations have been conducted for this region (Tetra Tech, 1994; Malcolm Pirnie, 1995) and in the Great Lakes region (USEPA-ARCS Program, 1994b; Environment Canada, 1996).

TECHNIQUES

Decontamination technologies range from “low-end” to “high-end” processes in terms of relative complexity, energy consumption, and cost. The low-end processes include dewatering, physical separation, solidification/stabilization (S/S), and untreated manufactured-soil production. These methods involve minimal handling and processing and are relatively inexpensive. However, other costs, especially those associated with materials handling and site acquisition, could add substantially to total costs. S/S has already found full-scale application in the region, with land and/or brownfield remediation as the primary beneficial use. It is addressed as a separate DMMP option (see Sections 2.3.3 and B.3.3).

The high-end processes are those technologies that destroy or remove contaminants in dredged material at a processing facility. Those that have been evaluated include sediment washing, solvent extraction, thermal desorption, and thermal destruction. In comparison to low-end processes high-end processes typically require greater handling, more unit operations, and/or high operating pressures and temperatures (requiring increased energy consumption). In addition, these processes may generate multiple waste streams (*e.g.*, wastewaters, stack emissions, waste oils, solid residues) that must then undergo separate treatment and/or disposal. However, high-end processes have the potential to produce end products with a higher market value (such as clean topsoil or blended cement), thus generating a revenue stream to help offset the higher processing costs.

Under the USEPA/NYD demonstration project, laboratory testing (5-10 gallons each) of ten technologies was completed by 1996, and pilot-scale testing (2-22 CY each) on five of these technologies was completed by 1997. The federal agencies have also worked with other technology firms, supplying them with sediment for process testing and helping them evaluate their processes. The next step in achieving full potential of these technologies is implementing a commercial-scale demonstration. These demonstrations are needed to improve cost estimates, resolve engineering scale-up challenges and "fine tune" and optimize treatment effectiveness. The key objective is to demonstrate the economic feasibility of processing large volumes (at least 0.5 MCY per year) on a long-term, self-sustaining basis (WRDA, 1996).

Two processes were selected for commercial-scale demonstrations:

BioGenesis, Inc will demonstrate a sediment-washing process that uses water jets and a proprietary mix of surfactants and chelating agents to strip organic and metal contaminants from dredged material. The end product is a clean manufactured soil material for fill, cover or topsoil applications. In March 1999, Biogenesis completed a 700 CY, 10 CY/hr. demonstration and is in the process of fabricating and siting a 250,000 CY/YR facility.

Institute of Gas Technology (IGT) will demonstrate a 30,0000 CY/YR thermochemical decontamination process (IGT, 1997a & b). in the winter of 1999 using 500 CY of dredged material from upper Newark Bay/Lower Passaic River. With minimal alterations this equipment is scalable to a 100,000 CY/YR facility. The process uses a rotary kiln to produce a pozzolanic material, which is then mixed with Portland cement to yield a construction grade cement end product. This would be marketed to the construction industries as a substitute to regular Portland cement. IGT has sited their demonstration facility at the Koppers Coke site in Kearny, NJ.

In addition, a third commercial-scale demonstration is being considered pending sufficient funding. This would be a demonstration led by WES of untreated dredged material for manufactured-topsoil production (Section B.3.3). WES has been working with several private firms and with the NJ Hackensack Meadowlands Development Commission (HMDC) in developing the demonstration project and arranging for suitable sites (WES proposal, 1998).

The NJMR issued a Request for Proposals (RFP) in March 1998 for pilot-scale testing and commercial-scale demonstration of sediment-decontamination technologies (excluding S/S) (NJMR, 1998). Those processes meeting project-specific requirements in pilot testing will be recommended for further funding for large-scale demonstration (30,000-150,000 CY). Pilot testing will be conducted in late1999. The NJMR's goal is to assess the feasibility of long-term decontamination for Harbor dredged material at full-scale costs of $29/CY or less (exclusive of dredging and transport to the processing facility).

NJMR has selected the following five technologies to conduct pilot testing and large-scale demonstration projects.

- BEM Systems of Florham Park, NJ will demonstrate the use of enhanced mineralization (Georemediation™) to decontaminate NJ Harbor sediments. A catalyzing reagent is mixed into the raw dredged material and allowed to react for at least 28 days in open holding/curing basins. Bench scale tests indicate that organic contaminants are reduced and metals are integrated into the crystalline mineral matrix of the sediment. BEM proposes that the decontaminated sediment can be used to make a manufactured soil product that is suitable for use as non-structural fill in roadway construction, brownfields remediation, or as landfill cover. BEM will conduct a 200-400 gallon pilot scale project in the fall of 1999.

- JCI/Upcycle is a joint venture between Jay Cashman, Inc. of Boston, MA and Upcycle Aggregates of New Providence, NJ. JCI/Upcycle will decontaminate harbor sediments using an existing rotary kiln at the Norlite facility in Cohoes, NY to thermally destroy organic contaminants and fix metals in the mineral matrix. The resulting decontaminated sediment would then be used as feedstock for the manufacture of lightweight aggregate at the same facility. Lightweight aggregate is used in construction throughout the NY/NJ

Metropolitan region and is in high demand (approximately 0.9 MCY/YR in the northeast). Bench scale tests performed to date indicate that the resulting product exceeds ASTM standards for lightweight aggregate. JCI/Upcycle is scheduled to process 2000 CY from Stratus Petroleum in a pilot project during the fall of 1999. Pending positive results of the pilot, negotiations will commence on a demonstration project at Eastchester Creek in Pelham, NY. Funding for the 50,000CY demonstration will be secured from some or all of the following agencies: NJMR, NYD, USEPA and Empire State Development Corporation.

- WEB Consortium is a consortium of three firms: Roy F. Weston Inc. of West Chester, PA, SK Services of Kearny, NJ and Biogenesis Enterprises of Oak Creek, WI. The Biogenesis sediment washing process utilizes high-energy scrubbing and chemical additives and catalysts to isolate the contaminants from the sediment particles (see above). Resulting wastewater is treated to remove remaining contaminants and the clean sediment is used as a base for a manufactured soil product. WEB proposes that the manufactured soil is suitable for use as topsoil, construction material, landfill cover, and in brownfields remediation. Bench and pilot scale tests performed under the WRDA program indicate the removal efficiencies for moderate to highly contaminated sediments are noteworthy. WEB is a finalist in the WRDA decontamination program and was awarded a 700 CY pilot that was completed during the spring of 1999. NJMR has also awarded the WEB Consortium a 30-50,000 CY demonstration project that is scheduled to begin in the spring of 2000 with material from northern Newark Bay. In addition, the WEB Consortium will be working closely with NJDEP, USEPA, NYD and NJMR on the decontamination of material dredged from the Passaic River during the construction of Minish Park beginning in the fall of 1999.

- NUI Environmental of Union, NJ proposes to utilize Big Blue ™ sediment washing technology to decontaminate harbor sediments. The Big Blue ™ process is a high-energy scrubbing and chemically enhanced organic degradation and waste separation process similar to the BioGenesis system. The intended product is a manufactured soil that could be used as fill material or brownfield or landfill cover. The Big Blue™ process has been shown effective on PAH contaminated sandy sediments, but has not yet been shown to be effective on fine grained sediments contaminated with a complex mixture of pollutants similar to those found in NJ Harbor sediments. NJMR is currently negotiating a contract with NUI Environmental to perform a pilot test of this technology using material from northern Newark Bay. The 200-400 gallon project is expected to begin in the fall of 1999.

- IGT/Endesco is a not-for-profit joint venture between the Institute of Gas Technology and Endesco Services of Des Plaines, IL. Their process has undergone bench and pilot scale testing in the WRDA Sediment Decontamination program (see above) and is moving forward toward commercial scale operation. NJMR is currently negotiating a contract with IGT/Endesco to perform a 50 CY pilot test of material from northern Newark Bay in cooperation with NYD and USEPA beginning during the winter of 1999/2000.

The PANY/NJ is conducting its own sediment-treatment demonstration projects. The PANY/NJ began its Matrix Evaluation Project in 1997. Four technology firms have conducted treatability studies of their processes. End products are either lightweight aggregate or flowable fill. The objective is to evaluate whether the selected processes can economically produce construction material from Harbor dredged material that meets ASTM and other applicable standards without any significant adverse environmental impacts. Treatability studies identified three companies: JCI/Upcycle (See above), Plasmarc and Riefill with end products meeting or exceeding the standards for use in PANY/NJ construction projects.

<u>POTENTIAL IMPACTS</u>

Siting of any decontamination facility would likely be at previously developed sites, including former or current industrial facilities. These sites currently have little natural-resource value. Some potential sites may have been abandoned, with the return of some vegetation and wildlife. The species present are typically those most adaptable to human activity and disturbed habitat. Impacts associated with a site that has re-vegetated would be the loss of habitat at the facility footprint. These impacts are not expected to be significant, however, since these sites rarely have the return of substantial species diversity without active management.

Wastewater effluent from any de-watering or some other unit operation would either be discharged to a sewage treatment plant or discharged directly to surface water. This effluent could impact the water column of the receiving water body by causing increased turbidity, salinity, and/or inflow of small amounts of contaminants. Procedures imposed by the individual state's permitting process would evaluate the risk to the receiving water body. Direct impacts on aquatic resources are not anticipated, but indirect impacts could be associated with spillage and surface runoff to waterways. Reasonable and prudent measures would be used to prevent spillage and surface runoff.

Upland animals are highly unlikely to be directly impacted by the use of a developed site. As for endangered species, the potential threat would be minimal because any site chosen would be already disturbed as a result of the past/present activities. Coordination on a site-by-site basis with federal and state resources agencies would be conducted for this option.

Under the WRDA and NJMR demonstrations air quality data will be collected to determine the potential for impacts. The initial data will be used in a qualitative assessment of air quality impacts and will aid in the design of more effective future controls. Air quality impacts largely depend on whether a thermal or non-thermal process is selected. For a non-thermal process, impacts would be associated with particulate emission and volatilization of contaminants from staging and processing areas. NJMR is funding a research project to assess the volatility of contaminants from processing sites (See Section B.3.3). With respect to specific volatilization of PCBs and dioxins, it is unclear how laboratory experiments translate to large-scale dredging and materials handling operations. These impacts would be minimized by proper dredged material handling, operational controls and management. The air quality impacts from thermal processes are of greater concern. Thermal facility require air permits from the presiding state and employ advanced air-pollution control equipment typically associated with hazardous waste handling facilities.

Apart from air-quality impacts, any health risk would largely be due to handling of the pretreated dredged material by facility workers. NJMR is currently conducting a study on the risk of exposure to contaminants resulting from working with dredged materials in an upland setting. There is the potential to encounter cultural resources at new or historic facilities. Cultural resource surveys will be programmed when proposed locations are defined.

IMPLEMENTATION

Low-end solidification/stabilization (S/S) processes (in conjunction with land remediation as the beneficial use) have already found commercial application in the region. (Sections 2.33 and B.3.3). Some of the commercial-scale demonstrations of treatment processes (other than S/S) will be initiated in the fall of 1999. These demonstrations will allow direct comparison of the decontamination technologies and the other management options. The role decontamination technologies will play in the long-term dredged material solution will depend on several factors. The key factor is assessing the benefit to the ecological and human health of the region. Towards this end, assuming project reauthorization and congressional appropriations, USEPA/USACE will perform a human-health and ecological risk assessment for any technology seriously considered for full-scale operation. The complete treatment train will be taken into account, from off-loading to final disposition of end products and waste streams.

A Cost Estimates

In the U.S. and around the world, treatment technologies (beyond S/S and other low-end processes) have not been widely applied in full-scale projects for soil or sediments, so reliable cost estimates are difficult to obtain at this time. Historical cost data on the pretreatment and treatment components are also very limited, and in some cases, the only data available are projections made by technology firms based on bench-scale and pilot-scale testing.

Cost elements include site acquisition, site preparation, permitting and regulatory requirements, capital equipment, start-up and shakedown, labor, disposal, transport of treated sediments, monitoring and analyses, maintenance and repair, contingency costs and cost recovery through sale of end products. Some of these costs are still uncertain at this time but it is expected that technological advances and economics will select the most effective and efficient processes as they scale-up to full scale processing. It is expected that Decontamination will be utilized on up to 1 MCY/YR. of material by 2004 and the cost will have been reduced from the current cost of approximately $54 to a competitive $29/CY.

High-end decontamination may remain slightly more expensive than some of the other options discussed. This may limit its application to the more contaminated dredged material in the Harbor. Possible sources of material would be the most contaminated portions of the navigation channels along Hackensack River, Arthur Kill, Kill van Kull, and Newark Bay. These may be possible candidates for subsidized treatment if upcoming studies show that the incremental expense (an estimated $6/CY) of full-scale decontamination is justified through the environmental and public health benefits to the region. Congress has recognized that there may be a need to specially manage, through removal of material, areas where contamination levels are very high. Sediment "hot spots" refer to these underwater areas and mud flats lying outside active federal navigation channels that act as sinks of more contaminated sediment that spread or could spread contaminant plumes to cleaner parts of the Harbor, including the channels. Section 312 of WRDA 1990, as amended by Section 205 of WRDA 1996 authorized USACE to conduct "environmental dredging" for the purpose of remediating these areas. However, to date the USACE has not used this authority anywhere in the nation. The siting of a reasonable cost, large volume, decontamination facility in the region may help bring this authorization closer to fruition.

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B-5 CONTAINED AQUATIC DISPOSAL PITS

DESCRIPTION

Contained aquatic disposal (CAD) pits are subaqueous depressions excavated into the bottom of a bay or other body of water (including channels and berthing areas). Dredged material is then placed into this CAD pit and covered by natural sedimentation, or it could be capped with a layer of clean sediment to isolate it from the overlying water and from organisms living in both the water column and the upper portion of adjacent sediments. If capped, the cap can be placed over the disposed material so that it extends above the natural bottom (forming a mound), be level, elevation-wise with the bottom, or be below natural bottom depth (leaving a shallow pit). The need to isolate the dredged material and the method of cap placement would depend on the chemical and physical character of the covered sediments. Factors in choosing cap type include the source of the dredged material, its proximity to the pit location, and the anticipated value of the topographic relief (to fish, shellfish, etc.) in and adjacent to the pit site.

TECHNIQUES

Three basic variations on subaqueous pits have been evaluated. Their capacities and costs are summarized in Table B-5-1. Each variation is described in greater detail below:

EXISTING PITS: A number of existing pits of varying depths and sizes are located within the harbor area. These pits, a secondary result of the excavations for sand earmarked for beach nourishment projects and construction fill, were identified in a Final Supplemental Environmental Impact Statement (FSEIS) on the Use of Subaqueous Borrow Pits for the Disposal of Dredged Materials from the Port of New York – New Jersey (NYD, 1991). The FSEIS recommended the use of four of the larger pits in Lower New York Bay (Figure B-5-1) as the preferred alternative for containing contaminated dredged material.

In 1992, based on the FSEIS findings, the NYD applied for a Water Quality Certification (WQC) from the NYSDEC to use the East Bank pit to dispose of an estimated 4 MCY of category II and III material (unsuitable for unrestricted ocean disposal). Under the current plan, the East Bank Pit alternatives are each considered option 5 preferences. At that time in 1992, approval of the WQC would have meant that the option could have been implemented and thus would have met ten years of maintenance dredging needs. Revised (1992) testing protocols drastically increased the volume of material considered unsuitable for ocean disposal. All four existing pits could have easily handled the new volume, a potential capacity of approximately 22.9 MCY. Though unable to provide for the currently projected long-term needs of the Port, these four existing pits could provide short-term capacity to augment current options that are unable to meet all the short-term needs. Since the pits already exist and are closer to most channels than the HARS, costs for the use of this option, beyond actual dredging and transport, would be minimal. Ancillary costs associated with their use could include some interior partitioning or other revisions to maximize safe use of the pit, as well as a pre-, interim and post-placement monitoring program. Each pit could be available for use in a short time frame, provided a WQC were issued. To date NYSDEC has not issued a WQC for the use of any of the four pits. The agency had withheld granting the permit to the New York District until issues pertaining to contaminant losses during disposal are adequately addressed. The current position of the agency has not changed.

