6-1-1978

Dredge Spoil Disposal with Particular Reference to Management Practices in Southern New England

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DREDGE SPOIL DISPOSAL

WITH PARTICULAR REFERENCE TO

MANAGEMENT PRACTICES IN SOUTHERN NEW ENGLAND

Submitted in partial fulfillment
of the degree requirements for a
Master of Marine Affairs

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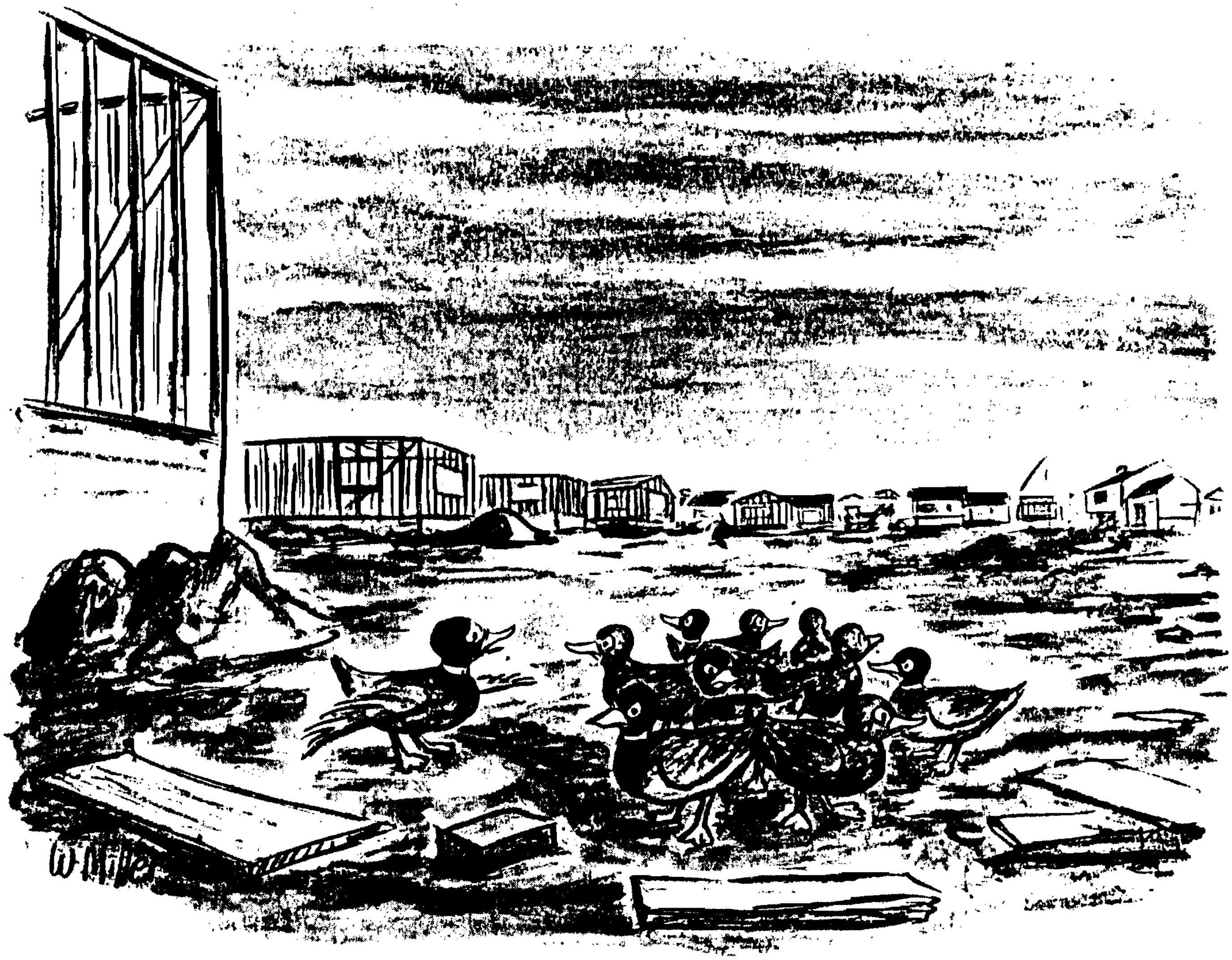
June 1, 1978



"Gosh, I'm sorry. I could have sworn this area was all wetlands last year."

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Introduction

For thousands of years, lush green belts of wetlands along the New England coast have been productive salt-marsh ecosystems. With each tidal cycle, large quantities of decaying nutrient-rich marsh grass are carried into estuaries to provide nourishment for microscopic algae, the basic component of a food web which supports large populations of fish and shellfish. Such areas are nurseries for fish and habitats for wildlife. Wetlands are also nature's sponges. They are invaluable in controlling coastal flooding, and any destruction caused by storm surge is soon repaired, because the marsh is a living thing and can rebuild itself.

Progress and development in our society has destroyed millions of acres of wetlands which are economically valuable for those reasons just mentioned. Since colonial times, wetland areas have been obliterated in man's lust for space and pursuit of private and industrial development. Men considered wetlands as useless parcels of land which needed to be altered to become useful. This meant destruction and conversion of marsh areas to solid ground for buildings and roadways and the dredging of water areas to provide navigable channels for shipping.

As early as 1641, the marshes surrounding Boston were filled. Man's continual tampering with the natural environment caused unhealthy conditions by the mid-1800's. Dams were built and decreased water flow. This led to stagnation. The building of railroad lines affected water circulation, and the marsh was eventually used as a city dump and as the ultimate receptacle for wastes from the city sewage system. A 24 year project was authorized to completely fill the section called Back Bay by 1882. The Prudential Center sits above this marsh today. Subsequent to the completion of this project, water circulation was severely restricted from reaching a marsh to the west. This area, in time, became stagnant and had to be filled in. Today, this is the site of Fenway Park. Boston had gained 2055 acres from these filling activities, but at the same time, Boston lost a valuable natural resource.

One-half million acres of U.S. coastal wetlands have been destroyed by dredging and filling operations since 1956. They are being destroyed at the rate of 0.5-1.0% each year. In one ten year period, Rhode Island lost 5% of its 2000 acres of wetlands to urban development, and Connecticut lost 12% of its marsh lands. Less than 1500 acres of marsh remain in Connecticut.

During the course of this research project, I examined one aspect of wetland destruction - the dredging and disposal of spoil materials onto wetlands and into the coastal waters of Southern New England. What follows is a compilation of facts, policies, and operating procedures on dredge and fill activities, and a discussion of how these activities impact the ecology of southern New England.

