

According to these findings, where loadings are in the tens of milligrams of metals per cubic meter of sediment per day, removal / sequestering rates may be relatively high. Since sediments in contact with the rhizosphere are prone to redox changes and metal mobilization, it should be recognized that these areas may be regulators of metal movement, but not ultimate sinks for the metals tested here. On the other hand, direct and indirect measures indicate that marshes and sediments are resistors and regulators of the movement of metals, and as such, afford some protection to human health and to surrounding food chain and food webs. These data indicate, however, that marshes act as regulators of metals at the tens of parts per billion level. At higher concentrations, marshes may become sources for metal release into estuaries. In sedimentary environments, however, marshes may be expected to accrete metals, especially lead, over time. Migration of some metals from sediments containing parts to tens of parts per million should also be regulated or suppressed in a sedimentary environment. Arsenic, cadmium, chromium, copper, lead, nickel, and zinc occur in the Royal Marina sediments in this range, and will be investigated as to mobilization.

4.2 Any adverse environmental effects which cannot be avoided should the proposal be implemented;

Dredging resuspends some sediments. While this can be mitigated, to some extent, by using silt curtains to contain the distribution of materials in suspension, there are limits to the efficacy of these measures. One reason for this is physical. A coarse silt particle 0.01 mm in diameter settles at 1/10,000 of a meter per second, or, a meter in about three hours (Peavy et. al. 1985, p131). Fine clay particles may take as much as a day to settle 1 meter. Silt curtains would therefore have to be left up for one to several weeks for these particles to fully settle out.

Some resuspension is also likely to occur while placing the sediments in the containment facility. While the exact mitigation steps to minimize negative impacts have not been yet worked out for this operation, the rock armor of the containment facility, and finer rock of the central core (if the facility is constructed in this way), would act to minimize suspended sediment dispersal because quiescent waters in the interstices between armor and gravel are from part of an inch to a few inches in diameter at a maximum. For the particles left suspended within these spaces, settling rates would be relatively large compared to the dimensions of these spaces and forces acting to move water out of these interstices. Similarly, gravitational and viscous forces on these interstitial spaces would be large compared to pressure differences acting to move water through these openings. While finer silts, clays, and organic colloids may settle only a meter or less in a year, other mechanisms such as coagulation with algae, bacteria, larger organic and inorganic particles, and adhesion to surfaces act to remove these materials from the water column.

With silt curtains around the perimeter of the entire 600' length and 270' width of the Royal Marina, to an average depth of 6', effects would be limited to about a million cubic feet, or about seven million gallons of water. By way of comparison, this quantity of water is about one three hundredths of surrounding Eastchester Bay, or about one third of one percent.

To compare this adverse environmental impact in terms of the effects of the Pelham Project's restoration of salt marsh, about ten acres of tidal marsh would filter out the fines in about a million cubic feet of water in one tidal cycle. So while the initial dredging of 20,000 yards of sediments from Royal Marina will increase the load of suspended solids in about a million cubic feet of water, a one and one half acre marsh constructed with these sediments would physically filter a million cubic feet of water in about a week, and continue in perpetuity to filter about 50

times this quantity each year. Using similar projections as hypotheses, the Pelham Project aims to quantify these filtration and sedimentation rates in constructed and control marshes.

#### 4.3 Alternatives to the proposed action;

With two possible actions of dredging or non-dredging, and wetland construction vs no wetland construction, there are only four possible outcomes: no dredging and no wetland construction; dredging with no wetland construction; no dredging with wetland construction; and dredging and wetland construction.

##### No Action Plan: No Dredging and No Wetland Construction.

If the sediments at the Royal Marina are left in place, contaminants will not necessarily remain 'locked in the sediments'. Natural forces are likely to intervene, and resuspend sediments in the water column through storm surges or wind driven wave action from the southwest. From anthropogenic causes, sediments will also be resuspended by the 30 to 40 foot per second scour of inboard and outboard motor thrust. While shallower slips are often less costly, they may leave power boats unusable during parts of the tidal cycle. Vessels of all sizes have utilized 'hydraulic dredging', turning up the throttle while docked to resuspend sediments to deepen slips and dockage, creating negative impact on the surrounding estuary. It is likely that such activities usually occur without regard for windows of least impact on fish or shellfish life cycles.