NEW PITS: The New York Bight Restoration Group (1984), a sub-committee of the Public Information and Coordination Group (PICG), proposed creating new pits specifically for containment of dredged material, as an alternative to using the existing pits. The group recommended four sites, two of which were in the Lower Bay. The other two sites were in the ocean and thereby ruled out as disposal sites under the criteria of the Marine Protection and Sanctuaries Act. Using a more extensive and updated database, a Geographic Informational System (GIS) analysis applied environmental, engineering and other siting criteria and weighing factors to the data to identify suitable areas for new pits (Palermo *et al*, draft 1998a). A great deal of new information went into this siting analysis, including an extensive survey of the benthic community and surficial sediments (Wilber *et al*, 1998), modeling of currents, waves and erosion (Chou *et al*, draft 1998), and bathymetric, side-scan and sediment profiling (USDOI/USGS, 1999 unpublished).

Two zones of siting feasibility (Figure A-5-1), one in Raritan Bay and another in Lower New York Bay resulted from the initial GIS analysis. Each zone is large enough for many small pits. Each pit, in turn, can be excavated to fill the coming years projected volume of maintenance and (when applicable) new work dredged material deemed unsuitable for use at the HARS (a total annual volume ranging from 1.5-6 MCY). This strategy would create over time a series of pits within a zone. Contaminated surface material from the digging of the first pit would be disposed in an approved facility or treated to render its contaminants harmless. Clean material from the construction of the remainder of the first pit would be used beneficially to remediate the HARS or other degraded habitats, or to nourish area beaches depending upon its grain size and engineering suitability. Unsuitable material from maintenance and/or new work dredging would then be placed into the pit along with any contaminated surface material excavated to construct the next pit in the sequence. The first pit would then be capped with some of the clean material removed in constructing the next pit, with any remaining clean material being used beneficially.

The capacity for containing dredged material in both zones, a total of 7,000 acres, has yet to be determined. However, preliminary estimates indicate that only one of these zones would have to be used to create pits that would far exceed the total projected volumes of material unsuitable for HARS remediation. Additional modeling and new biological data suggest that use of Zone 1 (Raritan Bay) may have a greater long-term potential for effecting shoreline erosion and water quality than pits in Zone 2 (Lower Bay). Although Zone 2, in the Lower Bay, on the other hand represents habitat of lower value and would now appear to be the better location for new pits, the potential for short-term impacts to the Bay still exist for this option.

To create each pit requires the excavation of a volume of material equal to or greater by 25 % than the intended capacity of the pit. With only a small amount of the excavated material needed to be used to cap the preceding pit, an estimated 48 – 80 MCY of clean, excavated material could be available for beneficial uses. This total volume of clean material is well above the projected volume needed to remediate the HARS (40.6 MCY), providing an enormous surplus of material that could be put to use remediating other degraded areas.

In addition to safely containing the dredged material, and returning the area to its previous condition (with no long-term loss of habitat or benthic communities), these new pits, if excavated in areas likely to have contaminated sediments (like Zone 1) would also serve to remediate those areas, by replacing the contaminated surface sediments with a clean sediment cap.

One of the major points brought out in the course of public agency review of previous DMMP documents was the desire to locate aquatic options within the same basin as the dredged material is excavated from. In the unlikely event that contaminants are lost during disposal they would, for the most part, be confined to the same waterbody they were already impacting before they were dredged. To meet this added protective measure, a number of smaller sites for pits were identified in the inner harbor (Upper New York Bay and Newark Bay). Using a list of potential sites developed by the DMMIWG, the NYD screened each site through a series of evaluation criteria; benthic data (Wilber *et al*, 1998), subsurface sediment cores, bedrock, contaminant levels and other pertinent statistics (NY/NJ Harbor Partnership, draft 1998) to arrive at several potential areas for new pits (Figure B-5-1). As with the scenario proposed for the Lower Bay pits, these inner harbor pits would both provide a contained disposal site for unsuitable dredged material, as well as the contaminated surface sediments from the pits dug to hold the subsequent year's material. By restricting both the Lower Bay and inner harbor pits to material taken from the same geochemical/geological or lithological stratum/formation/ litho-stratigraphy in which the pits are located, concerns regarding the spreading of contaminants from one part of the Port to another would be successfully addressed.

Preliminary analysis of new pits in the upper harbor indicates that the smaller area of bottom present in the upper harbor, limits the location to those areas of the inner harbor that have been identified and their overall capacity to 17.5 MCY. The depth to bedrock and the greater possibility of encountering heavy contamination at depth (as occurred in Newark Bay) is also a factor, which would limit the locations. However, new pits could be used in conjunction with Lower Bay pits either to provide supplemental capacity or to separate disposal options by sub-basin or waterway.

IN-CHANNEL PITS: New pits could also be excavated within the confines of a channel or berthing area below it's authorized depth. This option would minimize the impact to undisturbed areas and the introduction of contaminated sediments to areas outside the channel being dredged. It could also optimize dredging operations and lessen costs by reducing the transport distances of dredged material. However, if the channel bottom were already close to the underlying bedrock, the capacity could be less, and future deepening of the channels may be more costly if the disposed sediment had to be re-excavated. Potential impacts from resuspending the same sediment twice would also be a potential concern.

An analysis of areas where this option might be most suitable (NY/NJ Harbor Partnership, draft 1998) identified the Port Newark/ Elizabeth Pierhead channel, Wards Point Bend/Raritan Bay channel, Bay Ridge/Red Hook channel and the Port Jersey channel as potentially feasible for creation of in-channel pits (Figure B-5-1). Preliminary screening resulted in removing both the Wards Point Bend and the Hudson River Channel because the pits would be located primarily within the anchorage areas and could be adversely effected by ship anchors. Within the remaining three areas, there is an estimated capacity for an additional 14.5 MCY of unsuitable material, after taking into consideration the volume of potentially contaminated surface material that would have to be disposed of in creating the pits and the volume used up to cap each pit with HARS suitable materials. A similar volume of clean sediment, capable of being put to a beneficial use, would also be produced in excavating the new pits.

Due to the short transport distances, in-channel pits are especially attractive for material that comes from the channel in which the pit was excavated. Another cost saving component worth considering is eliminating the need for capping. One of the principal purposes of a cap is to isolate the contaminated material from the benthic community that would reestablish in the area when the pit was filled. However, the channel would continue to be disturbed by shipping, minimizing its potential to be repopulated. Rather than fill the pit, a depression could be left to allow natural sedimentation to fill in the pit over time. Further, since it is no longer critical to isolate the material quickly, it would be retained within a depositional environment below the depths at which ship movement could resuspend it. Besides saving the cost of obtaining and placing the cap, the depression would likely serve as a detention basin in which sediment would accumulate below the authorized channel depth, thus reducing the frequency for maintenance dredging. Consolidation of the deposit would further increase the depression, allowing for even more material to be deposited overtime before maintenance is needed. Modeling using field verified data would be used to help predicate the depth to which such a pit could be filled and left uncapped without loss of material.

In Boston Harbor, a similar approach to the dredging and disposal of contaminated sediments using sub-channel placement in CAD cells was undertaken. The Boston Harbor Navigation Improvement Project (BHNIP) encompassed the deepening of three tributary channels (Reserved Channel, Mystic River Channel and Chelsea Creek Channel) and two areas in the Main Ship Channel (Inner Confluence and the mouth of the Reserved Channel) (Figure B-5-2). In addition, the project involved six berth areas and one intake structure (Boston Army, Boston Edison Intake, Boston Edison Barge, Conley 14-15, Revere Sugar, Mystic Piers 1, 2, 49, and 50) (FEIS/R; NAE and Massport 1995). The project is currently being managed jointly by the U.S. Army Corps of Engineers, New England District and the Massachusetts Port Authority.

The designed maximum project depth for all of the proposed channels was –40 Mean Low Water (MLW), except for the Chelsea Channel, which was –38 MLW. The total dredged material volume that was proposed for removal for the full project (including channels, beneficiary berths, other berths and related areas) was estimated at 3.5 MCY (including over dredge (0.5 feet) and bulking factor (20%)). An additional 1.8 million yd^3 of the underlying parent material, composed primarily of Boston Blue Clay, was also proposed to be removed in order to provide for in-channel disposal (FEIS/R, NAE and Massport 1995). A total of 54 CAD cells were initially proposed in the FEIS/R, however, the final implemented plan consisted of less. As a result of continued natural deposition from the time the project was initially proposed until the time the final pits were selected, a span of 3-5 years, the final proposed volume of the project increased.

Phase 1 of the BHNIP, consisting of a single project and CAD cell was conducted in the summer of 1997. Based on modeling that predicted minimal loss of material during placement, no monitoring of disposal events were required. Most of the concern of the local agencies centered on successfully capping the material initially placed into the pit.

The results from the Phase I project indicated that most of the placed material was not uniformly covered with the sand cap. Although consolidation of the dredged material and the cap was continuing, attempts to modify the deficiency, after the fact, proved to complicate matters by further mixing the sand and fine-grained dredged material. It is thought that much of the problem was a result of capping the site before the fine-grained dredged material had completely settled (i.e., consolidated). The requirement for capping to begin within two weeks (10-14 days) of the last placement of material in the pit was a permit condition intended to minimize the time that the benthic aquatic community might be exposed to the material placed into the pit. Unfortunately, this may not have provided sufficient time for the material to consolidate enough to support the density of cap. It is also thought the use of a poorly controlled split-hull barge for cap placement may have added to the problem.

Chronic problems were addressed in Phase 2, which was undertaken one year later in the summer of 1998, with new operational and monitoring procedures designed to improve placement of the material, as well as increase the ability to diffuse the sand while capping. Consequently, the Phase 2 results reflect these changes in the form of greater control over the placement of sand, specialized measurements designed to identify cap thickness, etc. In addition, the Water Quality Certificate (WQC) issued by the State of Massachusetts and the dredging project specifications governing the construction and monitoring of the individual cells, were also modified after the results of Phase 1. Recommendations to modify the requirements for dredging and disposal operations were designed around the primary concerns raised by the dataset, including lack of spatial coverage of sand, variable thickness of sand, and potential mixing between sand and dredged material (ENSR 1997b; Murray 1997). Data from the hopper dredge and the post-cap monitoring studies of each cell suggest that the operational procedures implemented during Phase 2 fulfilled the environmental objectives proposed for the project. The overall objective was attained and the contaminated dredged material was successfully isolated from the marine environment by an adequate thickness of cap.

The Department of Environmental Protection for the State of Massachusetts has since amended the Water Quality Certificate to permit an extension in the consolidation period. The duration was increased from a minimum of 60 days to no longer than 120 days for cells shallower than 50 feet MLW. Consolidation times for cells in deeper water depths will be subject to review by the state and must be supported by favorable monitoring data.

DISPOSAL STRATEGIES: Many concerns raised at the public meetings, as well as several of the regulatory agencies, center around the loss of material during disposal. Studies from around the country summarized by the Waterways Experiment Station (WES, 1986) have shown that, depending on a number of conditions, no more than 5% of the total volume of material disposed would be lost to the water column before it reaches the bottom. In that the contaminants are most frequently associated with the fine grain fraction that tends to comprise the majority of material lost during disposal, there was still some concern for perceived large-scale spread of contaminants to areas outside the intended disposal site. When modeled specifically for the sheltered and shallow water conditions in Zone 2 of the Lower Bay Complex, the loss barely exceeded 1.5% of the fine-grain fraction of material in a barge under the worst-case conditions of disposal during maximum flood or ebb tidal flows (Palermo *et al*, 1998a). If: 1) dredging is restricted to the use of clamshell dredges (to increase the compactness and decrease the loss of material during disposal), 2) is restricted to the slower periods of tidal velocities, and 3) the material placed in the portion of the pit upstream of the dominant flow (center of pit at slack tide), then the model predicts that the total portion of fines that might be transported outside the pit area would not exceed 0.02 %.

Mechanical devices (tremie tubes and diffusers) could also be used to minimize dispersal of material as it descends through the water into the pit. Though the process does get material to the bottom with little contact with the water column, the material is more fluid (to allow it to move through the tube) and thus potentially more susceptible to resuspension and even loss during storm events. Geo-textile fabric bags were tested as a delivery system during the early part of the DMMP studies. From a logistical point of view, the operation proved to be very difficult and exceptionally costly (Gilbert, 1997). Given the operational controls discussed above, there would appear to be little to gain from this extra step.

In addition to potential dredged material placement restrictions (e.g., direct shunting, silt curtains, etc.) in the pit, CAD facilities could be sited in close proximity to the areas of the harbor from which the material is dredged to help confine any contaminant dispersion/loss from the filling process to the already impacted area. Also, subaqueous pits could be constructed, filled and capped annually to reduce the area physically impacted each year, minimize exposure of the benthic biota to the material, and hasten recovery of the impacted area. During annual pit operation, a series of pits could be sized to contain the volume of material needing to be disposed of in the upcoming year as well as any existing contaminated surface sediment that may be dredged in constructing the subsequent year's cell. Construction time to get the first cell ready for use would be approximately six months. Construction of a subsequent cell would be timed to ensure availability when the preceding cell nears capacity and becomes ready for closure. In areas of the Port where there is a very limited amount of dredging, this approach may be less effective due to placement considerations (e.g., water quality impacts, benthic impacts, etc.) related to local environmental effects. In these areas, adding the material into larger CAD pits created in other areas with greater dredging volumes may prove to be more environmentally protective.

In certain areas of the Port, seasonal restrictions (e.g., dredging windows) have been applied to the dredging phase of projects. These restrictions could significantly influence the utilization of CAD facilities in the Port. Often these seasonal restrictions are based on environmental and water quality concerns and have been overcome, in dredging projects, by employing specialized mechanical equipment *(i.e*., Tremie tubes) or management techniques/practices. These include, but are not limited to, disposing during a specific tide, closed clamshell environmental buckets, regulating bucket lift speed, not allowing barge overflow and employing silt curtains. Such management alternatives designed to reduce or contain sediment resuspension during disposal events are not as reliable or as easily implemented during disposal within a pit. Therefore, it may be difficult to obtain waivers of seasonal restrictions for subaqueous disposal alternatives. If waivers cannot be obtained, these restrictions/limitations could pose unique management complications by limiting the time and potentially increasing the costs for dredging operations that plan to use the pit.

Construction techniques also offer another avenue for addressing loss of material. The PANY/NJ and the State of New Jersey built the Newark Bay Confined Disposal Facility (NBCDF) in a shallow water area seaward of Port Newark/Elizabeth. Operations of the pit are managed by the PANY/NJ. A channel cut through the shoals of the Port Elizabeth Channel provides access to the pit. The pit configuration places the barge within the walls of the pit when it discharges its load, allowing the pit walls themselves to act as barriers to material that might otherwise spread into the bay. This approach may not be possible in channels or the deeper waters of the Lower Bay complex. However, the condition could be mimicked in the Lower Bay by using part of the excavated clean material to create a berm around the pit to confine material lost during discharge to the proximity of the pit long enough for it to settle within the pit boundaries.

CAPPING STRATEGIES: Capping, the practice of placing a layer of clean dredged material over an underlying deposit of contaminated sediments, has been used effectively to isolate material of this type from the surrounding environment. The technique is systematically practiced in both aquatic and terrestrial environments. In the Port of New York & New Jersey the procedure has been used often at the regional open water (e.g., ocean) dredged material disposal site, the Mud Dump. Twice in the past five years (1993 & 1997) the practice of placing clean sand over contaminated fine-grained dredged material removed from specific berthing facilities in the Port was carried out. Although never put into practice in the inner harbor areas of the Port, there is no reason to expect that the practice is not feasible in that setting.