Chapter One explains how dredge and fill activities are managed at the Federal level by examining Federal legislation that affects these operations. The federal agencies responsible for dredged spoil disposal activities are discussed, and there is a brief review of the current status of efforts at the federal level to develop a coordinated dredge spoil disposal program. Finally, there is an evaluation of the Federal permitting procedures and the criteria used to evaluate a Federal dredge spoil disposal project.

Chapter two examines the current problems associated with dredge spoil disposal. Current management techniques, state-of-the-art dredging, surveying, monitoring, and current disposal methods are examined. The social and economic attitudes towards disposal are explained from the public as well as the industrial point of view. The chapter ends with an account of the potential environmental effects that dredging and filling activities can create.

Chapter three consists of an evaluation of Southern New England's management procedures for dredge and fill activities. The state agencies responsible for these activities within Massachusetts, Rhode Island, and Connecticut are evaluated for their effectiveness in implementing state legislation that deal with dredge and fill operations. Disposal techniques compatible with southern New England's geological, hydrological, and biological conformations are discussed, and a case study of a proposed regional management program is presented and evaluated.

Chapter 1

Dredging is a process where sediments are removed from the bottom of streams, rivers, lakes, and coastal waters and transported by ship, barge, or pipeline to be discharged as spoils to land or water. The purpose of this activity is to improve, maintain, or extend waterways for the purpose of safe navigation. During the past few years, questions have been raised concerning the type and significance of the environmental impacts of dredging and disposal operations, and the future course of management programs and performance in this area.

Management of these activities has been the responsibility of the U.S. Army Corps of Engineers (hereafter "Corps") since 1899, and more recently, also the responsibility of the U.S. Environmental Protection Agency (hereafter "EPA"). This chapter objective is twofold: 1) to explain the regulatory responsibilities of these two lead agencies with respect to dredged spoil disposal, and 2) to determine the federal legislation by which the Corps and the EPA were delegated such responsibility and within which they must function to achieve their objectives. The major legislation considered here include:

1) The Rivers and Harbors Act of 1899 and Amendments
2) The National Environmental Policy Act of 1969
3) The Federal Water Pollution Control Act of 1972 and Amendments
4) The Marine Protection Research and Sanctuaries Act of 1972 and Amendments

A number of other pieces of national legislation also address, in some aspect, the dredging and dumping of spoils. These include:

5) The Submerged Lands Act of 1953
6) The Outer Continental Shelf Lands Act of 1953
7) The Coastal Zone Management Act of 1972
8) The Flood Control Act
9) The Fish and Wildlife Coordination Act

10) The International Convention on Ocean Dumping to which the United States became a party in 1975.

Excerpts of these pieces of legislation which apply to dredging and disposal activities are reviewed and may be found in Appendix A. References to these Acts will be made in the text of this paper as the need arises. The four Acts reviewed in this chapter are the major working pieces of environmental legislation today to which all major dredging activities must respond.

<u>The River and Harbors Appropriations Act of 1899</u> (30 Stat. 1151)

Most of the concern over the navigation of U.S. waters was expressed in state and local legislation until 1899. In that year, the Corps was delegated the regulatory function by the Federal government under the River and Harbors Act, also called the Refuse Act. Under this Act, the Corps is responsible for protecting navigable channels and harbors against encroachments, and its mission is to promote and achieve safe navigable waterways, hydropower production, flood control, recreation, and water supply storage[1].

This Act is primarily concerned with navigation, an interpretation strictly adhered to by the Corps until 1970 and the passage of the National Environmental Policy Act (hereafter NEPA). The Corps emphasized navigational and port uses and was deeply involved in identifying present and future navigational needs and in promoting the development of port facilities. Prior to 1970, permits were easy to obtain within a short period of time, and interpretation of these sections of the Act was quite literal:

Section 9 - prohibits the construction of any dam or dike across any navigable water of the U.S. in the absence of Congressional consent and approval of such plans by the Chief of the Corps and the Secretary of the Army.

Section 10 - prohibits the obstruction or alteration of any navigable water of the U.S. including the construction of any structure in or over the waterway, the excavation from or depositing of materials in such a waterway, or any alteration which might affect the course, location, condition, or capacity of such waterways unless authorized by the Chief of the Corps and the Secretary of the Army.
(The authority of the Secretary of the Army to prevent obstructions in navigable U.S. waters was extended to artificial islands and fixed structures located on the Outer Continental Shelf in Section 4 of the Outer Continental Shelf Lands Act of 1953 (67 Stat. 463)).

- This section is important in its inherent land use regulatory function along estuaries and in coastal waters.

Section 11 - authorizes that the Secretary of the Army can establish harbor limits considered essential to the preservation and protection of harbors, and define the offshore limits of structures and fills.

Section 12 - this enforcement section establishes a fine of up to a maximum of $2500 and/or one year imprisonment for any violations of this Act. This section also provides that any district court can require the removal of such structures which are in violation of Sections 10 and 11 of this Act.

Section 13 - authorizes that the discharge of refuse may be permitted into navigable waters provided that there is no damage to anchorage or navigation. Permits are required for disposal.

- Until the passage of NEPA, Section 13 was the only piece of Federal legislation that could be used to control wetland development and pollution problems. Since 1970 the permit authority of the Secretary of the Army has been superceded by the Administrator of the EPA under Sections 402 and 405 of the Federal Water Pollution Control Act of 1972 (PL92-500, 86 Stat. 816).

In 1970, the navigational interpretation of the River and Harbors Act was criticized as being simplistic, task oriented, and meeting only navigational needs. The Act did not address such matters as "fish and wildlife, air and water pollution control, aesthetics, ecology, conservation of natural and scenic resources, recreational needs, and other matters of public interest"[2]. Occasionally since 1899, the Corps had changed its regulations with respect to dredging and filling of wetlands, but these changes were navigational in nature. Only in 1968, did the Corps revise the Act to include the evaluation of "all relevant factors including the effect of the proposed work on navigation, fish and wildlife, conservation, pollution, esthetics, ecology, and the general public interest"[3]. These changes, however, did not automatically mean denial of a permit for these reasons. The decision was left to the discretion of the Corps. After the passage of NEPA, the purpose of which is to promulgate harmony between man and the environment and to promote efforts to prevent or eliminate damage to the environment and attain the widest range of beneficial uses of the environment without degradation, risk to health and safety, or other undesirable consequences, the Corps declared that future permit applications would be evaluated on the basis of impact on the environment rather than solely on navigation.