Dredging, on the other hand, would be done as a staged activity, in a regulated fashion, with due regard to spawning periods of fish and shellfish, larval settlement, juvenile sensitivities, and other key parameters of the life cycles of the biota in the surrounding waters .

The no action plan would have other impacts, as well. While dredging can add value to a marina, any potential for water based uses will be irretrievably lost without dredging. Derelict properties adjacent to the Royal Marina attest to the financial difficulties of water based economic activities in recent years. The non-dredging scenario will inevitably lead to consideration of other, non-water based uses of these waterfront properties. Commercial developments presently under consideration include a crematorium, and shops and condominiums. The latter would add stresses on existing infrastructure, from crowded roadways, to crowded classrooms. In other words, the no action plan would have irretrievable effects in the immediate and the long term future of water based economic activity of City Island, and concomitant negative effects on the Long Island Sound coastal communities of Queens, the Eastern Bronx, and surrounding coastal counties in general.

##### Dredging Without Building Local Wetlands.

Sediments may be removed from the Royal Marina and disposed of upland or below the waterline without the construction of intertidal marsh habitat. While this reflects past disposal options, this is now possible only in theory, since there are no cost-effective disposal means which would be affordable for the Royal Marina or other similar facilities. While dredging alone would alleviate short and mid term problems of slip depth, allowing access of deeper draft vessels through all parts of the tidal cycle, it does not address the problem which bulkhead and seawall infrastructure have created in channelizing flow and eliminating shallow, depositional, productive marsh environments. Also, disposing of sediments rather than incorporating these in habitats which remove BOD, nitrate, and suspended solids does not benefit water quality in the region where the dredging occurs. Neither can upland or deep water disposal support fin fish habitat creation and production. Finally, these alternative disposal means do not in any way rectify the local loss of more than a thousand acres of salt marsh, rocky intertidal, and rocky

subtidal habitat or the historic net loss of 45,000 acres (90% to 99%) of tidal wetlands in the whole of New York City.

Since the cost of dredging itself may account for one to several years of profit from a marina, disposal costs are key to maintaining water based activities on coastal properties. Since even the cost of testing sediments may be a substantial fraction of a years profits, low cost local disposal is a necessary inducement to do such testing, since sediment testing may not otherwise be perceived to be a good investment for marina owners. Since time and distance set certain costs in any dredging job, local disposal of local dredging projects provides efficiencies which otherwise are not available.

Building Local Wetlands Without Dredging. Building wetlands serves water quality goals, and increases fisheries production. Since each acre of tidal wetland has been valued at \$75,000 as a water treatment facility (Miller Living in the Environment, p 150), the thirty acre wetland proposed in the Pelham Project would be worth about \$2,250,000. The same source has valued commercial and recreational fisheries production by an acre of wetland at about \$8,000/acre/yea (more broad based approach by Costanza et. al. 1997, arrives at a figure between \$4,000 and about \$9,000/acre/year for similar contributions to ecosystem services) For the proposed 30 acre wetland, this adds up to about a quarter million dollars per year in perpetuity. Wetland construction alone could also contribute to the settlement of legal disputes. For example, a law suite has been filed against New York State by the State of Connecticut for polluting western Long Island Sound. In this context, marshes play a major regulating role in the nitrogen cycle, facilitating particulate organic nitrogen deposition in marshes, warm weather nitrification of ammonia, and 40 lbs/acre/year nitrate removal. Thus constructing marsh systems may then be considered, with other point and non-point pollution programs, as a means of meeting agreed upon standards (Valiela & Teal 1979a; 1979b; DeLaune et. al. 1989; White & Howes 1994). Denitrification along could account for half a ton per year nitrate removal by 30 acres of marshland, and the cost of building such wetlands may be one of the mitigation steps considered as a cost-effective means of meeting interstate water quality goals.

Coupling Local Dredging with Local Wetland Restoration Projects. While salt marshes would be of value to build for themselves for pollutant removal and fisheries production. But for whatever purpose they may be constructed, such marshes need to utilize specific size classes of sediments. These materials are available at Royal Marina and at other sites in local channels and docking areas. Using these sediments adds value to the rest of the local, regional, and New York State water based economy by allowing greater use of the surrounding waterways, and, where incorporated into intertidal marshes, by removing two causes of hypoxia and concomitant fish kills, BOD and nitrate, while increasing fish habitat size, contiguity, and complexity (Bohnsack et. al. 1991; Irlandi & Crawford 1997) and thus adding to commercial and recreational fisheries. Using these specific sediments also diminishes the cost of marsh construction, precisely because they are locally available.