In exercising the CAD Pit option, placing a layer of clean material over sediments that have various levels of contaminants may not be the best use of clean material, especially in the areas where the surrounding material is invariably contaminated and is likely to be dispersed. Sedimentation from the surrounding areas of the newly excavated sub channel pits will most likely take place and could potentially serve to isolate (biologically, chemically, & physically) the dredged material disposed.

POTENTIAL IMPACTS

Use of new pits would result in the removal of a portion of bay or channel bottom and the organisms that live within it. Though the habitat type (depth & sediment) would be restored within a year or two of construction, this would tend to be of lesser concern within a channel, where sediments are already often subject to regular disturbances from ship traffic and continued maintenance dredging. Outside the channel the impact would depend on the nature and productivity of the habitat that is removed. Within the Lower Bay complex, the two zones designated for new pit construction were selected in part based on a benthic screening analysis that sought to avoid areas of greater ecological value, thereby reducing the environmental impact of the loss (Wilber *et al*, 1998). Within the upper harbor, at Constable Hook and Newark Bay, the benthic populations tended to be less productive. In addition, by digging only small pits that would be filled in a year, the portion of habitat removed is minimized (generally 50 acres or less), hastening recolonization from surrounding areas. By using coring data to identify areas of deepest sand deposits, the surface area of bottom removed can be reduced even further, with similar disposal capacity being secured by digging the pit deeper instead of wider.

Existing pits have had many years to develop their own habitats. The 1991 FSEIS (NYD, 1991) characterized these habitats as marginal in terms of benthic use, containing many pioneer organisms suggestive of disturbed habitats. More recent investigations have shown the pits to be somewhat different from each other, especially those in the East versus West banks (Clarke *et al*, 1998). Still, the communities present do not represent particularly productive or unique habitats. Filling these artificial features provides an opportunity to return these habitats to conditions more closely resembling their natural state.

Another concern centers around potential impacts to water quality by the loss of contaminants during and after disposal. These concerns can be minimized through proper use of disposal techniques (as described in the preceding section). Using the tidal currents to confine any dispersal within the pit boundary could be a very effective strategy. Constructing several pits in different areas of the Port, and limiting disposal within each to material dredged from that same area would also help confine the contaminants to the waterbody from which they were removed. This technique would confine the loss of contaminants to the very area from which they came, thereby minimizing impacts to areas of little or no contamination, and avoid the need for increased cost for delivery systems or design features. Such a practice may necessitate constructing some very small pits in areas that may have limited dredging volumes some years (driving up their overall cost), or allowing the pits to be used over several years (keeping them open longer and increasing the impacts to the benthic community and their time for recovery).

Other potential impacts from use of pits involve the stability of the cap, their effect on shore erosion (redirecting currents or waves), and contamination of underground aquifers. All of these are major factors in the siting process that identified each zone (Palermo *et al*, 1998a). On the positive side, use of pits could help restore areas now contaminated by removing the surface layers of contaminated sediments and replacing them with cleaner material that should support more productive and healthier organisms.

Impacts to prehistoric resources have been initially assessed through a geomorphologic study of Zone 2 and in the proposed in-channel placement areas; Port Jersey/Newark Bay, Hudson River, Bowery Bay, Constable Hook, Red Hook/Bay Ridge and Ward's Point. During the late Pleistocene and Holocene periods these areas were on a relatively dry coastal plain that may have been inhabited by Native American populations. Preliminary analysis suggests that all areas examined have some potential to preserve prehistoric sites, although some are more sensitive than others (LaPorta *et al*, 1998). The area is rated to have a "high potential" is Ward's Point. Constable Hook was designated as having a "moderate potential." Bowery Bay and Red Hook/Bay Ridge were classified as "moderate to low." The Port Jersey/Newark Bay area was deemed to have a "low potential" primarily because modern construction has disturbed any remains of prehistoric occupation. The Hudson River channel was assessed as "low potential" for the middle channel where a river channel has been in place prior to any occupation of the area but the outer portions of the river channel have been assessed as "moderate to high."

Background historical research and a magnetic and acoustic remote sensing survey were conducted. No underwater archaeological investigations were undertaken. Current project plans call for the avoidance of targets and anomalies within the project area but if avoidance is not a viable option, additional archaeological investigations of the identified targets will be undertaken. Remote sensing was not conducted for the in-channel disposal options as the historic dredging in the channels and anchorage areas would have likely removed any historic wrecks or debris.

Existing borrow pits represent a disturbed environment from a cultural resources point of view. Any cultural resources that may have existed in these pits would have been significantly disturbed, if not completely destroyed, by sand mining activities. It is unlikely that intact cultural resources eligible for listing on the National Register of Historic Places (NRHP) will remain in existing borrow pits if all disposal activities are limited to areas previously disturbed by pit construction.

IMPLEMENTATION

Preliminary pit design was developed for the Lower Bay and the inner harbor (NY/NJ Harbor Partnership, draft 1998; Palermo *et al*, draft 1998b). Actual availability would take a somewhat longer time than use of existing pits, as they still must go through the permit review process and then be constructed. Construction time to get the first pit ready would, however, be relatively short (under a year) given its likely small size (several MCY depending on a given year's needs). Construction of subsequent pits would be timed to ensure their availability when the preceding pit is ready for closure. Table B-5-1 displays estimated costs and capacities for new pits. It should be noted that the cost for construction of the pit could be offset, at least in part, by selling the clean material or using it for beach nourishment (if suitable). An environmental benefit could be gained if the clean material were to go to remediate the HARS and other degraded habitats within the estuary or ocean.

Because of the potential for excavating substantial portions of existing surficial contaminated sediments to construct new pits in both Newark Bay and the Upper Bay, their costs are relatively high, in the order of, $24 – $50/CY. Comparatively, costs to construct similar pits in the Lower Bay are estimated at about $15/CY for both in Zone 1and Zone 2. The cost to restore existing CAD pits in the Lower Bay is relatively low at $1/CY due to the reduced contaminants in the existing surface sediment layers.

As with pits outside the channel, in-channel pits could be planned in small cells. The primary concern is not so much preventing recolonization inside the pit but rather decreasing the size of the cell to provide a more cost-effective means of disposing the contaminated material encountered in the upper layers of a pit's construction. By creating cells, the preceding pit provides a ready place to put the contaminated material that must be excavated to create the next cell. Obviously, if the layer of contaminated material were thick, most, if not all, of a pit's capacity would be wasted in disposing of the sediment from the next pit. This explains in part why this option is limited in location and capacity to areas of deeper bedrock and shallow surficial contaminant layers. As with the New (inner-harbor) Pit option, designs are now being developed for in-channel placement that would reduce the time needed to implement this option, making its availability similar to new pits outside the channel.

In-channel pits, which have the smallest overall capacity (18.5 MCY), could meet the short-term and more immediate disposal needs of the Port through 2005, as projected by Mud-1 (PANY/NJ, 1998). Their life expectancy would, however, be significantly shortened if the in-channel pits were used to hold new work as well as maintenance material. The inner harbor pits have a bit more capacity (29 MCY), and in conjunction with in-channel pits, could meet the Ports maintenance and planned deepening needs through all of the Mud-1 timeframe. Additional zones for potential CAD pit construction were identified within both the Lower (Zone 2) and Raritan (Zone 1) Bays. Preliminary volume estimates indicate that both zones have sufficient capacity to meet all maintenance and new work needs through the middle of the next century. The combination of the two zones could provide a mid- to long-term solution to the Port's dredging needs if a series of pits were constructed over time. Based on feedback from various resource agencies, Zone 1 is not now considered feasible (preference 5) due to concerns of impacts on biological resources in the Raritan Bay. Zone 2, while located further from the significant habitat complex of the Raritan and Sandy Hook Bays, also generated concerns regarding its potential use. Therefore, at this time the option is considered the least desirable that may potentially be feasible. However, the determination on the feasibility of this zone is pending further evaluation. Consequently, it is not utilized in the formulation of any of the plans in this report. Should future conditions necessitate reevaluation of this option, it may then be reconsidered as viable.

Sequencing the use of pits over many years provides the flexibility to respond to changes in sediment quality that may come about as a result of implementing contaminant reduction and/or decontamination measures. If these initiatives function well enough to markedly reduce the future volumes of contaminated dredged material, the construction of additional pits could be phased out with no loss of capital investment, as the pits would only be constructed on an as needed basis. Funding could be requested on an annual or less frequent basis and appropriations adjusted as other options come on line or are unable to meet projected schedules or capacities.

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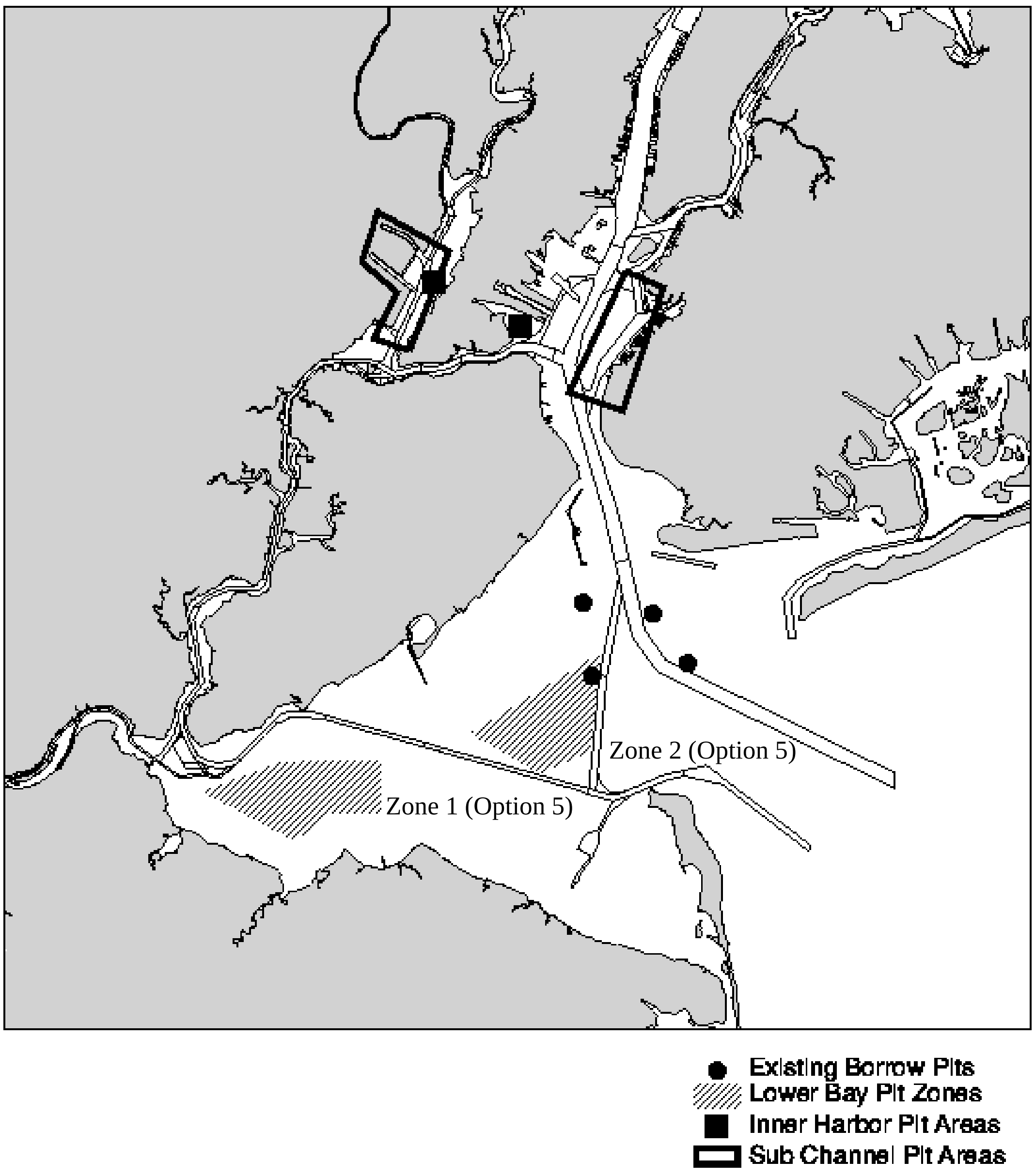
Table B-5-1 Estimated Costs and Capacities for Subaqueous Pit Options

OPTION	COST	CAPACITY
Existing Pits		
- Lower Bay	$1/CY	28 MCY
New Pits		
- Newark Bay	$25/CY	16 MCY
- Upper Bay	$35-40/CY	7 MCY
- Lower Bay (Zone 2)	$15/CY	TBD
In-Channel Pits		
- Newark Bay	$24/CY	10 MCY
-Bay Ridge/ Red Hook	$31/CY	8 MCY

Figure B-5-1 Location of Sub Aqueous Pit Option



B-6 CONFINED DISPOSAL FACILITIES

B.6.1 UPLAND CONFINED DISPOSAL FACILITY

DESCRIPTION

Upland disposal involves the construction of dikes or other retention structures with impermeable material or liners on land to contain dredged material. The upland CDF is then capped when it has been filled to its design capacity. The effluent is tested prior to discharge from the facility, and the adjacent surface and ground water is monitored to ensure that the material is properly contained (NYD, 1997).

Upland sites can be used to contain sediments that do not pass testing protocol for HARS placement. Although these materials being managed in the DMMP may not be considered suitable for HARS placement, they are not characterized as hazardous or toxic material.

Containment dikes can be constructed of almost any type of soil material with the exception of very wet fine-grained soils and those containing a high percentage of organic matter. High plasticity clays may present a problem because of detrimental swell-shrink behavior when subjected to cycles of wetting and drying (USACE, 1987).

Geotextiles are used in dike construction to provide tensile reinforcement where it will increase the overall strength of the structure. A liner may need to be constructed within the facility along with a storm water collection system or a water treatment facility to provide safeguards against loss of material through leaching (NYD, 1996).

The general construction sequence for a containment dike is foundation preparation, transportation and placement of the dike materials in the embankment, and manipulation and possibly compaction of the materials to the final form and shape (USACE, 1987).

POTENTIAL IMPACTS

Any water bodies on upland CDF sites are likely to be adversely impacted. This could include streams that may need to be rerouted or ponds that may be lost. Chemical impacts revolve around the loss of contaminants from the site, which is minimized by a number of design techniques and control measures such as effluent treatment and geotextile liners.

Use of upland CDF sites would effectively eliminate their use by flora and fauna until the sites cease to be used. The final use of the site would dictate its value for fish and wildlife. Secondary impacts might arise in conjunction with loss of contaminants, a risk that is reduced by factors designed into each site-specific facility.

People at risk include those who consume fish from nearby bodies of water where bioaccumulation of compounds of concern become an issue. Site location and design would minimize or eliminate this risk, and site monitoring would ensure the site was operating as designed.

In general, this option has the potential to impact a wide range of cultural resources if modern construction or land clearing activities has not already disturbed the proposed site. Potential resources may include standing historic structures, prehistoric and historic archaeological sites and historic landscapes. A cultural resources assessment will be undertaken for specific upland sites once they are determined.

IMPLEMENTATION

The DMMP Interim Report (NYD, 1996) identified 16 potential upland CDF sites which met preliminary site screening criteria. Six primary criteria were used for the site screening study:

1. Located within the limits of the defined study area,
2. Located within a defined distance from tidal waters,

3. Suitable existing site land uses,
4. Satisfied minimum size requirements,
5. Satisfied minimum dimension requirements, and
6. Contained suitable topographic constraints.