This new approach was first challenged in the case of Zabel v. Tabb (430 F.2d 199, 5th Cir. 1970). The Corps denied a permit to fill eleven acres of tideland in Boca Ciega Bay, Florida, for use as a mobile trailer park. The reasons were ecological rather than navigational impacts. This case sets a precedent that the Corps now consider, under Section 10, non-navigational factors in granting a permit. The District Court ordered the Corps to issue the permit because denial was based on non-navigational interests, and the Corps historically concerned itself only with obstructions to navigation. The Court of Appeals reversed this court order by stating, "nothing in the statutory structure (of Section 10) compels the Secretary (of the Army) to close his eyes to all that others see or think they see...and that it is proper and appropriate in weighing any application to consider the effects of the proposed work on the ecology of the area."[4]

NEPA, the Federal Water Pollution Control Act (hereafter the "Water Act"), and the Marine Protection Research and Sanctuaries Act became Federal legislation because of the growing concern for the environment, and these laws have impacted and further defined the once simple permitting procedure of the Corps. A look at the restrictive requirements of these Federal laws will generate a more thorough understanding of the permitting procedures for dredge and spoil disposal.

<u>The National Environmental Policy Act of 1969</u> (42 USCA 4321 et seq.)

NEPA's objective is to promote efforts towards protecting the environment whereby all Federal agencies must consider ecological factors when dealing with activities which may impact man's environment. A Council on Environmental Quality was established whose policies were to be implemented through the cooperation of Federal, State, and local governments, and concerned public and private organizations. NEPA requires Environmental Impact reports on proposals for major federal activities which could significantly affect the quality of the human environment. All federal agencies are required to bring their statutory authority, administrative regulations, policies and procedures in line with NEPA's policies and procedures.

NEPA, then, requires, the Corps to cooperate with State agencies. The 8th Federal Circuit Court has interpreted NEPA to be an expression of judicially enforceable substantive rights where the actions of the Federal agencies may be weighed against the goals of NEPA to determine if they are in compliance[5]. The effect of NEPA on Zabel v. Tabb was such that although NEPA did not exist when the Corps originally denied the permit in 1967, the 1970 situation was one where the Court now believed that a proper decision had to be based on current applicable standards despite the lack of such a requirement in Section 10 of the River and Harbors Act. This judicial decision was reached:

> "For we hold that while it is still the Action of the Secretary of the Army on the recommendation of the Chief of Engineers, the Army must consult with, consider, and receive, and then evaluate the recommendations of all of these agencies articulately on all these environmental factors. In rejecting a permit on non-navigational grounds, the Secretary of the Army does not abdicate his sole ultimate responsibility and authority. Rather in weighing the application, the Secretary is acting under a Congressional mandate to collaborate and consider all of these factors." [6]

The House Committee on Governmental Operations further stated that:

> "The Corps of Engineers, which is charged by the Congress with the duty to protect the nation's navigable waters, should, when considering whether to approve applications for landfills, dredging and other work in navigable waters, increase its consideration of the effects which the proposed work will have, not only on navigation, but also on conservation of natural resources, fish and wildlife, air and water quality, esthetics, scenic views, historic sites, ecology, and other public interest aspects of the waterway."[7]

Under NEPA, government agencies would begin to develop systematic and interdisciplinary approaches in their planning. New methods and procedures would be used to insure the quality of the environment for future generations. One such procedure, now familiar to all, is the detailed Environmental Impact Statement. This report considers the following information in assessing proposed activities which could potentially alter the environment:

1) The environmental impact of the proposed action.
2) Any adverse environmental effects which cannot be avoided should work begin.
3) Alternatives to the proposed action.
4) The relationship between short-term use of the environment and the maintenance and enhancement of long-term productivity.
5) Any irreversible and irretrievable commitments of resources which would be involved in the proposed action were it to be implemented.

All drafts must be coordinated with Federal and State agencies and public and private groups for comment. Final statements are filed with the Council on Environmental Quality which was established by the Act. No work may begin for 30 days subsequent to the filing of the Environmental Impact Statement.

The Corp's civil works program has been most directly affected by NEPA. Regulatory activities are now required to reflect environmental concerns through changes in administrative policy and procdeures. All dredging and filling activities must be authorized by the Corps, and no other agency can approve this activity. The Corps must work hand in hand with the EPA, authorized by Congress to protect the water quality of the nation's waters, to insure that any work accomplished meets the requirements of both agencies in preserving and protecting the nation's environment.

The water resource planning and development area of the Corp's civil works program was affected by NEPA. The federal navigation dredging program is responsible for maintaining 22,000 miles of inland waterways, 3000 miles of intracoastal channels, 107 commercial ports, and 400 smaller ports. All of these activities involve a dredging volume of 400 million cubic yards each year[8]. Prior to NEPA, only the funding of such projects presented any problems. Subsequent to NEPA, a new requirement involved the integration of project needs, funding, and pollution and environmental concerns into the Corp's planning processes. The dredging problems which now had to be addressed included:

1) a need for the total environmental assessment of the work involved and its impacts on surrounding areas.

2) a requirement to consider the best disposal practices both economically and environmentally.

3) a need to find some use for the annual 400 million cubic yards of spoils other than to fill bays or build mountains of gravel and sands.

4) a "need to know" the physical and chemical characteristics of the material to better plan dredging activities and alternatives to dumping.

5) a need to determine equipment and operational techniques to be used to make dredging activities environmentally and economically acceptable.

Congress authorized $30 million dollars to initiate a research program called the Dredge Material Research Program (hereafter "DMRP") to be organized by the U.S. Army Corps of Engineers Waterways Experiment Station in Vicksburg, Mississippi. The objective of this program has been to maximize the beneficial effects and minimize the detrimental effects of dredging while keeping the costs of dredging and disposal operations minimal. There was a tremendous need for environmental data associated with dredging, and some of the goals of this program included:

1) determining the environmental impact of open-water disposal in estuaries
2) determining environmental impacts of upland disposal
3) developing new disposal techniques
4) analyzing productive uses of dredged materials
5) investigating multiple-use concepts
6) developing new treatment techniques and equipment to improve water quality
7) reviewing current methods and equipment and recommending modifications which might increase efficiency and mitigate environmental impacts

This program is due to be completed in 1978. Since NEPA, many dredging projects have been halted completely, modified, or are now under litigation because of environmental requirements, many of which will not be determined until the DMRP publishes its findings.