4.4 The relationship between local short-term uses of the environment and the maintenance and enhancement of long-term productivity;

Where sediments are not incorporated into depositional environments, the historic pattern in the Hudson River Estuary and Long Island Sound, development of intertidal habitats which increase ecological productivity, water quality, fisheries production, and environmental health is suppressed. Where such depositional environments become intertidal, they develop increasing

capacities to remove chemicals of concern, including dissolved organic carbon (BOD fraction), nitrogen in the form of nitrate, hydrocarbons, and some metals.

In both short and long term, regional New York City and local Eastern Bronx coastal environments have lost most of their biochemical and geochemical buffering capacity, as well as the majority of shoreline erosion and flood control protection they previously afforded. Channelization, bulkheading, and straightening the coastline all proceeded by in filling in the majority of these wetlands. Evaluated against present measures of marsh capacity, these losses are very large, probably amounting to the removal of 90 to 99% of prior biogeochemical buffering capacity and perhaps a similar reduction in fisheries production. In essence, human built infrastructure has largely eliminated the physical processes in estuaries which had previously incorporated sediments into the productive capacities of estuaries. The coastal environmental has been structured to largely eliminate intertidal depositional environments and the critical habitat these areas provided. The development and accretion of marshes and flats in this manner has been arrested. Human built infrastructure has thus reduced or eliminated long term water quality enhancement from the development of these natural systems.

In the short term, the economy of the Port of New York, together with regional and local economies dependent on water based activities are either declining, or growing at a lower rate than well developed maritime infrastructure would allow. Economic components of the Port are thus suppressed in the short and long term, as are those populations and ecological communities of the estuary dependent on depositional areas, together with the ecosystem services they provide for environmental quality enhancement and fisheries production. This will continue indefinitely into the future under the no action plan.

4.5 Any irreversible and irretrievable commitments of resources which would be involved in the proposed action should it be implemented.

The major irreversible and irretrievable change involved in the proposed action should it be implemented is the covering of sedimentary benthic habitat, due to the placement of dredge materials to bring the salt marsh restoration to the proper grade. As discussed above, this loss of sedimentary benthic habitat is balanced by production of equal or greater quantities of rocky tidal and subtidal habitat, which was historically more prevalent in this area than it is now.

In terms of commitments of material resources to build the facility, the Pelham Project aims to quantify how well contaminants in sediments can be effectively broken down or sequestered in constructed salt marshes within containment facilities. To do this, it will be necessary to modify the coastline so that it once again supports larger intertidal marsh communities, as the geomorphology of the coast did in historic times. The capital resources involved in this change are quite modest, even including the cost of initial and on-going studies. The material resources, rock armor for the containment facility together with harbor sediments, are already geo-physical and geo-chemical components of the ecological systems of the estuary. Since it is necessary to move sediments to make the Port of New York viable, and since sediments, and the rock armor to contain them, are essential components of intertidal salt marsh and rocky habitat, the aim of this project is to restore coastal communities which, to this moment, have been irretrievably lost to bulkheading and channelization.

In this case, the environmental impact of the no action plan will lead to the irreversible and irretrievable loss of the competitive viability of the Port of New York, and to a continuance of

the status quo of relative economic decline of the water based economies of the region. On the other hand, constructing wetlands on sediments dredged from nearby piers and channels to create salt marshes will incrementally serve local, regional, and national economies by lowering the costs of water based activities and transport while increasing water quality in the process.