In the spring of 1997, the NYD held a series of public information meetings at which local citizens and public officials provided feedback regarding potential upland CDF sites. Based on the comments from those meetings and subsequent letters and feedback from the states indicating that there was lack of support for many of the sites, only remained under consideration. This site is located in Belford, Monmouth County, New Jersey (designated UD-7 in the Interim Report). A 20-acre portion of this site, commonly referred to as N-61, was historically used for disposal of material dredged from the area. Dredged material could be placed in the facility and allowed to de-water over time. The ultimate placement of the de-watered dredged material will be for an 85-acre landfill closure project adjacent to the N-61 site. Given the currently proposed use of the site to remediate the landfill, further evaluation of this site has been transferred to land remediation in the beneficial use section of this report. Consequently, now there are no sites being investigated strictly as upland CDF sites.

The DMMP Interim Report (1996) provided a generic upland disposal expense of $25/CY to $35/CY, with most sites initially identified having total capacities of only 1.3 to 3.3 MCY of sediment.

Ultimately, the decision on the acceptability of dredged material placement in an upland site is made by the states of New Jersey and New York under their guidance for end-use acceptability.

REFERENCES

U.S. Army Corps of Engineers (1987), “Confined Disposal of Dredged Material” Engineer Manual No. 1110-2-5027, Washington, DC.

U.S. Army Corps of Engineers, New York District (1996), “Dredged Material Management Plan for the Port of NY & NJ – Interim Report,” New York, NY.

U.S. Army Corps of Engineers, New York District (1997), “Dredged Material Management Plan for the Port of NY & NJ – Progress Report,” New York, NY.

B.6.2 NEARSHORE CONFINED DISPOSAL FACILITIES

DESCRIPTION

Nearshore confined disposal facilities (CDFs) involve the construction in coastal waters of an enclosing dike, attached to land, isolating the interior ponded water from exchange to the ecosystem. Once the dike is constructed, the inner area is filled with dredged material and then capped to isolate the material from the environment. Nearshore CDFs have been used extensively nationally and internationally for containment of contaminated sediments. Craney "Island" in Norfolk, Virginia is a peninsular containment facility built in the 1970's to contain dredged material from the inner areas of the Port of Norfolk. Highly contaminated sediments from a Superfund site in the Puyallop River in the Port of Tacoma, Washington were used to fill an adjacent nearshore CDF to expand Port facilities and to remediate the Superfund site. The largest CDF in the world, the Slufter in the Port of Rotterdam, the Netherlands, was constructed to contain approximately 200 MCY of contaminated sediments dredged from inner areas of the Port.

Given the limited area available in the inner portions of NY/NJ Harbor, most sites that have been discussed are generally limited to total volume capacities of a few million cubic yards capacity. Further, if sites are selected and implemented, their size limitations would make effective consolidation of material placed within the site difficult. Consequently, additional active consolidation techniques would likely need to be employed if the ultimate use of the site (e.g., container port facility) required structural stability.

TECHNIQUES & SITES

Several materials could potentially be used for constructing the dikes, depending upon several factors (e.g., physical environment - wave regime, sediment strata, etc.). Built of materials such as armored stone/sand, steel sheet pile and geotextiles, the dike would be designed to withstand coastal and potential shipping forces that it would be exposed to. Once the dike structure is built and isolation of the interior waters achieved, dredged material would be placed into the CDF. Effluent from the site would be treated, as necessary, to meet applicable water quality standards. Once filling is complete, the site is then capped with materials such as sand, soil, and geotextile membranes to isolate the fill material from exposure the upland environment. The land created from this process can then be utilized for a variety of purposes including upland habitat creation, commercial development (typically Port related), or recreational uses.

Several sites have been discussed for potential nearshore CDF construction in the Port. Currently, five nearshore fill/CDF sites have been identified that may use dredged material. These sites are Long Slip Canal, NJ; River Terminals, NJ; OENJ Bayonne, Phase 2 (Constable Hook flats), NJ; Atlantic Basin, NY; and South Brooklyn Piers, NY. If all these sites were implemented, their total capacity is approximately 12¾ MCY. The placement cost per cubic yard for these nearshore CDF sites have been estimated to range from approximately $29/CY to $37/CY.

Other nearshore fill sites are also under consideration for Port expansion by the Port Authority of NY/NJ, the New York City Economic Development Corporation and other agencies. Given that these facilities are under consideration primarily for Port expansion and not necessarily for dredged material disposal, it is now uncertain whether dredged material would be used for fill material at these facilities and, if so, what the price and capacity would be. Should they be designed to use dredged material (presumably stabilized) and be comparably priced with other potential dredged material options, they would then be incorporated into this DMMP.

POTENTIAL IMPACTS

While environmental impacts would need to be evaluated in detail once a specific site is proposed for implementation, the main environmental impact that would result from the implementation of a nearshore CDF is the permanent loss of nearshore aquatic habitat and associated species. With the development and urbanization of the Port region in the past several hundred years, a substantial acreage of nearshore habitat has been lost to filling activities. Consequently, any potential implementation of a nearshore CDF in the region would likely require some type of "out-of-kind" mitigation to generate an equivalent or net beneficial environmental impact. The Empire State

Development Corporation has recently initiated a three-year investigation of nearshore habitats to assess their use, value and potential mitigation need. The study will also evaluate reef-like modules for their potential to replace structure and low energy habitats lost if this option were to be implemented.

Other environmental impacts that would need to be evaluated with a nearshore CDF include the effect of effluent on adjacent water quality conditions, groundwater contamination, human health and ecological risk assessment of potential contaminant uptake. These factors have been shown in other regions with similar material to be controllable through proper site design and management. These potential effects would be evaluated on a case-by-case basis in a supplemental environmental impact statement or other NEPA document in a suitable time before the option were needed (see schedule below).

Two types of cultural resources, prehistoric and historic, may be potentially impacted as a result of implementation of a nearshore CDF. Prehistoric archaeological sites may exist in the near-shore area, but would probably be buried under thick accumulations of sediment or considerable landfill. Additional studies may be required. Many near-shore resources in the New York area, such as piers and waterfront structures, have been listed on or determined eligible for listing on the National Register of Historic Places (NRHP). Some of these historic properties however, may have been recorded and removed as specific projects proceeded. Additional studies to identify other resources may be required. Indirect impacts to historic sites will also need to be assessed. This work should evaluate the effects of the proposed facility on landscape and setting as well as on the viewsheds of significant properties like the Statue of Liberty and Ellis Island, two National Historic Landmarks. Historic resources of particular concern for CDFs proposed immediately adjacent to the shoreline are derelict vessels and waterfront structures such as bulkheads, wharves and piers related to industry and historic landfilling. Dredging may have occurred along segments of shoreline that could have adversely impacted resource preservation.

IMPLEMENTATION

To implement the nearshore CDF option, a site would have to be identified, preliminary plans developed against which potential impacts could be assessed. Additional NEPA evaluations and documentation would be prepared concurrent to physical characterization and design of the facility as specific sites are identified and proposed. Following these tasks and with the acquisition of the necessary Federal and state permits, the project cooperation agreement (PCA) would be executed (for a Federal action) and the facility constructed.

Table B-6-1 Implementation Tasks

Main Tasks Needed to Implement Option	Year 1	2	3	4	5
Identify Site & Prepare Preliminary Site Plans	→				
Prepare NEPA Documentation (e.g., EA, EIS)	→	→			
Characterize Sediments at Site	→	→			
Prepare Designs/Plans & Specs		→			
Obtain Permits, Acquire site, Execute PCA & Construct Facility			→		
Operate Facility				→	→

REFERENCES

Port Authority of New York & New Jersey memorandum (1996), Red Hook Terminal – Atlantic Basin, New York, NY.

U.S. Army Corps of Engineers, New York District (draft 1998), "New York and New Jersey Harbor Navigation Study - Without-Project Condition Report," New York, NY.

B.6.3 ISLAND CONFINED DISPOSAL FACILITY (CDF)

DESCRIPTION

Environmental assessment of this option has determined that while the project is feasible from an engineering standpoint, and would be cost effective, both potential and perceived environmental impacts are unacceptable. An island CDF is therefore a non-preferred option in the DMMP and is no longer under consideration. The following is provided solely for information purposes.

An island confined disposal facility (CDF) (also known as a containment island) involves the construction in open bay or ocean waters of an enclosing dike isolating the interior from exchange to the ecosystem. Once the dike is constructed and interior containment achieved, the inner area is filled with dredged material (typically over many years or decades) and ultimately capped to isolate the material from the environment.

The dike of an island CDF is a maintainable, permanent structure designed to withstand extreme coastal storms without failure or loss of material. Dredged material is placed inside the facility by pumping or mechanical transfer methods. As dredged material fills the isolated interior area, water is displaced. Excess water is treated (as necessary to meet applicable water quality standards) and released from the facility through a weir system. To ensure proper containment, periodic monitoring of the waters, sediments and biota surrounding the facility would be performed.

Once dredged material fills the facility to the point that it is exposed out of the water, passive and/or active consolidation and dewatering techniques would likely be employed to consolidate the sediments. This would maximize the useable volume capacity of the facility and/or minimize the size (i.e., acreage) needed for a selected volume capacity. Natural/passive sediment treatments have been found to occur or are typically incorporated into CDF options. These include sand separation/reclamation, mineralization, bioremediation, photolytic degradation, etc. When applicable, these treatments can be used to reclaim usable materials from the sediments (e.g., sand), or to stabilize/decontaminate the sediments further reducing their potential adverse environmental impacts.

Once filling is completed, the structure would be capped with clean fill material, resulting in newly created land that may be used for a variety of purposes. These purposes could include commercial development, stationing harbor operations/management, siting decontamination processing facilities, recreational uses (e.g., beach facilities), and wildlife uses (e.g., upland habitat creation).

Similar to nearshore CDFs, island CDFs have been used around the world, including the eastern seaboard of the U.S. Hart-Miller Island, a 1,140 acre CDF, was constructed in the early 1980's in the Chesapeake Bay north of Baltimore Harbor to contain contaminated sediments dredged from the inner areas of the Port of Baltimore. A new island CDF known as Poplar Island is under construction in Chesapeake Bay for containment of dredged material, as part of a habitat restoration effort.

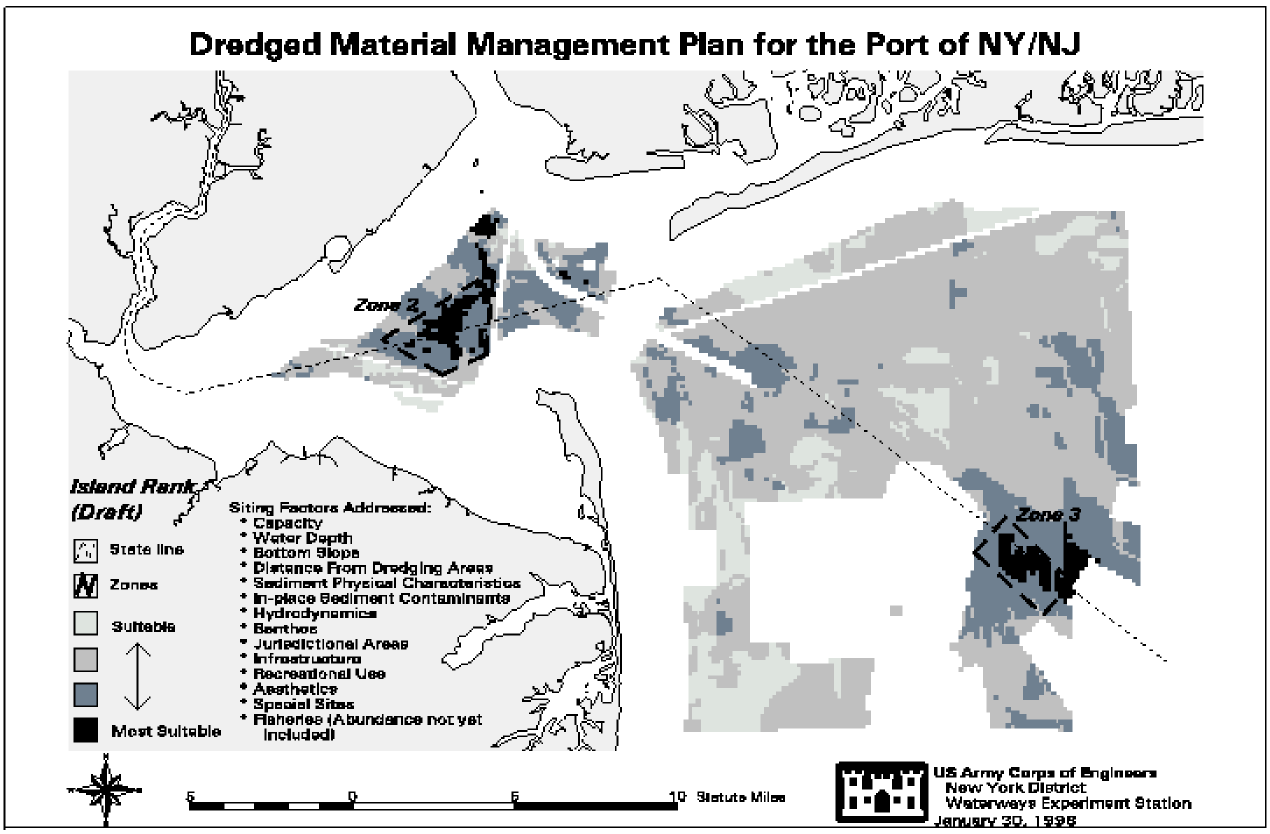
TECHNIQUES & SITES

The primary feature defining an island CDF is the perimeter dike. Many methods and materials can be utilized to construct the dike to ensure both containment of the material placed within the facility and protection of the facility from coastal storms. Coastal storm events, such as Nor'easters or hurricanes, can transfer large amount of dynamic forces upon the dike structure. The design of the dike structure must encompass factors such as wave height, wave period, currents, storm surge, water depth, foundational sediment strata and physical characteristics, anomalous geologic events (e.g., earthquakes), and the characteristics of the material to be placed within the facility. As most of these factors are affected by physical and geological conditions, siting of the island CDF is directly related to the dike design.

During the early stages of the DMMP study, the Corps reevaluated preliminary siting efforts performed in the region in the past two decades to develop siting criteria to identify suitable locations in the NY/NJ Harbor and Bight for island CDFs. These siting criteria included biological factors (bottom-dwelling organisms, fish distributions, and habitat types); geological conditions (surficial, subsurface, sediment transport, seismicity); cultural resources (historic features, aesthetics); chemical make-up (sediment chemistry, biological test results); and physical factors (bathymetry, baseline data, wave, current and storm characterizations). Based on the siting criteria, the NYD identified three areas or zones of siting feasibility for the potential construction of an island CDF or CAD pits (NYD, 1996). These three zones were identified as Zone 1 (south-central part of Lower Bay including part of Raritan Bay), Zone 2 (central part of Lower New York Bay), and Zone 3 (north-central part of the New York Bight Apex, near Diamond Hill / Ambrose Light).

A preliminary evaluation of subsurface conditions, along with feedback from the States, environmental organizations, the fishing industry, and other stakeholder agencies, resulted in a revision to the siting criteria and data identifying the two zones of siting feasibility (Zone 2 and 3) for potential island CDF construction (see figure B-6-2). (Note: Zone 1 in Raritan Bay was previously only identified for potential CAD pit construction which has subsequently been dropped from further consideration). The NYD has coordinated the siting criteria and GIS-based data layers used in this siting effort with the involved Federal, state and local agencies (Palermo *et al*, draft 1998). Comments from other federal and state agencies have been received along with the preparation of preliminary engineering design information on zones 2 and 3. With this information, zones 2 and 3 will undergo further revision to reflect this information.