Since the passage of NEPA, maintenance dredging has increased 100% in the South Atlantic region, and there has been a 50% increase in the use of hopper dredges. Some of the nation's maintenance projects have not been dredged on an annual basis because of high inflation costs and because of new and expensive environmental costs. Many projects have been deferred since environmentally acceptable disposal areas are not within economical pumping or barging distances. The cost of these environmental constraints have been the most significant impact on the Corps since the passage of NEPA, and until environmental costs abate or funding constraints are lifted, it is likely that essential channel maintenance will continue to be deferred and have an increasing adverse impact on the movement of waterborne commerce.

The Federal Water Pollution Control Act of 1972 and Amendments (33 USC 466 et seq.)

Generally referred to as the "Water Act," this piece of legislation placed the rationale for the regulation of our natural resources on the preservation of water quality. It is to this law that most of our nation responds today by setting forth new environmental methodologies. As the scientific experts in this country become more knowledgable about the effects of pollution on the water environment, new amendments are passed. The latest amendments were published in December 1977. These amendments continue to reinforce the objective of the Act which is stated in Section 101(a): " to restore and maintain the chemical, physical, and biological integrity of the nation's water."[9]

A number of sections of this Act apply to the dredging and disposal of spoils. I will briefly note the various passages so that you, the reader, can see the comprehensive nature of this law.

Section 101(a)"It is the policy of the U.S. that discharge of pollutants into navigable waters be eliminated by 1985,... that interim water quality standards be achieved by 1983 where possible."

Section 101(b)"It is the policy of the U.S. to recognize, preserve, and protect the nation's waters. The primary responsibility of the states is to prevent, reduce, or eliminate pollution of waters. It is the policy of Congress that the States...implement the Permit programs under Sections 402 and 404."

Section 101(d)"The Administrator of the EPA shall administer this Act." (The EPA has veto power over the use of a disposal site if it can be determined that such a discharge will have an adverse impact on municipal water supplies, shellfish beds and fishery areas, wildlife, or recreational areas.)

Section 101(g) "Federal Agencies shall cooperate with the state and local agencies to develop comprehensive solutions to prevent, reduce, and eliminate pollution in concert with programs for managing water resources."

Section 102 "The Administrator shall in cooperation with other federal agencies and state agencies develop programs for reducing and eliminating water pollution of navigable waters, underground waters, surface and ground waters. The Corps shall determine the need for reservoir and storage areas except as to determine water quality. The Administrator of the EPA shall determine the water quality aspect and announce this to Congress."

Section 115 "The Administrator is directed to identify "in place" pollutants with emphasis on toxic pollutants in harbors and navigable waterways, and for the removal, appropriation, and disposal of these pollutants."

(This Section puts the EPA in control of the disposal of the Corp's dredged materials.)

Section 313 "Each agency of the Federal Government engaged in any activity resulting in the discharge or runoff of pollutants shall be subject to and comply with all Federal, State, interstate and local requirements, administrative authority, and sanctions respecting the control and abatement of water pollution."

All of Section 400 includes the provisions for permitting and licensing.

Section 401 The Administrator of the EPA authorizes permits to discharge after application and certification by the EPA. The Secretary of the Army is given authority to allow the use of disposal areas under his jurisdiction for the purpose of this Section.

Section 402(4) "All permits for discharges into the navigable waters issued pursuant to Section 13 of the River and Harbors Act of 1899 shall be deemed to be permits under this title and permits issued under this title shall be deemed to be permits under Section 13 of the 1899 Act, and shall continue in force and effect for their term unless revoked, modified, or suspended by provisions of this Act."

Section 402(5) "No permit for a discharge into the navigable waters shall be issued under Section 13 of the 1899 Act after the date of enactment of this title. States, determined by EPA to be capable of administering permit programs, shall be authorized to issue permits for discharge into navigable waters within the jurisdiction of each State."

Section 403 This Section requires the development of guidelines for the disposal of pollutants into territorial seas, the contiguous zone, or the oceans. "No permit is to be issued where insufficient information exists on any proposed discharge with respect to its toxic effects on human health, the marine environment, and alternative uses of the ocean."

Section 404(a) "The Secretary is authorized, after due notice and opportunity for public hearings, to approve the discharge of dredged material into navigable waters at specified disposal sites. No later than 15 days after all information pertaining to a permit application is received, the public notice shall be published."

Section 404(b)"Subject to subsection (c), each disposal site shall be specified for each permit request

1) through application for guidelines developed by the Administrator in conjunction with the Secretary of the Army. The guidelines are to be based on criteria applicable to Section 403(c) on ocean discharge, and
2) through application of economic impact on navigation and anchorage criteria where (1) alone would permit."

Section 404(c)"The Administrator(EPA) is authorized to prohibit specifications of any defined area as a disposal site, or deny or restrict the use of any defined area for specification as a disposal site when he determines, after due notice and opportunity for public hearings. Before making such a determination, the administrator shall consult with the Secretary of the Army."

(Dredge spoil is defined, without qualification, to be a pollutant subject to the provisions of this Act.)

Section 404(e)"The Secretary of the Army may issue general permits on a State, national, or regional basis if such activities are similar in nature and cause minimal adverse impact on the environment. A general permit shall not be issued for a period of more than 5 years after the date of issuance and may be revoked if terms of the permit are violated."

Section 404(g)"The Governor of any State desiring to administer its own individual and general permit program for the discharge of dredged or fill material into navigable waters within its jurisdiction, must forward the State's proposed program and legal approval from the Secretary of State to the EPA Administrator to assure that the State has laws which provide adequate authority to carry out the proposed program. Comments must be received by EPA and the Dept. of Interior's Secretary acting under the U.S. Fish and Wildlife Service Secretary within 90 days, and within 120 days there must be approval or denial of the proposed State program. If no determination is made within 120 days, the program is deemed approved. If the State violates the program, the EPA shall withdraw approval if no corrective action is taken within 90 days, and the Secretary of the Corps of Engineers resumes permit issuance control."

Section 404(i) authorizes that if Federal projects require dredge or fill materials, they are not subject to regulation under Section 404 if an Environmental Impact Statement has been prepared under NEPA, and this statement has been submitted to Congress before actual discharge of dredged material and prior to authorization of the project or appropriation of funds for the project.

Section 511(a)"Nothing in this Act shall be construed as affecting or impairing the authority of the Secretary of the Army to maintain navigation under the Act of 1899. Any permit issued under Section 404 shall be conclusive as to its effect on water quality or any discharge resulting from any activity subject to Section 10 of the 1899 Act."

The Corps, in conjunction with the EPA, submitted proposed regulations in response to Section 404 of the Water Act and also in response to the order of the U.S. District Court for the District of Columbia in NRDC v. Callaway, et al., (F. Supp. 7ERC 1784(D.D.C., March 27, 1975)). In this decision, the definition of navigable waters as used by the Corps in its initial response to Section 404, published in Regulations of April 1974, was deemed too restrictive for the purpose of achieving the 1985 water quality goals set forth in the Water Act. The Court ordered an expansion of the permit program to include all waters of the United States.