## 5.0 Clean Water Act

Under the Clean Water Act guidelines, and in compliance with the Clean Water Act (CWA), a Joint Application for Permit was filed with the New York Department of Environmental Conservation and the United States Army Corps of Engineers, New York District for approval. The Pelham Project may uniquely fit the intent of the congressional declaration on the Clean Water Act, which addresses the following goals (headings as given in CWA):

- (a) "Restoration and maintenance of chemical, physical and biological integrity of Nation's waters; national goals for achievement of objective The objective of this chapter is to restore and maintain the chemical, physical, and biological integrity of the Nation's waters....
- (2) "it is the national goal that wherever attainable, an interim goal of water quality which provides for the protection and propagation of fish, shellfish, and wildlife and provides for recreation in and on the water...;
- (3) "it is the national policy that the discharge of toxic pollutants in toxic amounts be prohibited;
- (6) "it is the national policy that a major research and demonstration effort be made to develop technology necessary to eliminate the discharge of pollutants into the navigable waters, waters of the contiguous zone, and the oceans; and
- (7) "it is the national policy that programs for the control of nonpoint sources of pollution be developed and implemented in an expeditious manner so as to enable the goals of this chapter to be met through the control of both point and nonpoint sources of pollution.

On all of these points, the Pelham Project is specifically structured to reach the water quality and ecological goals in question.

- (a) The objective of the Pelham Project is the restoration of physical, chemical and biological integrity and activity in order to restore the ecosystem services of lost wetland, intertidal and benthic habitat.
- (2) This project aims to increase the habitat diversity, biodiversity, ecological productivity, and essential fish and waterfowl habitat in and around Eastchester Bay, increasing the value of this area for fishing, boating, and swimming in the process;

- (3) The Pelham Project aims to remove toxics and pollutants from Eastchester Bay, especially BOD, nitrate nitrogen in stormwater and combined sewer overflow, and landfill leachate from these waters to improve water quality and diminish the potential for fish kills and hypoxia;

- (6) It is the mission of the Pelham Project is to demonstrate the feasibility, long term stability, and advantages of engineered constructed wetlands for dredge material treatment and disposal. This research and development program aims to integrate questions from engineering, hydrodynamics, geophysics, biology, and geochemistry to address the removal of chemicals of concern through the ecosystem services provided by wetlands constructed on dredged materials. This research program aims to quantify the pollutant removal by the ecologically based technology of wetland construction and restoration.

- (7) The construction of wetlands around the Pelham Bay Landfill and the southern tier of Pelham Bay Park has the specific goal of removing pollutant inputs from point and non-point sources including storm water, combined sewer overflow, and landfill leachate, while removing or sequestering contaminants in dredged sediments.

The Pelham Project strongly supports the essence of the “no net loss” concept of the Clean Water Act and wetland protection by serving to enhance and expand Eastchester Bay intertidal wetlands including salt marsh and rocky habitat, together with rocky benthic habitat. This also fits the requirements of more recent regulatory aims to enhance Essential Fish Habitat while increasing the beneficial functions and values of these habitats, including, but not limited to, sediment decontamination.

This project reflects the “no net loss” objectives while at the same time moving to protect human health. Because the Pelham Project aims to improve water and sediment quality by enhancing water based economic activity, it provides opportunities for coordination and cooperation between regulatory agencies, applicants, public and private conservation organizations, and investors in water based economic activities to increase wetland diversity and acreage, protect and purify fresh water inputs into estuaries, and support the biota that rely on these waters. This project has the potential to become a state and national model which combines environmentally and ecologically sound engineering principles with community-based improvement efforts and environmental protection regulatory directives. It exhibits a more proactive, value-added approach to obtaining “no net loss” of present and historic wetlands through dredging and harbor maintenance. While directly supporting all aspects of the Clean Water Act, the Pelham Project also encompasses the components of a sustainable environmental and economic development program. With the local support the project has received from SoundWatch, the Bronx Council for Environmental Quality, the City Island Civic Association, BayKeeper, and other environmental and community groups, the project further promotes the US EPA's commitment to develop community-based environmental projects.