Figure B-6-1 Potential Island CDF (Containment Island) Zones of Siting Feasibility



An island CDF would be sited within one of these zones or their revised locations when finalized. Site-specific studies would need to be performed in the selected zone in conjunction with planning & design constraints to identify its exact size and location. Based on current projected dredging needs an island CDF would occupy a fraction of the area of either Zone 2 or 3. For example, using construction methods that minimize the area impacted, the largest island CDF potentially needed to meet the regions long-term dredging needs would have approximately 100-MCY capacity. It would take up approximately 625 acres or 18% of Zone 2 or, if sited in Zone 3, 525 acres or 21% of the zone.

Extensive data and modeling efforts have been performed and are underway to better characterize the region for the siting and design for construction of a potential island CDF. Geophysical surveys, corings, vibracores, surficial sediment grabs, sediment profile imagery, and cultural magnetometer surveys have been performed in these zones to further characterize their engineering, biological and cultural suitability. Numerical modeling of wave climatology, nearfield currents, water quality, shoreline impacts, etc. has been performed to evaluate the siting and design of potential island CDFs in zones 2 and 3.

The primary materials under consideration for potential construction of an island CDF dike are an armored stone/sand dike (zone 2 or 3) or concrete caisson (zone 3). The design of the dike structure has been evaluated from many different engineering perspectives (Moffatt & Nichol Engineers, draft 1998). These factors include dike height, island size & shape, project life, cellular (or modular) construction, etc.

Containment of contaminants into an island CDF is fundamental to the primary purpose of the facility. Evaluations of non-HARS dredged material composited from several federal navigation projects in the port indicate that once material were placed within an island CDF, clarifying the effluent (by ponding) will treat the supernatant to make it acceptable for release. Also, tests of the harbor composite dredged material show that an island CDF would allow up to approximately 30% consolidation of sediments placed within the facility over time. This consolidation would increase the final capacity and/or reduce the impacted area for a specified volume capacity.

Several construction and operation methods may be used to minimize the impact that the acreage needed for a selected capacity would have. One method involves excavating the interior area of the facility to minimize its footprint. While this may not be possible in currently identified zone 3 due to the existing water depth, it would reduce the size by approximately 40% in zone 2 for the same disposal capacity. The excavated material may then be used in the construction of the facility or used beneficially (e.g., beach nourishment, construction aggregate, and habitat restoration/creation). An alternative method involves the construction of modular or sectional island CDF cells. While utilizing this method would increase the price per cubic yard of this option, it would allow for greater flexibility in planning and a reduced impact to the environment, particularly if future conditions demonstrate that full construction of the facility is no longer necessary.

Due to the economies-of-scale, the price per cubic yard of material placed within an island CDF decreases as the size of the facility increases (including construction, engineering & design, supervision & administration, and operation & maintenance expenses for a fifty-year project life). Due to the deeper water and increased wave heights, this is particularly notable with an island CDF sited within zone 3. Due to the economies-of-scale and the prices of other options, an island CDF in Zone 2 is not considered viable at volumes of less than approximately 50 MCY. Similarly, an island CDF in the currently identified zone 3 is considered less favorable than an island CDF in zone 2 due to the considerably increased price.

Due to the potential environmental impact that an island CDF would have on the loss of bottom habitat, mitigation would likely be necessary. Since in-kind mitigation (i.e., creating more bottom habitat) is not feasible, out-of-kind mitigation methods would need to be employed as acknowledged at an interagency scoping session held on May 1, 1998. These methods may include creation of reef-like structures around the island CDF dike for varied fish habitat, restoration of degraded phragmites wetlands in the area, restoration of anadromous fish runs (by removing dams and other obstacles), restoration of shell fish habitats in other impacted areas, creation of bird habitat in other areas of the harbor, etc. Identification of specific mitigation methods would be evaluated and incorporated into the price of an island increasing its total price and price/CY.

An island CDF could generate ancillary benefits in the potential end-use of the land created. Any potential economic benefits to be attributed to such an island are a function of its eventual uses. It should be noted that benefits attributable to an island as land are impossible to evaluate without knowledge of the services (e.g., utilities, transportation) that may be available on the island. As a result, a preliminary list of possible uses for such an island serves as a means of arriving at a general estimate of these potential benefits.

The most immediate uses of such an island are recreational. For example, the Port of Baltimore's Hart-Miller Island, 1,140 acres in size, currently offers recreational opportunities to visitors who arrive by boat. If utilities are provided on such an island, additional uses are also possible. The Sandy Hook Pilots have expressed an interest in establishing a pilots' station on a island CDF to facilitate the harbor movements of the pilots. An island CDF may also serve as a logical location for a sediment treatment/decontamination facility. In fact, physical sediment treatments (e.g., sand separation) would likely be employed to recover usable sand from the material when feasible. This technique has been used in both the Hart-Miller Island in the Port of Baltimore and at the SLUFTER CDF in the Port of Rotterdam, the Netherlands. In addition and on a more ambitious scale, an island CDF may also serve as a site for a power-generation plant or a small airport. Examples of such uses exist in Asia.

<u>POTENTIAL IMPACTS</u>

The most notable impact resulting from the potential construction of an island CDF, both in the bay and the ocean, would be the permanent loss of the benthos, and, to a lesser extent, the water column. As partial offset for the loss of bottom habitat, a relatively small amount of "reef-like" surface area would be created from construction of the dike structure, more so at zone 3 than 2 due to the greater water depth.

Biological sampling associated with siting for either site for a potential island CDF indicates that neither site has unique benthic communities. Further, zone 2 is sited in an area of the Lower bay which has relatively lower benthic community productivity. Once the facility is filled and capped, an equivalent amount of upland would be created, and could be made available for wildlife (especially birds).

Slow moving fish or immobile megainvertebrates would be directly impacted by the construction of an island CDF, however partial mitigation by transplanting and/or relocation of certain megainvertebrates (e.g., clams) may be possible prior to construction. A preliminary ecological screening-level risk assessment (Cura *et al*, draft 1998) has indicated that care would need to be given during the filling of the facility to minimize the avian colonization of the interior of the facility. Cetaceous mammals (e.g., whales and dolphins) would also be indirectly impacted through the loss of water column habitat however when compared to the total amount of water column available, this loss is not considered substantial. Pinniped mammals (seals) would also lose foraging habitat but would also potentially gain winter haul-out areas along protected areas of the dike structure.

Endangered and threatened species which inhabit and/or migrate through the study area include four species of sea turtle, the peregrine falcon, the bald eagle, the piping plover, the roseate tern, and several species of cetaceans. If this option were selected for further evaluation and/or implementation as a part of the DMMP, coordination with the USFWS or NMFS, as appropriate, would be undertaken to assess the likelihood and magnitude of the potential impacts and any reasonable and prudent actions that need to be used to avoid the impacts.

Due to concern for the potential adverse impacts to the local benthos and water column from effluent of an island CDF, environmental testing was conducted of sediments that would be placed into the potential facility. The results indicated that contaminants, which tend to remain bound to the sediment particles, would be retained within the structure by allowing sufficient ponding of the supernatant. This settling process would make the effluent acceptable for release into the water column (Schroeder *et al*, in preparation).

Due to the distance from shoreline and the wider window of prominent wave attack, shoreline impact modeling studies indicate that an ocean island CDF would not affect adjacent shorelines. However, an island CDF in zone 2 of the Lower Bay may protect shorelines along the eastern to southeastern sections of Staten Island due to the sheltering effect the island would create. If this option were selected for further evaluation and/or implementation, additional shoreline impact studies would be needed to determine the potential beneficial or adverse impacts that this sheltering may create.

Monitoring and notices by the U.S. Coast Guard would counter any shipping/navigation hazards that an island CDF may create to ensure the safety of commercial shipping. Noise and air quality impacts resulting from the potential construction and operation of an island CDF in either zone 2 or 3 are anticipated to be minimal given the distance of the zones from the mainland, the prevailing wind direction, and the control measures that are possible to minimize volatilization of contaminants or fugitive dust release from the facility. Aesthetic considerations were included as both exclusionary and ranking criteria in the siting of zones 2 & 3. As zones 2 & 3 are also in areas of notable recreational use, aesthetic concerns related to fishing and boating activities as well as potential recreational impacts would need to be evaluated further.

A geomorphological study is currently being conducted to assess the potential for prehistoric resources in zones 2 and 3. The data generated from this study will be used to reconstruct the paleo-environment and ascertain areas that may have been favorable for site locations and that are more likely to be preserved, having withstood geological and human scouring processes. Preliminary analysis suggests that zone 2 has a high potential to preserve prehistoric data although some areas within the zone are more sensitive than others while zone 3 has been assessed as possessing a "moderate potential" (LaPorta, 1998).

For zone 2, background historical research and a magnetic and acoustic remote sensing survey were conducted in March and April 1998. No underwater archaeological investigations were undertaken. The preliminary analysis of the data suggests that two targets have the potential to be submerged cultural resources (Cox, 1998). Current project plans call for the avoidance of targets and anomalies within the project area. If avoidance were not a viable option, additional archaeological investigations of the identified targets would be undertaken.

IMPLEMENTATION

Environmental assessment of this option has determined that while the project is feasible from an engineering standpoint, and would be cost effective, both potential and perceived environmental impacts are unacceptable. An island CDF is therefore a non-preferred option in the DMMP and is no longer under consideration.

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C VOLUME PROJECTION ANALYSIS & DETAIL
C-1 DATA SOURCES AND ASSUMPTIONS

Based on information provided by the Corps, New Jersey and the Port Authority of New York and New Jersey, a detailed database of projected dredging projects was prepared for the DMMP (see Table C-2-1). For purposes of developing this database, several factors that can effect future dredging could not be taken into account. These factors include timely authorization and funding of dredging projects, future shoaling rates and anomalous storm events, channel usage, changes in testing protocols, availability of sufficient dredging equipment, final determination of the acceptability (for ongoing deepening studies), etc. Consequently, these figures should be considered the maximum likely dredging that is anticipated occurring during the DMMP planning period, based on current conditions and testing methods. Further, as these figures are subject to constant change, they should be viewed as a “snapshot” in time of anticipated future dredging needs. For the purposes of the DMMP *(i.e*., identifying options and an approach for their use), small changes in the amount or sequencing of the dredging projections should not effect the overall plan developed substantively.

In the database, each project was broken down into the following fields:

- Corps or non-Corps dredging
- New work (deepening) or maintenance dredging
- Type of material to be dredged (see below)
- State boundaries (New York, New Jersey, or Shared Waters)
- Waterbody (see below)

As the purpose for the DMMP is primarily to identify sufficient management options for Corps dredged material for at least the next twenty years, the database separated dredging projections by Corps and non-Corps dredging. Figure C-2-1 presents the volumes of Corps and non-Corps dredging projected for the next ten years. It clearly shows that the vast majority of dredging that is projected to occur over the next ten years is to be performed by the Corps, as part of either deepening or maintenance work.

For maintenance material, project-specific projections were used for years 2000-2005. For years beyond this, an average of material dredged from years 1999 through 2005 is used for maintenance. For deepening material, the most recently available volume projections and schedules for construction from each of the ongoing Corps' deepening projects were used. The following Corps deepening projects were used:

- Kill Van Kull & Newark Bay Channels, 45’
- Arthur Kill to Howland Hook Channel, 41’
- Port Jersey Channel, NJ, 41’
- Belford Harbor, NJ, 10’/14’
- NY & NJ Harbor Navigation Anticipated Recommended Channels
    - Ambrose Channel, 53’
    - Anchorage Channel, 50’
    - Port Jersey Channel, NJ, 50’
    - Kill Van Kull Channel, 50’
    - Arthur Kill to Howland Hook, 50’
    - Newark Bay Channels, NJ, 50’
    - Bay Ridge Channel, NY, 50’

Figure C-2-2 plots the total projected maintenance and deepening (new work) material projected for the next ten years. For most years, the majority of material to be dredged is from one or more of the deepening projects listed above. For each area of the harbor that is deepened, the predicted incremental increase in maintenance dredging (due to increased sedimentation from the deeper water) is included once the deepening is completed. These incremental increases vary considerably throughout the harbor and are synergistic in nature.

Since many different dredged material options under consideration are limited to or targeted for dredged material with specific chemical or physical properties, the volume projections were broken down into 7 different types of material. These material types are as follows:

- Sandy HARS material (A) – Potentially suitable for HARS, habitat restoration/creation, beach nourishment, construction aggregate, etc.
- Fine-grained HARS material (B) – Potentially suitable for HARS or habitat restoration/creation.
- Glacial Till/Mixed HARS material (C) – Potentially suitable for HARS or other beneficial uses.
- Stiff Clay HARS material (D) – Potentially suitable for HARS, fill for habitat restoration/creation, land remediation (e.g., landfill cover/cap), etc.
- Rock Material (E) – Potentially suitable for fish reef creation or construction material.
- Non-HARS material (F) – Potentially suitable for inshore fill material at selected habitat restoration/creation sites (e.g., degraded pits), land remediation (typically stabilized), or for construction material (typically stabilized or decontaminated).
- Non-HARS, Decontamination Preferred (G) – Due to increased concerns from higher contaminant concentrations (as may be encountered in select areas of the estuary), decontamination methods (rather than stabilization methods alone) are preferred prior to use for land remediation, construction material or other uses.

Figure C-2-3 shows the amount of each of these types of material projected to be dredged over the next ten years. Given the substantial amount of deepening projected to occur over this time period, the total amount of HARS suitable material is approximately twice that of non-HARS material. This is essentially the reverse proportion between HARS and non-HARS material than what is projected into the outyears for maintenance material alone.

Since one of the major constraints to developing a DMMP for the Port is the state boundary, the volume projections distinguished each project to the waters from which the material is to be dredged. All private projects and some federal projects were classified into either of the two states while some federal projects which lie upon the state line were identified as being in both states waters (i.e., shared waters). Figure C-2-4 shows the anticipated amounts of material coming from each of these three areas (New York waters, New Jersey waters, and shared waters). From it, one can see that the largest amount of dredging over the next ten years is from shared waters (which is exclusively Corps material), followed by New Jersey and New York, respectively. This again illustrates the large volumes of material projected to be dredged from deepening projects in shared waters over the next ten years (e.g., Kill Van Kull, Arthur Kill, and Ambrose channel).

Lastly, given the desire to keep the material as close as is feasible to the location from which it was dredged, the volume projections were characterized by geographic location (i.e., the waterbody from which the material is to be dredged). For this, 8 different geographic waterbody areas were defined and used in the database. These 8 areas are as follows:

- Newark Bay & tributaries (i.e., Passaic and Hackensack Rivers) (NB)
- Arthur Kill (AK)
- Kill Van Kull (KVK)
- Upper Bay (UB)
- Hudson River (HR)
- East River and Western Long Island Sound (ERLIS)
- Jamaica Bay (JB)
- Lower Bay, Transect and NY Bight Apex (including tributaries (e.g., Raritan River, Shrewsbury and Navesink Rivers)) (LBA)

Figure C-2-5 shows the volume projections by geographic areas. As much of the dredging projected to occur over the next ten years is produced from deepening of the Port and since deepening typically is performed from outward boundaries (Apex) inward to the berthing facilities, the figure reflects this general geographic progression resulting from the deepening. Large amounts of dredging are planned in the Lower Bay area followed by the Upper Bay area then the KVK/AK/NB areas.

C-2 LONG-TERM PROJECTIONS

A two-page summary of the future dredging requirements is shown on Table C-2-2. In this table, long-term maintenance amounts are based on flat-line projections of HARS and non-HARS material (i.e., no contaminant reduction). However as described in Section B – 1 of this Appendix, contaminant reduction efforts are now underway and the targets established are assumed to be realized in the outyears (2016 and on). Figure B-1-10 illustrates the significant amount of non-HARS material that is projected to be converted to HARS material through ongoing and future contaminant reduction efforts. If over the period of 2016 – 2040, the contaminant reduction targets can be met, then approximately 35 MCY of HARS unsuitable material will have been converted to HARS suitable material.