The new guidelines for the disposal of dredged or fill material into all navigable waters was published in July of 1975 with a supplemental revision in September 1975, in the Federal Register.[10] Described in these permit regulations is a three-phase program by which the Corps will gradually expand its authority through 1977. Phase I of the program, effective after July 25, 1975, includes discharges of dredged or fill materials into coastal waters and coastal wetlands contiguous to or adjacent to or into navigable waters of the U.S. and freshwater wetlands contiguous to or adjacent to navigable waters. Phase II, effective July 1, 1976, includes discharges of dredged or fill materials into primary tributaries, and lakes under Corps authority. Phase III, effective July 1, 1977, includes discharges of any dredged or fill materials into any navigable water.[11]

In this context, "navigable waters" are defined to include all waters including the territorial sea for the disposal of fill materials and excluding the territorial sea for disposal of dredged materials, and any waters historically, or presently used, or susceptible to use as a means to transport interstate commerce landward to their high water mark, and those tidal waters shoreward to their mean high water mark. This definition also includes all coastal wetlands, mudflats, swamps contiguous or adjacent to navigable waters, rivers, lakes, streams, artificial channels and canals, freshwater wetlands, any interstate or intrastate lakes, rivers, and streams used by travelers for recreational purposes or industrial purposes or any waters determined by the Corps as necessary to regulate for the protection of water quality as expressed in the Water Act.[12]

Marine Protection Research and Sanctuaries Act of 1972 and Amendments of January 11, 1977 and November 28, 1977. (PL92-532, 86 Stat. 1052)

The purpose of the Marine Protection Research and Sanctuaries Act, often referred to as the Ocean Dumping Act, is to regulate the transportation for dumping, and the dumping of materials into ocean waters. It commits the U.S. on a national basis to the regulation of

> dumping all types of materials into ocean waters and to prevent or strictly limit the dumping into ocean waters of any material which would adversely affect human health, welfare, or amenities, or the marine environment, ecological systems, or economic potentialities. (Section 2(b) of the Act)

Title I is the marine protection section which requires the Administrator of the EPA and the Secretary of the Army to establish permit programs designed to exclude from the ocean all waste materials that might result in unreasonable degradation or endangerment of the marine environment or human health. This involves dredged materials for the Corps and non-dredged materials for the EPA. Project approvals for ocean dumping of dredged material are made by the Secretary of the Army in accordance with regulatory criteria established by both the Administrator of the EPA and the Secretary of the Army. Disagreement as to compliance with dredged material criteria between the Corps and the EPA result in overriding veto power by the EPA. The EPA Administrator oversees this Act.

The Ocean Dumping Act provides for a case-by-case evaluation of ocean dumping proposals. Permit approvals are a reflection of the belief that no unreasonable degradation will occur, and that the dumping criteria, which are established by 8 factors in Section 102(a) of the Act, are satisfied. These considerations include:

1) the need for dumping
2) the effect of dumping on human health and welfare; economic, esthetic and recreational values.
3) the effect of dumping on fisheries, shellfish , plankton, and wildlife resources, shorelines and beaches.
4) the effect of dumping on marine ecosystems and potential changes of marine diversity, stability and productivity, and population community dynamics.
5) persistence and permanence of the effects of dumping, and the particular volumes and concentrations of certain materials.
6) appropriate methods and locations of disposal or recycling.
7) the effect on alternative ocean uses such as fishing, scientific study, other living and non-living resource exploitation.
8) use of areas beyond the Continental Shelf as recommended disposal sites whenever possible.

The Ocean Dumping Act came into force on April 28, 1973, several days after the Water Act was signed into law. Provisions were made so that each Act would not interfere with the other. The Ocean Dumping Act regulates transportation of materials to be dumped in the territorial sea, contiguous zone, or the oceans beyond, or the high seas. The Water Act regulates inland waters and marine waters within the outer limits of the territorial sea. These two Acts set up a comprehensive ocean dumping regime for the United States.

On January 11, 1977, the EPA promulgated a final revision of Regulations and Criteria for the Ocean Dumping Act.[13] Original final regulations were issued October 15, 1973. The EPA felt a need to define in more detail 1) considerations which go into determination of permit issuance, 2) the regulation of ocean dumping sites, 3) the disposal of materials, and 4) specific consideration of determining ecological effects of ocean dumping. These regulations went into effect February 10, 1977.

There is emphasis in these new regulations of a more integrated approach of the EPA with the International Convention on Ocean Dumping which became effective August 30, 1975. The matter of emergency permits and the regulation of certain toxicants in ocean dumped material are now consistent in both documents.

The Ocean Dumping Act established a need for permitting procedures to which the EPA and the Corps complied by promulgating Ocean Dumping Criteria. The regulations issued in 1973 disclosed the following procedures. First, the Administrator of the EPA must consult with the Corps prior to recommending dumping locations, dumping times, and methods to be used. The EPA can issue ocean dumping permits except for dredged material disposal which is under Corps Authority. Second, the Corps must apply EPA criteria but make an independent determination after considering the cost effectiveness of ocean dumping versus other alternatives to dumping. However, the Secretary of the Army must notify the EPA prior to issuing permits, and the determination of the EPA prevails. Third, the EPA may grant a waiver to dump, unless there is an unacceptable adverse impact. However, dumping will be allowed if there is no other economically feasible method or site available. Fourth, the EPA or the Corps requires an applicant for a permit to provide information necessary for review and evaluation of the permit. This information includes:

1) type of material to be transported for dumping
2) amount of material to be transported for dumping
3) location for transport and the dumping site
4) special provisions considered by the EPA or the Corps as necessary for monitoring and surveillance of transportation and dumping

And finally, no state can adopt or enforce any rule relating to any activity regulated by the Ocean Dumping Act. A State may propose criteria for dumping materials into ocean waters within its jurisdiction, and the EPA may adopt these criteria.

There are five types of ocean dumping permits. First, there are general permits which are issued for small-volume, non-toxic materials. The applicant must specify the type and quantity of waste to be discharged. There are no renewals of general permits. An example of this type of permit is burial at sea. Second, special permits can be issued for waste disposal of materials which meet the Ocean Dumping Act criteria but which are not considered under the general permit category. Special permits have a fixed expiration date (three years maximum), and they must specify the exact quantities and location of the proposed dump. These permits may be renewed. An example of a special permit might be the authorization to dump unpolluted spoils.