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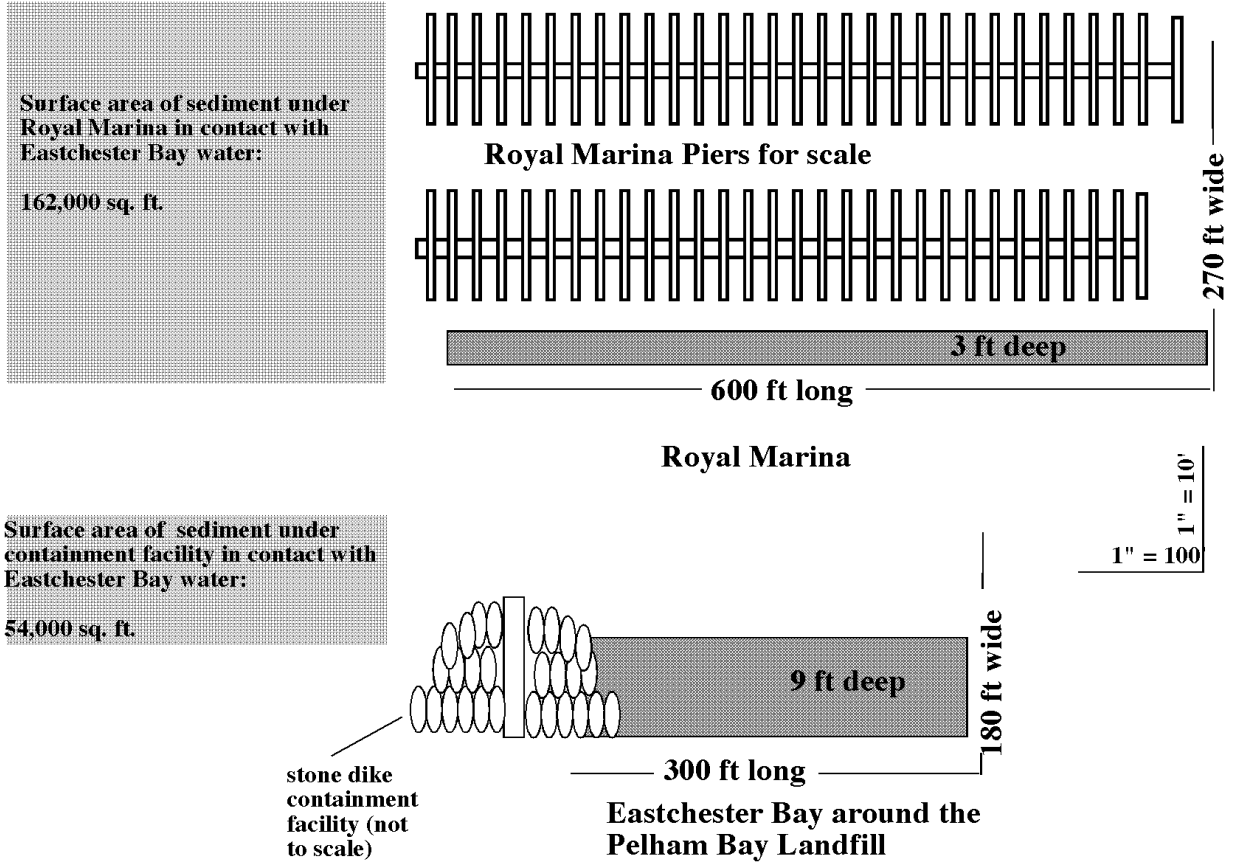
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Figure 1. Surface Area of Sediments before and After Dredging