Figure C-2-1 Dredged Material Volume Projections by Corps and Non-Corps Dredging

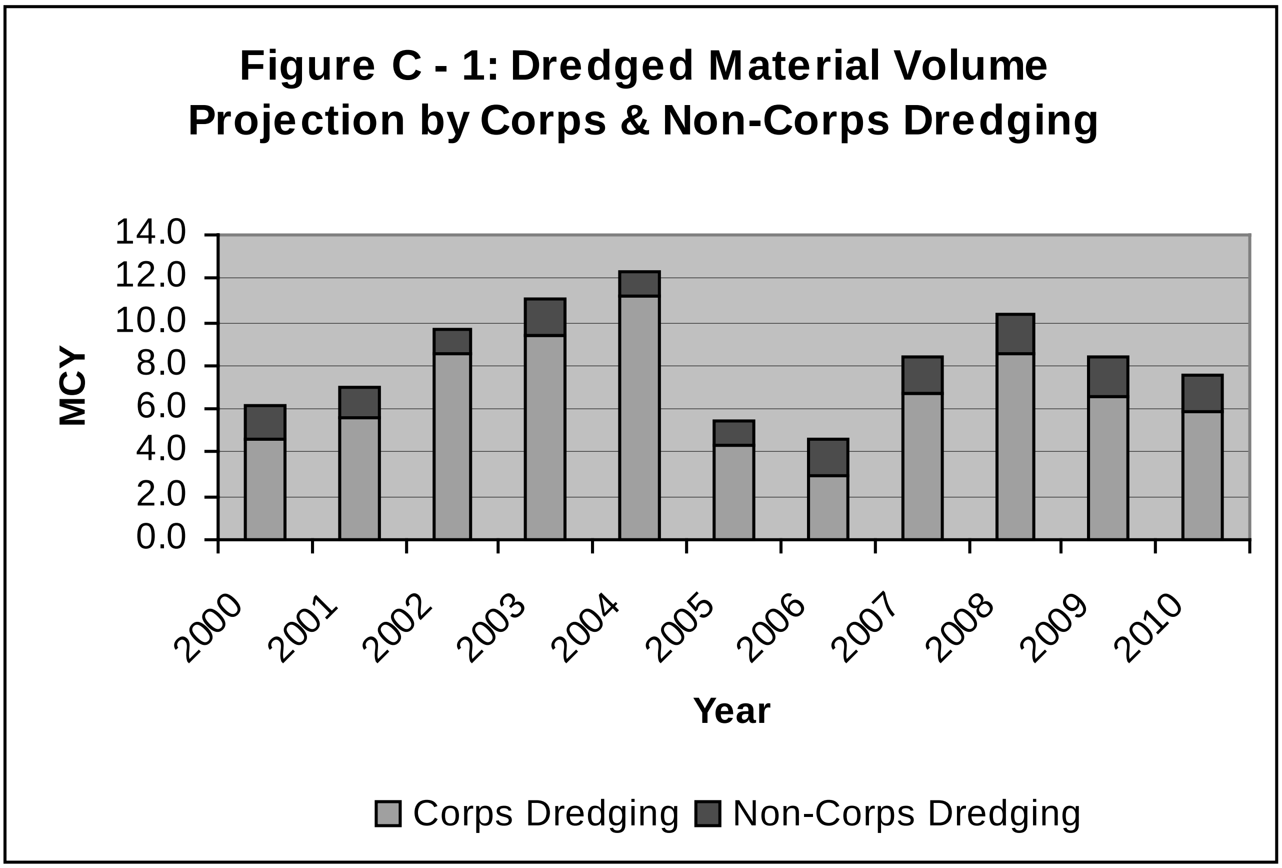


Figure C-2-2 Dredged Material Volume Projections by Maintenance and Deepening Material

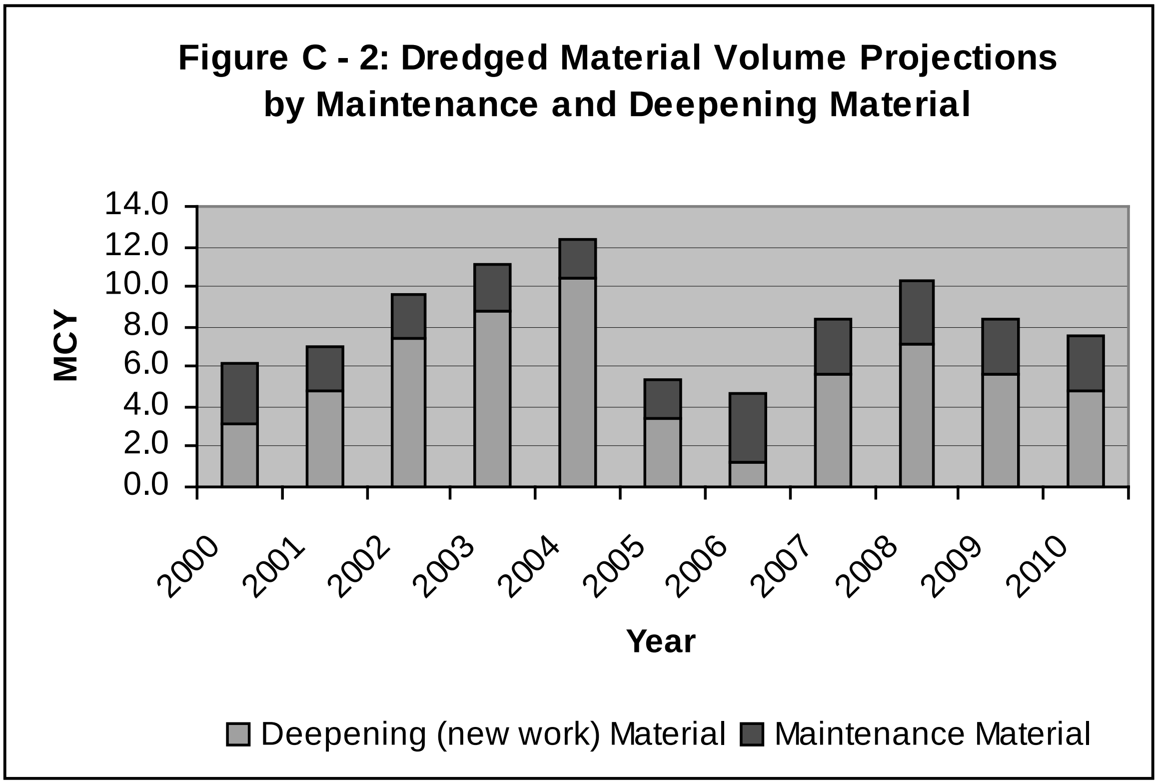


Figure C-2-3 Dredged Material Volume Projections by Material Type

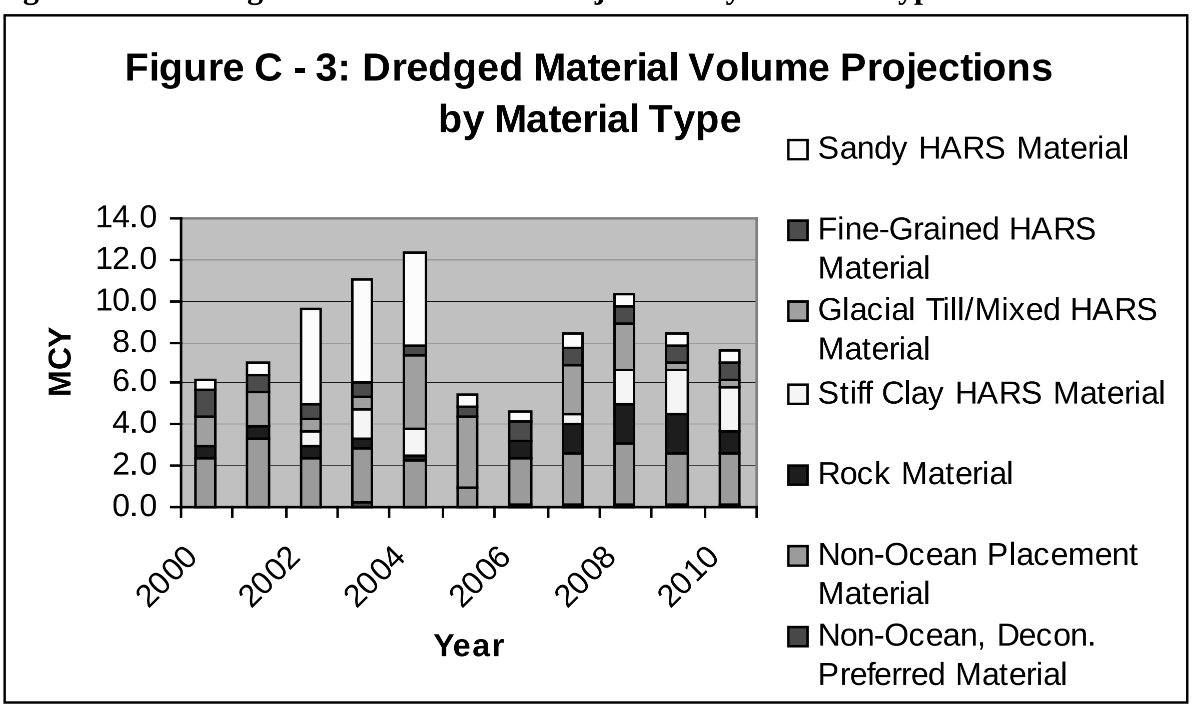
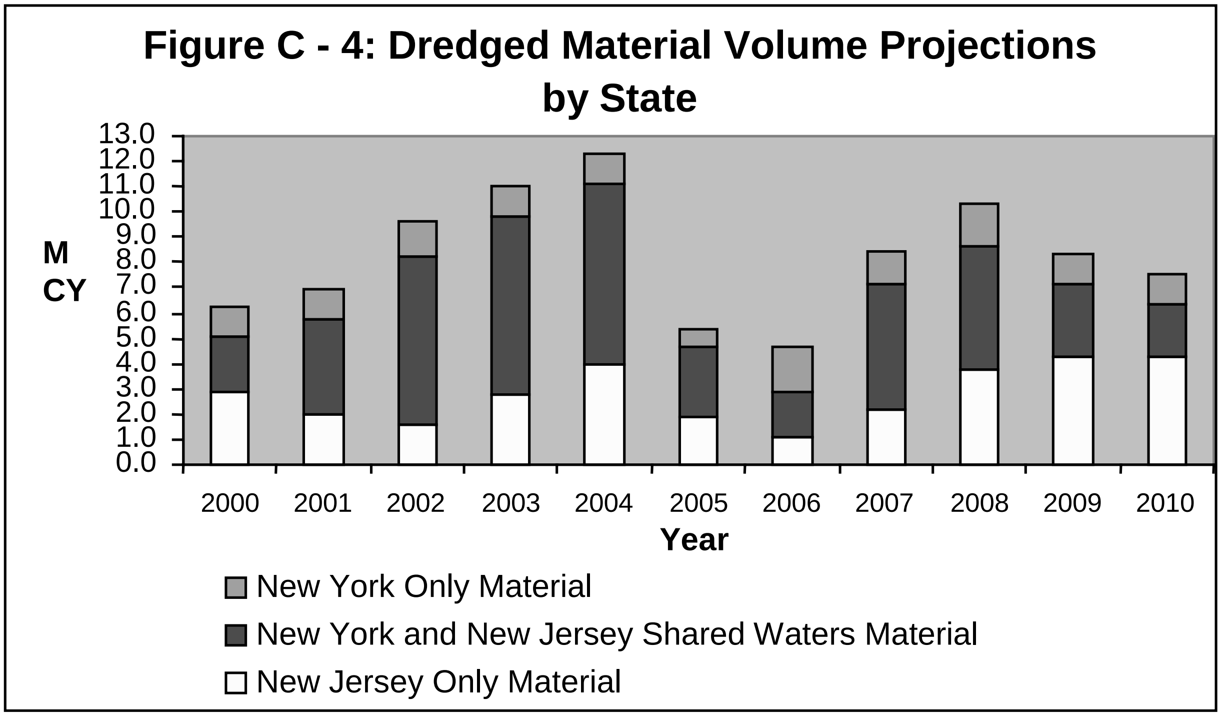


Figure C-2-4 Dredged Material Volume Projections by State



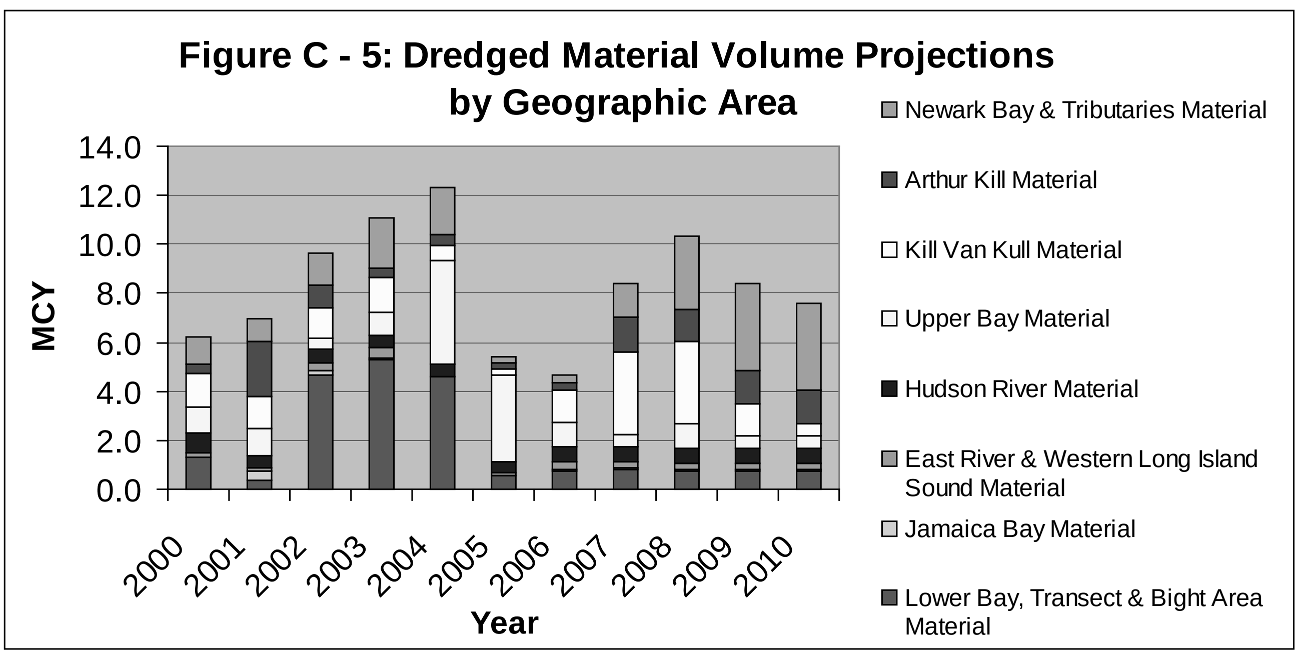


Figure C-2-5 Dredged Material Volume Projections by Geographic Area

Table C-2-1 Detailed dredged Material Volume Projections

Detailed dredged Material Volume Projections page 2

Detailed dredged Material Volume Projections page 3

Detailed dredged Material Volume Projections page 4

Table C-2-2 Dredging Requirements Volume Projections Summary

Dredging Requirements Volume Projections Summary page 2

D FORMULATION OF PLANS

D-1 EVALUATION FACTORS

Section B of this Appendix described the technical information regarding the various options that could be utilized to manage HARS suitable and HARS unsuitable material.