A third type of permit is the emergency permit which may be issued after consultation with the Department of State and other officials for materials which pose an unacceptable human health risk and for which there are no other feasible alternatives. No renewals are made, and examples include the dumping of polluted dredge spoils and hazardous materials.

A fourth category of permit, interim permits, may be issued for disposal of materials exceeding the established dumping criteria. It is the intent to prevent or strictly regulate material disposal which might damage the marine environment. Materials identified as exceeding the criteria for trace constituents may be released under this type of permit. Interim permits are issued for one year and can not be renewed. However, a new interim permit can be issued when a previous permit has expired. Examples of materials dumped under **this** type of permit include industrial wastes and sewage sludge.

In the January 11, 1977, revision, a significant portion of Section 220 deals with interim permits. The Act now reads that interim permits will be granted to permit holders who have exercised "best efforts to meet the requirements of a special permit by April 23, 1978, and have implementation schedules adequate to allow phasing out of ocean dumping or compliance with the requirements of a Special permit **by** December 31,1981."[14]

Congress has been impatient with the continued issuance of interim permits. EPA believes that five years is sufficient time to develop appropriate technology and alternatives to ocean dumping. Ocean dumping is being phased-out to assure that Section 227 of the Act is not violated, that is, that there are no adverse environmental effects, esthetic, recreational, economic or other-use effects on the marine environment.

The fifth type of permit is called the Research permit. They are viable for eighteen months and allow for the scientific determination of a waste's impact on the marine environment, provided the merit of the project outweighs any potential damage which might be created by waste release. An environmental impact statement must be provided, notice posted, and public hearings held before research permits are approved.

Part 227 of the Act, the Criteria for the evaluation of permit applications for the Ocean Dumping of materials was severely criticized in its original form because of vague definitions of toxic contaminants and vague discrepancies with earlier sections of the Act on the best alternatives to dumping and the potential harm which might be inflicted on the marine environment. After a series of technical workshops, this environmental section was brought into line with the rest of the Act. The new criteria have been based on impacts of dumped materials on the marine ecosystem, as measured by various types of bioassays, rather than determining toxic effects by chemical analysis of specific constituents in the waste. These criteria are now based on actual impact studies rather than on tests which lead to assumptions regarding allowable deviations from normal ambient values. The section has been revised to use liquid, suspended particulate, and solid phase bioassays as the basis for determining trace contaminants. The bioassay is now required procedure. Lee et al. have produced an interesting critique of the bioassay procedures recommended by the EPA and Corps jointly in a technical document dated July 1977.[15] This article forwards the idea that such bioassay techniques are a simplistic approach to approval or disapproval of dumping, and also that they are too expensive for industry to run on a routine basis. The authors have suggested an alternative bioassay procedure to the one published in the Federal Register.

Part 227 defines the limiting permissible concentration for each phase of the bioassay program. The liquid phase has been associated, where possible, to the marine water quality criteria set forth in 1976 by EPA in the Quality Criteria For Water, also known as the "Red Book." Unfortunately, the authors of the bioassay program neglected to note that all numbers in this EPA volume are recommended concentrations for chronic, long-term exposure rather than an acute 96 hour exposure. Therefore, these numbers tend to be much lower than they could be for brief acute exposure. Bioassays for solid and suspended particulate phase concentrations allow for initial dispersion of the waste.

The protocols for these tests may be found in "Ecological Evaluation of Proposed Discharge of Dredged Material into Ocean Waters," published in July 1977. These procedures were presented for the evaluation of potential environmental impacts of the discharge of dredged materials into ocean waters, an evaluation required in considering permit applications for the transportation of dredged material for ocean disposal. Detailed guidance is provided on sediment and water sample collection, chemical analysis of the three phases for bioassay assessment, estimation of bioaccumulation potential, and estimations of initial mixing zones. The elutriate test, originally designed for hydraulic dredging, may be required if toxic elements are suspected but are not evident from bioassay work.

The Environmental Impact Section 227.4, has been revised more realistically to require "no unacceptable adverse impacts to human health, the marine environment, or no unacceptable adverse persistant or permanent effects," rather than the original version which read, "no adverse effects on the environment, ..." Similarly, Section 221 originally required a full description of the material to be dumped, but the new revision allows for an adequate description of the material to be dumped with respect to its chemical constituents.

Materials which the Ocean Dumping Act prohibits disposal of in the marine environment include:

1) high-level radioactive wastes
2) radiological, chemical or biological warfare agents
3) materials not sufficiently described by the applicant to satisfy the Ocean Dumping Act's requirements
4) persistent inert, synthetic or natural materials which remain in suspension, float or interfere with fishing, navigation, and other uses of the ocean
5) materials which can not be dumped as other than trace contaminants include:
    a) organohalogen compounds
    b) mercury and mercury compounds
    c) cadmium and cadmium compounds
    d) oil of any kind or in any form
    e) known carcinogens, mutagens, teratogens or those suspected of being such by the scientific community (Special studies may be required for this category)

   These may be present only as trace amounts and may not cause any undesirable effects, such as bioaccumulation, when tested according to the appropriate bioassay protocol.

Section 228 states that EPA will designate dredged material disposal sites and the procedures are described in the January 11, 1977, Federal Register. The Ocean Dumping Act allows the Corps to use other sites when EPA designated sites are not feasible, but both EPA and the Corps must use the same site criteria. Site criteria include a determination of geological, chemical, biological, and physical structure of the proposed dump site. Specified times for sampling and sampling procedures for the biological and chemical parameters are explained in detail in this new revision.

Permitting Procedures

In July of 1975, regulations for permitting procedures were issued by the Corps for activities in navigable waters along the coast and in ocean waters. These regulations applied to structures in navigable waters, dredge and fill activities and ocean dumping. They were issued in reply to the requirements of the Federal Water Pollution Control Act, the Marine Protection Research and Sanctuaries Act, and the Coastal Zone Management Act. These three Acts supplement the Corps of Engineers involvement in promoting navigation under the River and Harbors Act of 1899.