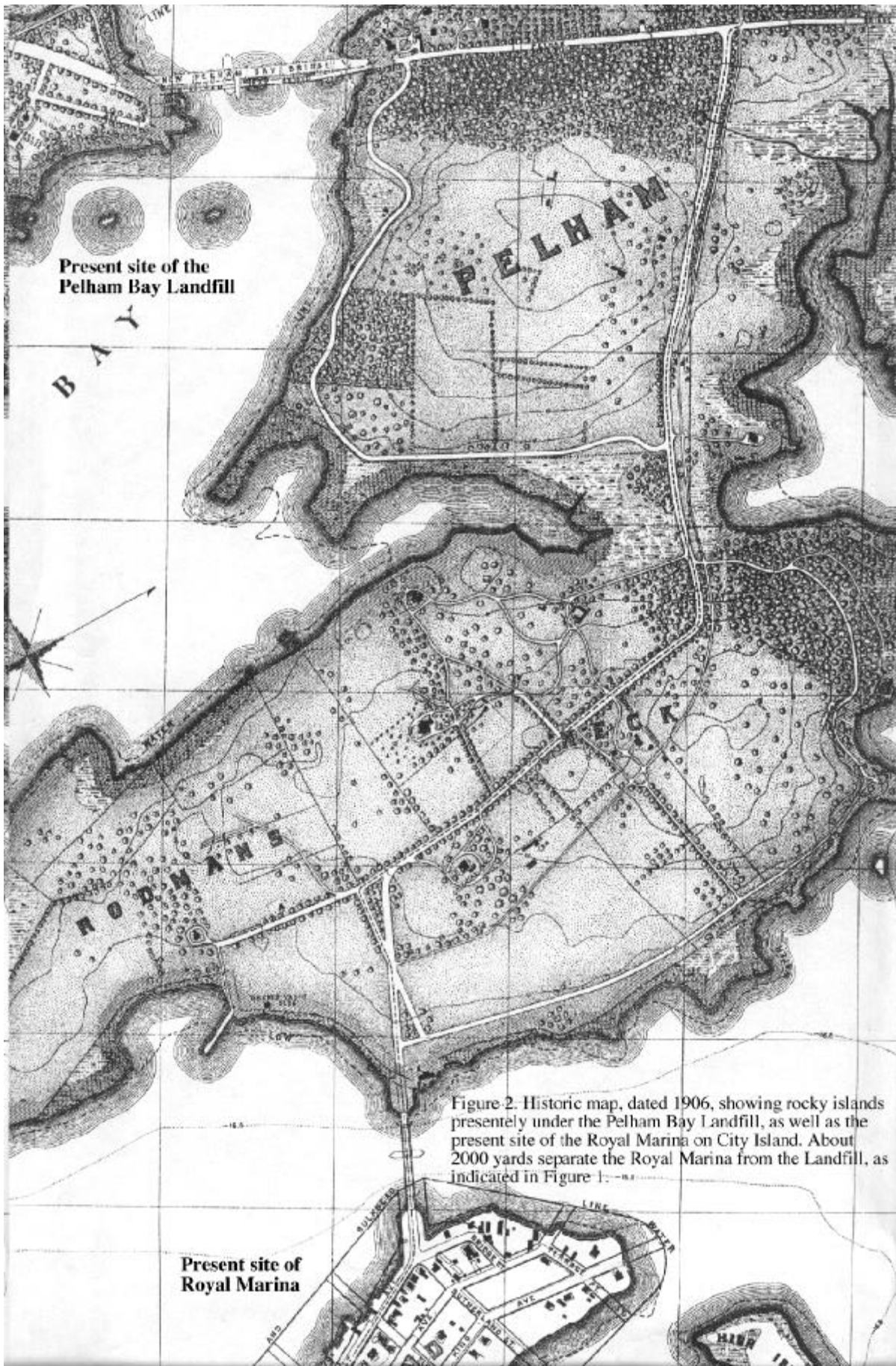
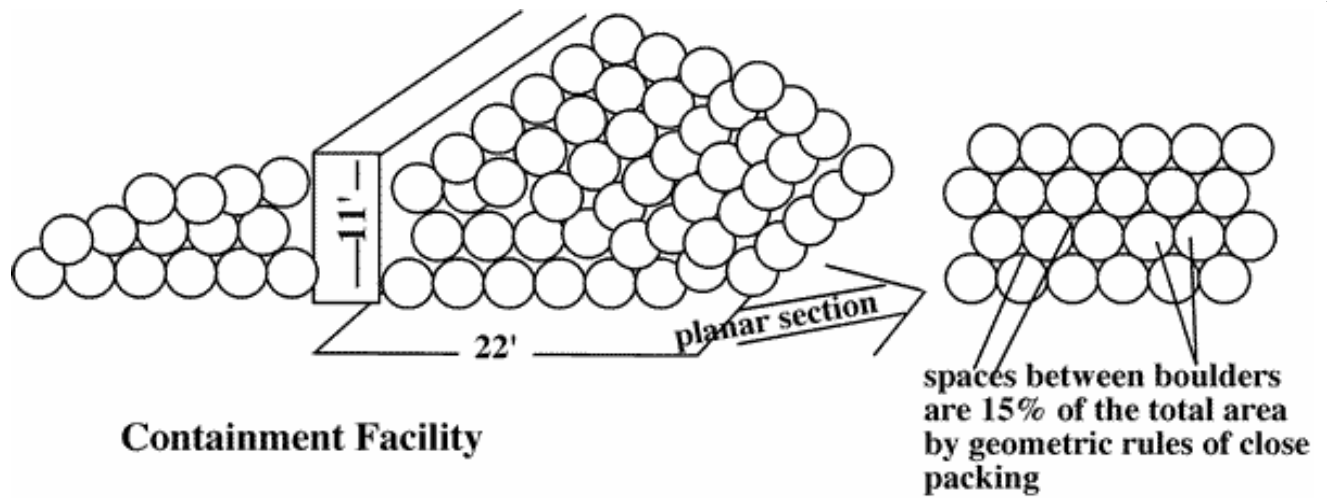