Clearly, no single option or site will be able to meet all the dredged material management needs of the Port. Also, many uncertainties exist regarding actual dredging needs, the future quality of sediment from different parts of the Harbor and the cost effectiveness and efficiency of a number of newer and developing management options. The challenge is how best to combine the various options to meet the short and long-term needs of the Port in an economical and environmentally acceptable manner. The more traditional USACE approach of a fixed plan based strictly on proven solutions and lowest cost does not fulfill this challenge. The plan must be flexible enough to respond to change. Since the timeframe agreed to among the stakeholders for this DMMP is 40 years, some of the decisions in implementing evolving management strategies can be programmed for the future. This will allow the opportunity to test and evaluate a number of promising techniques now under development.

A number of different factors must be taken into account when combining the various options into a comprehensive plan. These factors (listed below), provide the rationale for developing the recommended course of action for the DMMP.

- Environmental Protection/Enhancement
- Availability
- Reliability
- Flexibility
- Capacity & Project Life
- Localizing Impacts
- Bi-State Equity
- Economic Benefits & Costs

ENVIRONMENTAL PROTECTION/ENHANCEMENT – The primary concern related to dredged material management stems from the potential effects that may be caused by the trace levels of contaminants found in the majority of material to be dredged. Accordingly, the protection and, when possible, the enhancement of the environment is the primary consideration in developing the DMMP.

To fully assess the potential impacts of each of the options that have been under consideration for the DMMP, a draft Programmatic Environmental Impact Statement (PEIS) has been prepared and accompanies this DMMP. It evaluates, to the extent that is possible given currently available data, the potential positive and negative environmental, cultural and social impacts of the options which may comprise the recommended action.

Fundamental to the management of HARS unsuitable material is the concurrent implementation of additional contaminant reduction measures (*e.g.*, point and non-point pollution source control, remediation of existing sediment hot spots, etc.) to eliminate future generation of HARS unsuitable material. Until this goal can be realized, three main types of options for HARS unsuitable material – treatment/decontamination options, containment options, and the no action option. While the no-action option may appear to have less risk or environmental harm than the with-action options, in actuality the no-action option is less environmentally preferable. It leaves existing contaminated sediments in channel areas exposed to impact and bioaccumulate into the ecosystem and also incurs adverse other transportation impacts (see PEIS for additional information on the no-action option).

While most environmental concerns related to dredged material management stem from concerns over the potential effects of contamination, other environmental concerns not related to sediment contamination also exist. These concerns, such as increased turbidity, effects on the physical environment (*e.g.*, shoreline erosion), grain size suitability, etc. must also be considered for options under consideration for both HARS suitable and HARS unsuitable material.

Given that the HARS is only to be used when no practicable option is available, a wide range of environmentally preferable beneficial use options exists to utilize this material. These options include beach nourishment (which has been and will continue to be used when possible), construction aggregate, filling existing degraded pits, creation of habitats, etc.

AVAILABILITY – This factor addresses the time required to implement the various options used in the development of the DMMP. Implementing options that need long planning, engineering and construction time are less favorable than options that can be implemented relatively quickly. Also, availability also favors the use of many options in use at any time in that one option may be able to be made available to fill in for other options that may not have been able to be implemented. Some options (*e.g.*, land remediation) can be implemented in a relatively short period of time while others (*e.g.*, an island CDF) require considerably more lead-time.

RELIABILITY – An important consideration in the development and implementation of the DMMP is the reliability of the options. Investments in Port development, both public and private, are generally based on long-term forecasts of cost levels and stability. Therefore, for a DMMP to be successful from a business perspective, it must be sufficiently reliable to allow for timely and cost effective maintenance and expansion of Port facilities as needed.

In addition to other factors described in this section such as cost and capacity, reliability also relates to other, more intrinsic, factors. For example, reliability also is dependent upon the ability of the region to forecast and actively address future potential dredged material management needs so that they can be met before crisis conditions are encountered. The management *process* by which future needs are identified and decisions made to accommodate them in a timely manner are fundamental to the successful implementation of the DMMP.

Some options or methods of managing dredged material have been in existence in the region for several decades while others are at preliminary stages of investigation. While the DMMP may consider and even recommend options with little proven reliability, it must also address the risk, uncertainty, and potential contingencies of such options in the event they are not implemented as fully as anticipated.

FLEXIBILITY – Similar to availability and reliability, flexibility is a factor desirable in the development of the DMMP. For purposes of this comparison, it is the ability to change readily change from one option to another, as needed. Implementation of some options (*e.g.*, site-specific land remediation) can be varied, as needed, during their operation to expand to accept more or less material. Other options (*e.g.*, island CDFs) require considerable capital investment during their construction and consequently require a known, typically large, volume of material to be placed or processed at the site to be economically feasible.

CAPACITY & PROJECT LIFE – Options that can manage substantial volumes of the anticipated future dredging needs for as long as possible are preferable to short period or otherwise limited needs. Under-projecting the yearly dredging need has, in other areas of the country, caused substantial disruptions in the ability to maintain and expand Port facilities. According to EC 1165-2-200, a dredged material management plan should allow for unimpeded maintenance of a channel for at least twenty years while the maximum planning horizon for channel deepening studies is fifty years (EP 1165-2-1). As several channel deepening studies/projects are currently underway, a longer project life is preferable.

LOCALIZING CONTAINMENT IMPACTS – One specific environmental consideration that various environmental groups and others have raised is to place dredged material in a site close to where it is dredged. This is to minimize the potential for transport of contaminants from one area of the harbor to another through the disposal process. This concern is especially applicable to the contained aquatic disposal facility option as it involves the open water placement of material. It is also preferable for other beneficial use options, when possible, to utilize sites adjacent or close to the dredging site to minimize concerns related to the potential loss of material in transport.

BI-STATE EQUITY – Given that the Port is split between the States of New York and New Jersey, the material to be dredged is generated from both states' waters. Consequently, options which partition the impact equitably between both states jurisdictions is preferred over those which over utilize one state more than the other, or options that have a particular reliance on a single state's territory.

ECONOMIC BENEFITS & COST – Economic benefits and costs are a major consideration in the long-term maintenance and viability of the Port. Historically, the placement cost of ocean disposal of dredged material (the predominant management method used in this region prior to the implementation of the revised Green Book testing protocols) was essentially $ 0/CY. Shortly following the implementation of the more environmentally protective protocols, dredging and disposal costs for material unsuitable for direct beneficial use peaked at over $ 100/CY and have subsequently been dropping to lower levels to the current placement cost of $29/CY. Given this wide range of costs, several factors must be considered in the economic evaluation. First, the costs developed for the different plans considered have been for the cost of placement, since the dredging and transport costs are different for each project. For purposes of cost-sharing, however, the entire dredging, transport and placement of different options must be evaluated. Another consideration that must be factored into this evaluation is changing benefits. Options, such as those that create or remediate impacted are to make them usable land, would also generate additional economic benefits.

Long-term budgetary constraints are another concern that needs to be considered. For example, future fiscal constraints may not allow for a disproportionate amount of Federal funds being used to maintain a single Port. Further, as relatively high dredging costs continue, market forces will force business interests to transfer to other locations, to modify their present methods of transportation, or to quit altogether. This is particularly true for the smaller Port users (*e.g.*, marinas, dry docks, etc.) as their overall budget cannot accommodate relatively high dredging costs for long periods of time.

D-2 FORMULATION OF DMMP

This DMMP Implementation Report is the culmination of a multi-year iterative process. It has gone through several working drafts since June 1998, being reviewed by the many stakeholders through the DMMIWG process and a Senior Executive Review Group (SERG). The SERG is made up of the upper-level management from the Corps (North Atlantic Division), USEPA, U.S. Coast Guard, the State of New York, the State of New Jersey and the PANY/NJ. A working draft of the PEIS has also been reviewed by those agencies that agreed to serve as cooperative agencies under NEPA.

The SERG directed the formation of a work team, comprised of staff from each of its member agencies, to work with the NYD to evaluate the remaining options and come to consensus on those that should be part of the plan. This was accomplished by assigning a preference to each option based on its potential to beneficially use dredged material (especially for environmental restoration/remediation), or safely contain it. The following rankings were used to indicate the preference of each option:

2. Preferred option: Options that beneficially use dredged material, often with a positive impact on the estuary.
3. Fall-back option: Options that can safely manage HARS unsuitable material and not pose an unacceptable risk to the estuary when properly sited and utilized.
3. Uncertain option: Options that require more analysis regarding technical or economic feasibility but warrant continued consideration because of their potential to beneficially use dredged material.
4. Least preferred option: Options that have either a low potential for beneficial use and/or a potential for unacceptable risk to the estuary.
5. Non-preferred option: Options that have potentially unacceptable impacts or are technically/economically infeasible.

Using these preference levels as the primary selection criteria, the Recommended DMMP was developed. In addition to the DMMP, three other alternative plans were developed for evaluation. These alternative plans are the No Action Alternative, the Environmentally Preferred Plan, and the Base Plan. The following paragraphs briefly describe the key elements of each of these plans.

D.2.1 RECOMMENDED DREDGED MATERIAL MANAGEMENT PLAN FOR THE PORT OF NEW YORK AND NEW JERSEY

The Recommended Plan updates and builds on the DMMP developed by the NYD in December 1998. In addition to considerations such as environmental impacts and cost, it has constraints that partition some of the material dredged based on state boundaries, with material from NY waters not relying on NJ options and material from NJ waters not relying on NY options. This constraint was a decision on the part of both states; and was memorialized in the *Joint Dredging Plan for the Port of New York & New Jersey*, October 1996 issued by Governors Whitman and Pataki. The Joint Plan consisted of three parts: a bi-state component representing initiatives common to the two states, and individual components particular to each state's dredging needs. This strategy is intended to ensure that the states share in the responsibility to implement and site the recommended options. Dredged material from channels in shared waters (many of the Federal channels) may go to options sited in either state based on need and availability.

Another constraint employed with selection of options was to, to the extent practicable, keep material confined within the general water basin from which it was removed. This especially applies to new subaqueous CAD facilities. For example, material dredged from Newark Bay/Arthur Kill would be targeted to sites identified in Newark Bay; and the Upper Bay, East/Hudson River material to sites in the Upper Bay. However, since new CAD facilities are not included in the Recommended Plan, this constraint had little effect.

While cost was a consideration in the selection process, it was not the primary factor in deciding whether to include an option in the Recommended Plan. This means that in some cases more costly options were selected because they yield additional desired benefits (*e.g.*, environmental). Since this was done to meet the region's important environmental goals, the stakeholders accepted the responsibility of the added costs this approach will incur.

The overall plan, which will be reevaluated by the regional stakeholders on a yearly basis, must be flexible enough to respond to change and take into consideration that preferred options may also affect the justification (as measured in the benefit to cost ratio) for any specific Federal dredging project. These options will continue to be explored in future updates of the DMMP, as they become available and specifically identified.

As there is a considerable amount of deepening work planned over the next ten years, two timeframes were developed to describe the DMMP, the 2010 plan and the 2040 plan. The 2010 plan covers the time period of 2000 – 2010 and describes in greater detail the options and volumes used. The 2040 plan covers the time period of 2011 – 2040 and includes longer-term options such as contaminant reduction.

THE 2010 PLAN

The initial part of the plan covers the next ten calendar years (beginning in 2000), which includes the planned and underway deepening projects, as well as the anticipated maintenance volumes to keep the existing or improved channels/berthing areas open. The 2010 plan relies exclusively on preference 1 options from Table 2 – 2 of the Implementation Report, looking to create, remediate and restore a variety of existing degraded or impacted habitats in the region with suitable material. The remaining material is treated and stabilized, as needed, and then applied to remediate degraded and potentially polluting areas such as brownfields, landfills, and mines or converted to marketable products at the NJ processing facility and private decontamination facilities.

Table 3 **–** 1 of the Implementation Report summarizes the recommended 2010 plan. It provides more detail than the December 1998 DMMP, and includes ongoing (KVK deepening to 45 feet), planned (Arthur Kill and Port Jersey deepening to 41 feet), and potential deepening (as described in the soon-to-be released draft NY & NJ Harbor Navigation Report). Table D-2-1 contains a more detailed breakdown of volumes, options and yearly costs of the DMMP Recommended Plan (from 2000 through 2040).

Of the total HARS unsuitable material needed to be dredged through 2010 (27.3 MCY), about two-fifths would be treated and used to remediate various NJ upland sites (listed in Table 2 – 2) and one-fifth treated and used to remediate the Lehigh Anthracite Mine in PA. Another 8.8 MCY are processed and converted to marketable products at the NJ processing facility and the private decontamination facilities. Of the remaining HARS unsuitable material, another 440,000 CY would be used to complete the demo project at Bark Camp mine in PA, with smaller volumes used to cap the Fountain and Penn Landfills in NY, and 100,000 is used to create marsh habitat at the head of Claremont Channel in Jersey City, NJ. These options and the other remaining preference 2 options combined provide capacity considerably in excess of the currently estimated needs through 2010. Nearly all of these options have a placement cost of approximately $29/CY for HARS unsuitable material or less – in some instances, substantially less. This allows these options to accommodate more material should additional needs develop beyond those currently projected.

Given the plans for deepening in the Harbor, nearly twice as much HARS material (about 54 MCY) has to be managed over this same timeframe. The Recommended Plan takes maximum advantage of the suitability of much of this material for land and ocean remediation, at HMDC landfills (clay only), Hunterdon quarry (sand only) and at the HARS. These three options utilize approximately 49.4 MCY of HARS suitable material. Smaller amounts of material are also used, when possible, for beach nourishment and construction material. Approximately 1.8 MCY of HARS suitable material is used for a habitat restoration project in Norton Basin, Jamaica Bay, NY. The remaining volume is used to create oyster, shellfish and bird habitat, and to cap the Newark Bay CDF.

As mentioned earlier, most options for HARS unsuitable material have a user placement cost of $29/CY or less. It is assumed that additional sites would be approved for processing and decontamination facilities, and that they, along with the other upland remediation options, would be sponsored/supported as needed by non-Federal entities to maintain the $29/CY price. If the price of remediation can't be substantially reduced from its current levels, or sites aren't approved, other options will be substituted using other preference 1 options or preference 2 options listed on Table 2 – 2 of the Implementation Report. These disposal options would be used only if a preference 1 option was unavailable in the timeframe needed. Their use would be limited in duration until a preference 1 option was available.

Of note is the shortfall New York has with respect to options for HARS unsuitable material through 2001. Of an approximately 1.0 MCY of material anticipated from NY waters during those two years, over 500,000 CY currently has not been assigned a DMMP option. Contract disposal (described in Section 2.7) however, may be used to address this shortfall on a project-by-project basis. This could alter or delay some scheduled private maintenance work in NY waters, but is not expected to impact the ongoing or planned Federal deepening projects.

THE 2040 PLAN

The 2040 Plan covers the Port's needs for the thirty years following completion of the majority of the channel/berthing area deepening and other Port improvements. It is primarily aimed at managing maintenance material, including increased volumes needed to keep the deeper channels open. The plan is based on an assumption that contaminant reduction programs are implemented to meet the targets established in section 2.1 of this report, thereby converting a significant portion of the volume of HARS unsuitable material to HARS suitable material (approximately 34 MCY). It employs only preference 1 options from Table 2 – 2 without the need to use any lower preference options. This plan is summarized in Table 3 – 2 of the Implementation Report, and is shown in greater detail on Table D-2-1. Overall, the 2040 plan is less detailed, because outyear dredging needs, funding, future shoaling and contaminant reduction rates are uncertain. Based on the options used in the Recommended Plan, Figure D-2-2 plots the annual total placement cost for managing the projected dredged material need in the region from 2000 through 2040.