On December 26, 1970, Executive Order 11574 (35 Federal Register. 19627) established the Refuse Act Permit Program. Under this program, the 1899 Act provided the authority to prohibit the discharge of pollutants into navigable waters without a Corps of Engineers permit. Since 1973, all discharges must comply with the Water Act's water quality standards. The Corps contended that, despite NEPA, it was not required to prepare Environmental Impact Statements for every permit. The District of Columbia Court disagreed (Kalur v. Resor,335 F. Supp. 1(D.D.C. 1971)), and the Corps refused to issue permits thereafter. This put pressure on Congress to exempt Corps of Engineer projects from NEPA requirements. In 1972, with the passage of the Water Act amendments, Congress responded by giving pollution permit issuance functions and ultimate veto power to the Environmental Protection Agency.[16]

General Policies for Evaluating Permit Applications

The decision to issue or deny a permit is based on an assessment of the probable impact on the public interest of proposed dredging and environmental preservation. A careful evaluation is made based on the national concern for both protection and utilization of important resources, including those factors of conservation, economics, aesthetics, general environmental concerns, historic values, fish and wildlife, flood-damage prevention, land-use classifications, navigation, recreation, water supply, water quality, and the needs and welfare of the public. No permit is granted unless its issuance is found to be in the public interest, and no permit will be granted where Federal, State, and/or local certification has been denied.

The following general criteria are considered when evaluating an application:

1) The extent of the public and private need for the proposed work.

2) The desirability of using appropriate alternative locations and methods to accomplish the objective of the proposed work.

3) The extent and permanence of the beneficial and/or detrimental effects that the work may have on the public and private uses to which the area is suited.

4) The probable impact of each proposal in relation to the cumulative effect created by other existing and anticipated work in the general area.[17]

Permits are required for commercial sand and gravel dredging and filling, dredge spoil disposal and the building of piers, wharfs, retaining walls, breakwaters, laying pipe, cable, and tunnels under and over navigable waters, and the transportation of dredged material for ocean dumping.

Unless there is overriding public interest, general approval is given for applications by riparian owners to build piers, moorings, and platforms for small boats, as long as there is no obstruction of the waterway and no impact to a neighbor's water, and it is in a safe location.

Minor work such as bulkheads and fills which are constructed in other than navigable waters for property protection or work which involves a discharge of less than one cubic yard per foot and are less than 500 feet long are exempted from requiring a permit. However, a permit might be required in such cases because of coastal zone regulations or because of an alteration in water quality.

Application for a permit is made to the District Engineer in charge of the district where the proposed work will be done. Permit applications must be prepared in accordance with standard instructions in "Applications for Department of the Army Permits for Activities in Waterways."[18] The application must include a complete description of the proposed activity, sketches or plans, the location, purpose and intended use of the proposed activity, and approvals by appropriate Federal, State, interstate, or local agencies. If the activity involves dredging in navigable waters, the application must include a description of the type, composition, and quantity of the material to be dredged, the method of dredging, and the site and plans for disposal of the dredged materials. If the activity involves transportation of dredged material for the purpose of dumping it in ocean waters, the quantity of material, method of transportation, and location of disposal sites must be included in the application. A fee of $100.00 is required for each application if the quantity of material to be discharged exceeds 2500 cubic yards. $10.00 is required for quantities less than this volume.

If dumping of dredge spoils will be located in the coastal zone of a State having a coastal zone management program approved by the Secretary of Commerce, the applicant must certify that his activity complies with the State's coastal management program. The application must also comply with Ocean Dumping Act regulations for proposals to dump in ocean waters.

If the District Engineer believes that granting a permit is warranted but also believes that the proposed activity would have a significant impact on the environment, an Environmental Impact Statement must be prepared prior to final action on the permit application as required by Section 102(2)(c) of NEPA. Information which must be submitted by the applicant includes environmental data, selection of alternate sites and methods of dumping, and analyses of the materials to be discharged.

Standard Procedures for Processing Applications for Permits

The District Engineer reviews all applications for completeness and design and issues a public notice within 15 days of receipt of an application. For a period of 30 days, comments may be submitted on the application. During this period, the District Engineer must determine whether or not an Environmental Impact Statement is required. If he finds that there will be no adverse impact on the environment, he must publish his conclusions to this effect in a public notice. He may also change his mind about this, in which case, he must reissue a public notice to the effect that an impact statement is required. If an impact statement is initially found to be required, a notice is published to this effect and distributed to all known individuals, agencies, and interest groups.

The District Engineer may hold a public meeting to give affected parties an opportunity to express their views and to develop pertinent data to further evaluate the application. The District Engineer must hold a public meeting when requested by any party who may be affected by the proposed activity if it involves the disposal of dredged materials if the request presents substantial issues of public interest.[19] A 30 day advanced notice is issued to the public. If an impact statement has been required, it must be completed 15 days prior to the meeting and made available for public review at that time.

After the hearing, a period of 10 days is allowed for additional comment. After this time, the hearing record which includes a complete transcript of the hearing is considered closed. The District Engineer then evaluates all comments received, the transcript, and may consult during this time with Federal Agency experts on the application. He then reaches a decision to approve or deny the permit. This decision appears on a monthly list of permits which have been acted upon.
The originally proposed time period for all of these procedures to be completed was 60-90 days from receipt of application to granting of a permit. The realistic time period is often longer than one year.
Since controversial cases are decided in the Corps Office in Washington,

D.C., permit approval may take several years.

Emergency and special permit activities require an abbreviated procedure to assure quick and timely action. In such cases, the District Engineer consults with the Secretary of the Army in Washington, D.C., prior to issuing instructions.

While it is appropriate to obtain local and State approvals before applying to the Corps for a permit, applications for both may be processed simultaneously, but the Corps will not issue a final judgement until the local or State agencies approve or deny the permit application. If the local or State agencies deny the permit, the applicant is given 90 days to resolve the problem. If the State or local agency denies the permit a second time, the Corps will also deny permit approval.

With the exception of maintenance dredging, all works constructed under a Corps permit must be maintained in good condition, and no further authorization is required for routine maintenance. Major renovations to such structures must be authorized. Permits for works requiring periodic maintenance dredging may be authorized for a specified period not to exceed 10 years.

Enforcement of violations involve a cease and desist notice to the pertinent parties. If this fails, the District Engineer may request an appropriate restraining order from the appropriate U.S. District Attorney. The District Engineer commences an investigation. Legal action is immediately initiated for all unauthorized structures or dredging operations according to the River and Harbors Act, Section 10. The District Engineer must also refer to the U.S. Attorney any violations of Section 404 of the Water Act where unauthorized disposal of dredged material has occurred in navigable waters. Such violations require the District Engineer to determine whether civil and/or criminal penalties are appropriate.

All of the above procedures are required for dredging projects. There is a State permit authorization procedure which differs with each State but generally corresponds to the Corps procedure. The permit procedures for the southern New England States of Connecticut, Rhode Island, and Massachusetts are explained in a following Chapter.