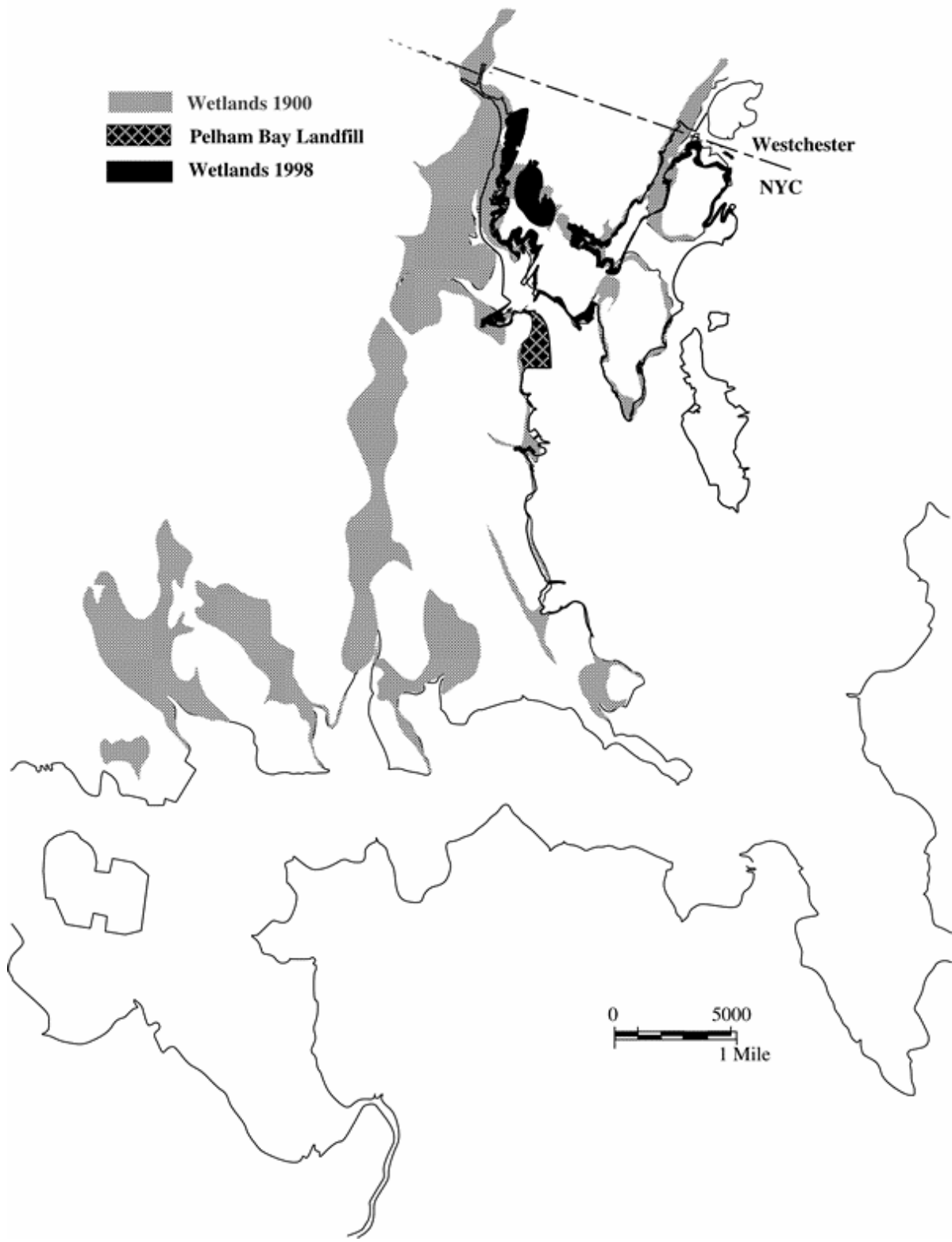