Similar to the 2010 plan, the 2040 plan relies heavily (in fact, *entirely*) upon the use of land remediation and decontamination methods for the management of HARS unsuitable material. HARS suitable material, which is anticipated to increase on a yearly basis due to future pollution prevention efforts, achieves the minimal requirement for remediation of the HARS relatively early in the 2040 plan (currently estimated to occur in 2018). When the HARS reaches its minimal remediation capacity, the USEPA may then determine whether applying additional remediation material is prudent and beneficial to the site. Reasons for applying further material may include using a cap layer thicker than the one-meter layer currently projected, or replacing material that may have been lost due to erosion or consolidation. At the point that the USEPA does consider the HARS to be fully remediated, the NYD will work in coordination with the other regional stakeholders to identify and develop other comparable beneficial use opportunities for the excess HARS material.

As in the 2010 Plan, maximal uses of all practicable alternatives to the HARS are used. These options include remediation of Hunterdon quarry, NJ with 13 MCY of sandy material and beach nourishment with remaining sandy material (approximately 4.5 MCY). For HARS unsuitable material, approximately 19.3 MCY of stabilized material is used to remediate land sites in New Jersey and Pennsylvania (Lehigh Anthracite mine). Also, 6 MCY are processed over the 30 years at the NJ processing facility. The remaining HARS unsuitable material is managed by utilizing decontamination technologies with beneficial reuse (approximately 20.3 MCY).

D.2.2 NO ACTION ALTERNATIVE

This scenario is not a comprehensive management plan for dredged material and is not regionally supported. However, analysis of this scenario is procedurally required under NEPA and is useful for comparison purposes. Without a comprehensive and regionally supported DMMP, dredging and disposal continue on a project-by-project basis, so long as funding and privately developed placement options allow. This type of approach does not take advantage of the economies-of-scale or the reliability inherent in any other alternative; hence, the overall cost would likely be high. This project-by-project approach would also increase concerns by Port businesses about the long-term reliability of maintaining their channels and berths. Concerns such as these are likely to deter investment in the region, negatively impacting the expected increase that is currently projected for Port commerce. This in turn would reduce the dredging required to maintain commerce and for navigational safety, further reducing the reliability and economic viability for Port users. Eventually businesses would likely move out of the region, with a negative long-term effect on the economy.

Without a defined plan, long-term and/or innovative programs are less likely to be investigated or funded through demonstration or pilot phases. This is likely to reduce the potential for decontamination and sediment treatment options coming on line as full-scale, standard options. Similarly, the support for and commitment to contaminant reduction may also be diminished, without the potential economic benefit to the Port to push it. The volume of contaminated sediment that would be removed from the system each year would also be reduced, resulting in a substantial slowdown in the recovery of the estuary. Environmental impacts may again be addressed in a more piecemeal fashion. Plans and funds for restoration projects would be more difficult to pursue and justify. Similarly, other benefits associated with land remediation, such as the reduction in pollutants leaching out of contaminated sites into ground and surface waters, and the return of economic uses of these contaminated sites, would not be likely under the No Action Plan.

D.2.3 ENVIRONMENTALLY PREFERRED ALTERNATIVE PLAN

This plan, also procedurally required under NEPA, would be based solely on environmental benefits to the estuary, without considering cost, proven reliability, or local support, although the state boundary constraint described earlier still applies. This plan places primary importance upon selecting options that maximize the potential for habitat restoration and other environmentally beneficial uses. Both sediment stabilization and high-end decontamination technologies are utilized to remediate existing off-channel hot spots in the Harbor and to create suitable material for land remediation, construction projects and other uses. By remediating off-channel hot spots in the Harbor through the maximal use of decontamination technologies, additional contaminant reduction is assumed causing an even quicker recovery of the ecosystem from past and present pollution. The identification of potential hot spots for remediation, however, and the potential effect of their removal on the recovery of the ecosystem are (as yet) undetermined.

A variety of potential habitat restoration methods are also used (*e.g.*, creation of marsh, oyster, shellfish and bird habitats, restoration of habitat by filling existing degraded pits). Maximizing environmentally useful options disallows the use of containment or disposal options. With the greater usage of habitat restoration options (*e.g.*, filling existing degraded pits), the cost of the environmentally preferred plan could be *less than* the Recommended Plan of action. However, the State of New York and the NYD have jointly determined that the further utilization of existing degraded pits (*e.g.*, in Jamaica Bay) should proceed only if the data collected from the Norton Basin restoration project illustrates the environmental benefit of the project. This information must also be sufficiently documented to convince involved agencies and public that application of the technique to other existing degraded pits to warrant issuance of permits for further restoration. Since the use of these habitat restoration options assumes this benefit (as currently anticipated but yet unproven), the use of these options in the Recommended Plan is not prudent at this time.

D.2.4 BASE PLAN

The Base Plan, a requirement for all DMMPs (EC -1165-2-200), identifies the least costly, environmentally acceptable plan. It identifies the base cost for meeting a given objective (in this case, managing dredged material to keep the navigation channels in the Port open). The reader should note that while Corps regulations require the development of a Base Plan, some of the options used in the plan may never be implemented due to the preference of the region to use more beneficial or reliable options (in accordance with the goals established for the DMMP in Chapter 1).

In developing the Base Plan, the distinction between options using material from each state's waters was still applied in that each state could potentially enter into a different cost-sharing agreement with the Corps. For this economic analysis, all those options with a preference ranking from 1 – 4 were considered (with the exception of a Lower Bay CAD facility in zone 2, which is a non-preferred option by some stakeholders). Options that were not included in the Recommended Plan because they may not meet more stringent state or local criteria may be in the Base Plan, as long as they meet Federal standards. Costs incurred to meet more restrictive standards generally would be considered the responsibility of the entity imposing those standards.

The primary difference between the Base Plan and the Recommended Plan in section 3.1 is the cost savings based on the (presumed) large-scale use of habitat restoration of degraded pits and the use of additional CAD cells in Newark Bay. Over the course of the 40-year planning horizon, the use of these new Newark Bay CAD facilities and further restoration of Jamaica Bay pits could save over $850,000,000.

Most HARS unsuitable material from New Jersey waters is managed in the Base Plan by constructing new CAD facilities in Newark Bay. Combined, these options manage approximately 26 MCY of material generated from navigational dredging in New Jersey waters and from construction of the facilities themselves. New CAD cells in Newark Bay, constructed to meet annual dredging needs, are not expected to generate significant long-term impacts (a more thorough assessment of the impacts of CAD creation, operation and closure will not be complete until the currently operating NBCDF is closed). By using the Newark Bay CAD facilities, the Base Plan does not provide the environmental and socio-economic benefits of the Recommended Plan, and does not meet regional goals of dual Port and environmental benefits.

The remaining New Jersey material (approximately 18.5 MCY) is managed using a combination of the NJ processing facility, New Jersey land remediation sites, and private decontamination facilities. A relatively small portion of New Jersey material (100,000 CY) is used in 2000 to create marsh habitat at the head of the Claremont Channel in Jersey City, NJ.

Material from New York waters and, when possible, from shared waters (*e.g.*, KVK, Arthur Kill, Hudson River) is primarily used to restore degraded pits in Jamaica Bay (Little Bay, Grassy Bay and JO/CO Marsh pits) and the Hoffman/Swinburne south pit in the Lower Bay. The total volume of material used as fill in these pits is approximately 28.2 MCY. Approximately 2.2 MCY of material from New York waters is anticipated to be decontaminated in years 2001-2003 while the habitat restoration potential of filling the degraded pits is evaluated.

Based on preliminary studies, the Jamaica Bay borrow pits are believed to have limited habitat value due to poor flushing and impacted surficial sediments. Consequently, restoring the habitat at these pits (by filling with HARS unsuitable material capped with HARS suitable material) is not expected to have a significant adverse impact (This is as yet unproven pending small-scale localized pilot projects described in Section 2.3.2). Therefore, these options are assumed to meet Federal standards for environmental acceptability and are included in the Base Plan.

The Base Plan utilizes the same options for HARS suitable material as the Recommended Plan with the exception that material is not used to remediate the HMDC landfills, the Hunterdon Quarry, and for beach nourishment as these options all have costs notably greater than that of ocean remediation. As the Base Plan utilizes CAD options, a considerably larger amount of HARS suitable material is generated. Consequently, the HARS site reaches its minimum remediation objectives years earlier than in the Recommended Plan. . Table D-2-2 illustrates, in detail, the Base Plan for the Port of NY & NJ.

The Base Plan assists in determining what, if any, added cost would have to be incurred to implement an alternative approach, such as the Recommended Plan described in Section D.2.1 above. This additional cost (termed the incremental cost) generally serves, in combination with other relevant analyses, as the basis for determining a Federal/non-Federal cost-sharing ratio of this added cost. However, this determination must be made on a project-by-project, option-by-option basis.

At present, the costs of the land remediation options (used in the Recommended Plan) appear to be comparable to Newark Bay CAD facilities used in the Base Plan. However, the cost difference between the land remediation options used in the Recommended Plan and the habitat restoration used in the Base Plan is more substantial. Over the course of the 40-year planning horizon, the use of these new Newark Bay CAD facilities and further restoration of Jamaica Bay pits could save over $850,000,000 in placement costs.

However, the use of land remediation and decontamination options (as in the Recommended Plan) does generate substantial environmental and economic benefits to the region. Since these benefits have not been evaluated and quantified from a Federal perspective, they cannot presently be used in the formulation of the Base Plan to counteract the higher cost of the preferred options. Consequently, should the environmental and economic benefits of the land remediation and decontamination options be further evaluated from a Federal perspective, then they may be shown to have the least net cost and would therefore be selected as Base Plan options.

Currently though, preferred non-traditional options are included in the recommended DMMP if they are anticipated to have total costs comparable to those identified in the Base Plan. For example, should preferred land remediation options be at a total cost (*i.e.*, dredging, transport, treatment, placement, etc.) comparable to that of a typical Base Plan option, then, because of the other additional significant environmental (or other) outputs provided to the region, the land remediation option is included in the DMMP Recommended Plan and will be utilized. However, should the cost differential between typical Base Plan options and the regionally preferred options become significant, then additional separate Federal evaluation of the national environmental or other benefits may need to be performed to justify cost sharing the difference. Included in this additional evaluation is the potential Federal cost sharing possibilities for beneficial use of dredged material. If a federal cost sharing of the incremental difference cannot be justified, then the non-Federal sponsor would bear the remaining incremental cost difference. Similarly, if the production rates for a beneficial use project cannot keep pace with dredging contract schedules, then the non-federal sponsor would need to commit additional resources to meet the schedule, or risk project delays. To avoid this situation, the non-Federal sponsor may choose to implement a preferred contingency option. Another solution that the non-federal sponsor may employ would be to either provide additional processing capacity or contract with another vendor to provide the additional processing capacity needed to meet the schedule.

New Jersey is currently working on acquiring its own processing facility and an innovative contracting mechanism (NJDIG) which would enable the State to direct dredged material as necessary to meet project and regional goals.

Generally, the incremental cost difference between the Recommended Plan and the Base Plan would be paid in full by the non-Federal sponsor that requests an alternate plan be used instead of the Base Plan. However, as mentioned earlier, when the cost differences are comparable between the sponsor-preferred option and the Base Plan option, then the Secretary of the Army can waive this requirement. This is especially true if a case can be made for significant environmental outputs resulting from the added investment required to implement the Recommended Plan. Also, under section 204 of Water Resources Development Act (WRDA) of 1992, projects for the protection, restoration, or creation of aquatic and ecologically related habitats may be undertaken if the Secretary finds that the environmental, economic, and social benefits of the project, both monetary and nonmonetary, justify the cost thereof and the project would not result in environmental degradation. If this requirement is met, up to 75% of the incremental costs of carrying out the Recommended Plan can be paid by the Corps, within the authorization limits of section 204 ($15 million annually) and subject to congressional appropriation.

The DMMP does represent a special case because it has been developed and approved through regional consensus among States, the USEPA, the Corps and the PANY/NJ. The dual goals of the DMMP (keeping the Port open and restoring the estuary) are regional goals. They represent the combined desire of these agencies, which share a responsibility in meeting the incremental costs associated with achieving those inseparable goals.

Figure D-2-1 Annual Total Placement Cost of Recommended Plan

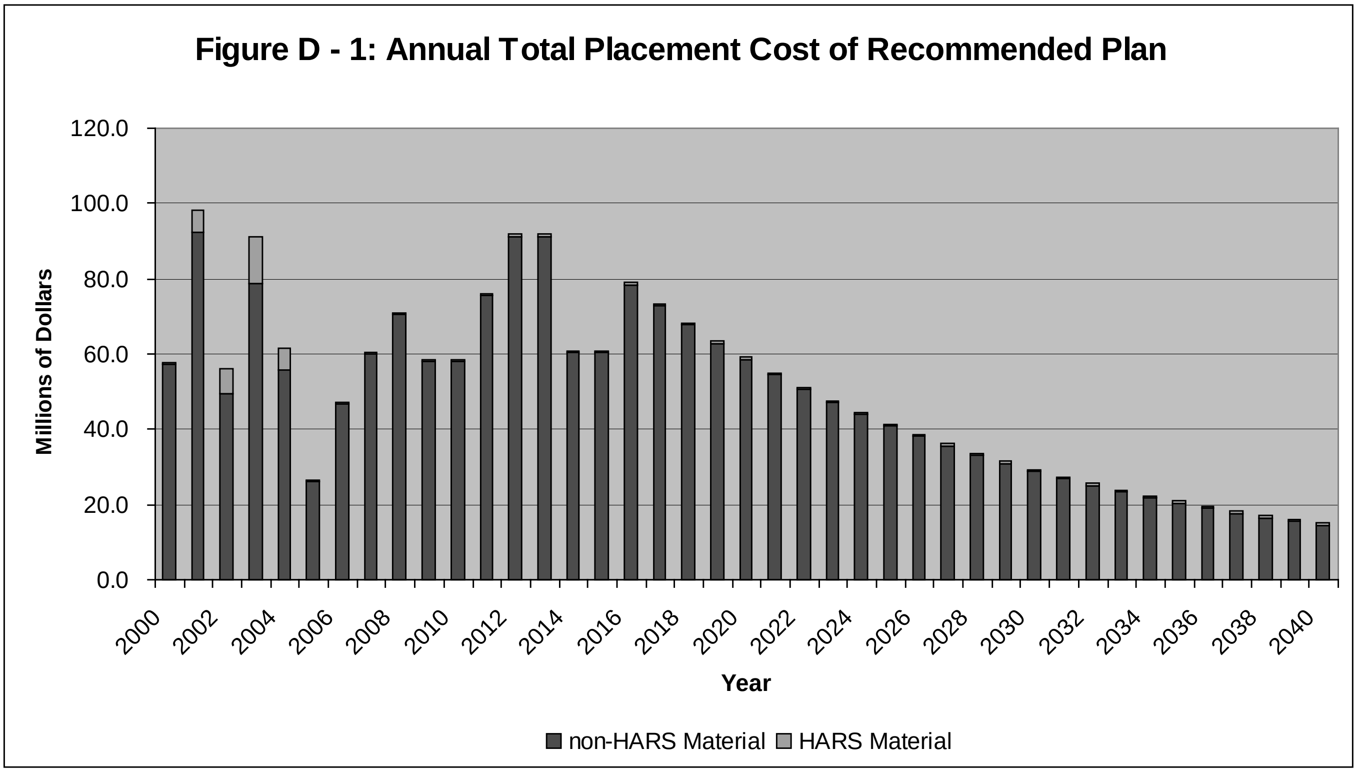


Table D-2-1 Recommended 2000 – 2040 Dredged Material Management Plan for the Port of New York and New Jersey

Table D-2-2 2000 – 2040 Detailed Base Plan for the Port of New York and New Jersey