Figure 2. Historic map, dated 1906, showing rocky islands presently under the Pelham Bay Landfill, as well as the present site of the Royal Marina on City Island. About 2000 yards separate the Royal Marina from the Landfill, as indicated in Figure 1.

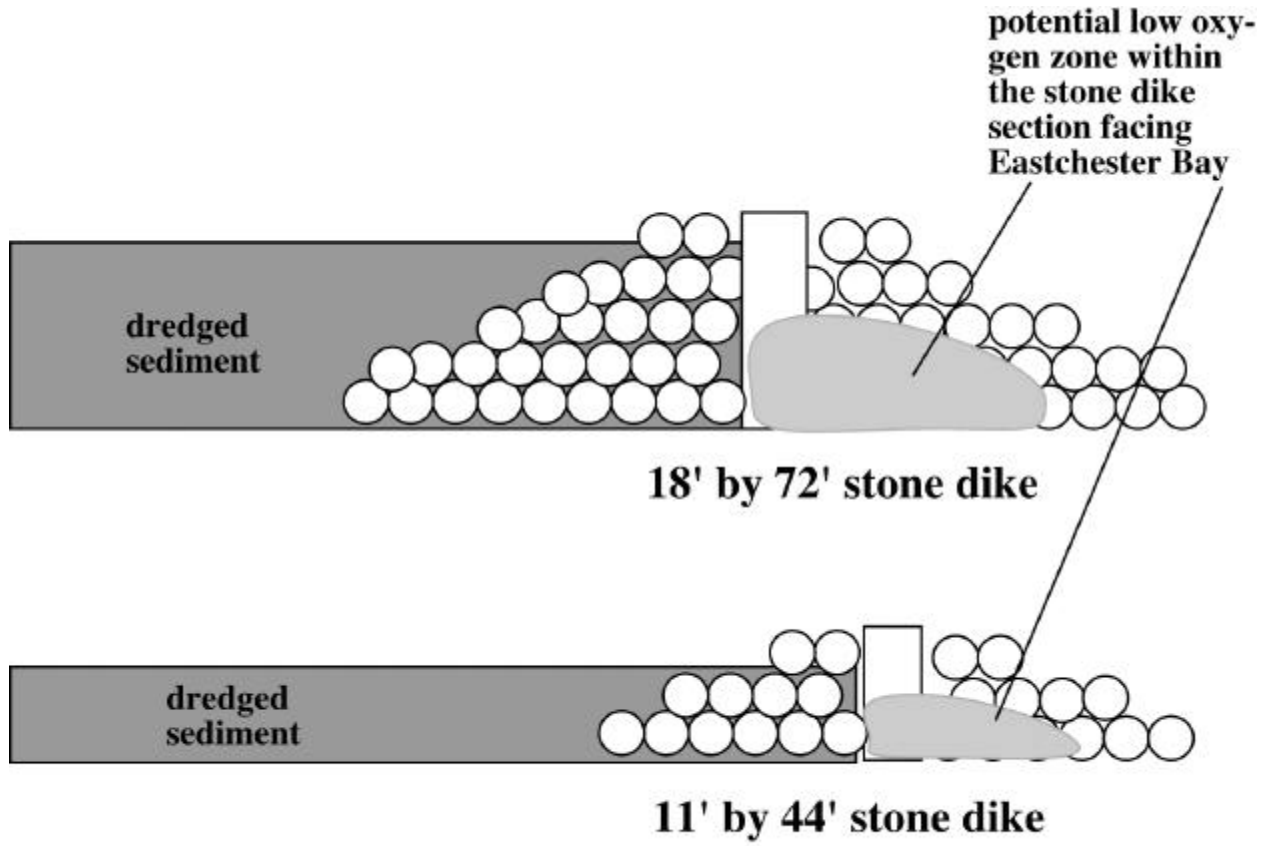


**Figure 3. Stone Dike Geometry.** The stone dike, pictured at left, would be constructed of layers of four foot diameter rock. The first layer would be placed on the sediment, with each successive layer placed on top of the preceding layer. As the section through the rock armor at the sediment level (pictured at right) indicates, there would be spaces between the rock where sediment would remain exposed to the water column above.

**Figure 5. 1900 & 1998 Wetlands**







**Figure 4.** Areas of potentially depressed oxygen levels within the stone dike.