Chapter 2

Introduction to Dredges

Boyd et al. published, in 1972, the first of a series of articles and documents which described the dredging industry in the United States, examined dredging and filling methodologies, and focused on the potential environmental effects which might result from these activities. With this report, the Dredged Material Research Program got underway in the Corps of Engineers Waterways Experiment Station Laboratories in Vicksburg, Mississippi.

To demonstrate the tremendous problem of dredge spoil volume in the United States, Boyd compiled some statistics. For example, maintenance dredging and new dredging accounted for 280 million cubic yards of dredge spoils in 1972 for a total cost of $150 million dollars.[1] Lee stated that 400 million cubic yards of sediment must be dredged each year to maintain desired navigation depths.[2] Dredge spoil is, "by weight, the most significant class of material disposed in the oceans. From 1968 to 1973, tonnage of dredged spoils was approximately five times the tonnage of all other dumped wastes combined. Based on water quality measurements, over 13 million tons, or 34% of all dredged spoils, were considered polluted in 1973."[3]

Furthermore, the control of polluted dredged spoil

> "is made difficult by the unavailability of adequate records of amounts and locations as well as imprecise specification of which disposal operations are tabulated. If the total amount and the amount of polluted dredge spoil are not known, it will continue to be difficult to derive a fair estimate of the effects of dredging disposal operations. The amounts of dredging and resultant disposal should be clearly tabulated ... and include the type of material, the operator, the amount removed, and the amounts placed to specific areas."[4]

Current Dredging Equipment and Practices

There are two basic categories of dredges: the mechanical and the hydraulic dredge. The diagram in Figure 1 indicates the different kinds of dredges within each of these categories.[5]

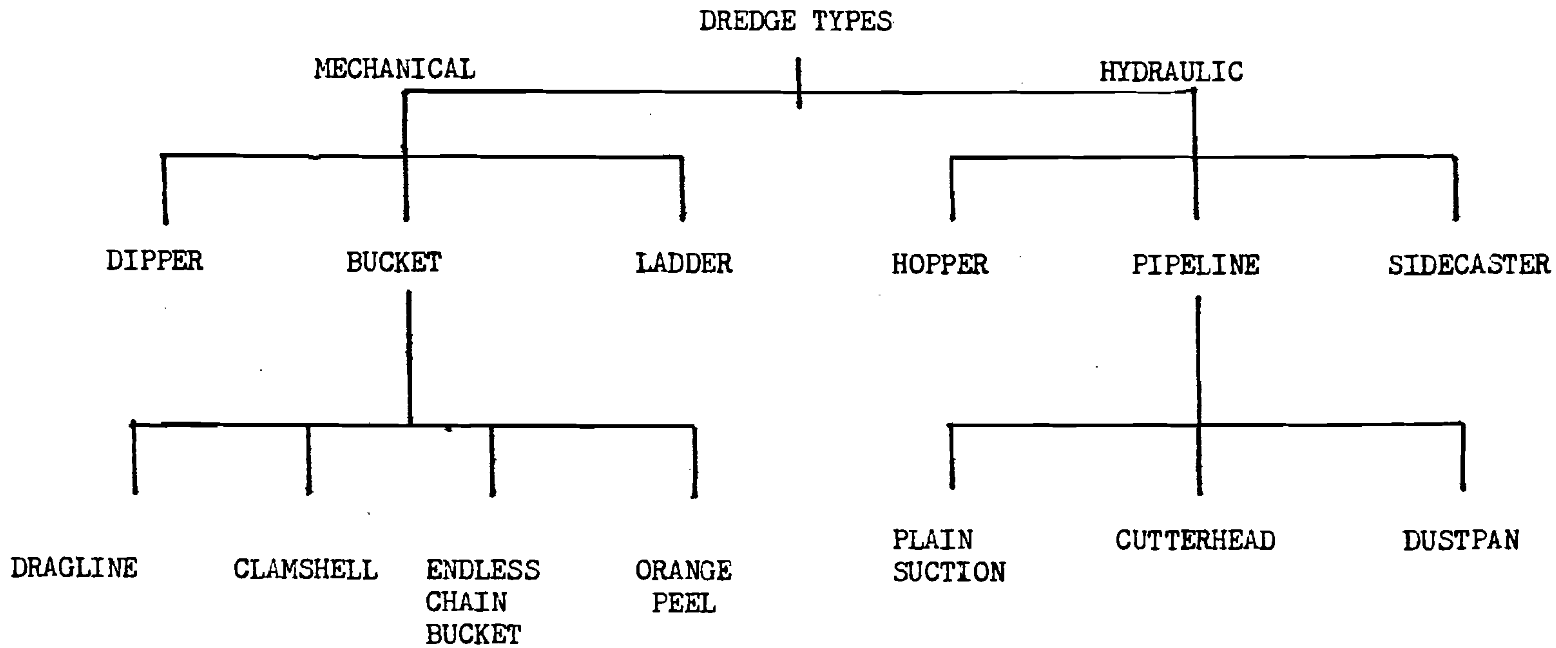
Mechanical dredges, usually mounted on barges, look like dry land excavation machines. They are used in areas where the substrate is rocky and the area to be dredged is quite small or localized. The spoils are deposited on barges and taken to ocean or land disposal sites. This category of dredge creates few environmental concerns since interaction of the sediments with the water column is minimal, and there is little turbidity and little chance for trace metals and other contaminants to become suspended in the water. This category of dredge requires less energy for its operation, and hence, is more economical in terms of overall dredging costs.[6] Unfortunately, this type of dredge is slower to complete its job than the hydraulic counterpart, and accounts for approximately 4 million cubic yards of maintenance dredging each year.[7]

Barged spoils can be dumped in several ways. In some cases, the barge has bottom doors which can be opened when the barge has reached the dumpsite, and the spoil is quickly dumped below. On on-deck barges, spoil can be mechanically pushed over the side or washed overboard with high pressure water jets.

Hydraulic, or pump dredges, mix large volumes of water with sediments. This fluidized slurry is then pumped away as a sludge. This type of dredge procedure results in the discharge of large volumes of water

Types of Dredges

Figure 1



which have been in contact with the sediments and may be polluted by materials which have adsorbed onto the soil particles. The spoils of hydraulic dredges can be disposed of in several ways. They can be collected in large sedimentation tanks aboard a hopper dredge and then dumped offshore. Pipeline dredging methods require that the sediment slurry be pumped like a vacuum cleaner or snow-blower and pumped from the site of dredging directly to a nearby diked area. Spoils are then allowed to concentrate as the water leaches out of the spoil. This process is called dewatering.

Hydraulic pipeline dredges account for 70%, or approximately 206 million cubic yards of maintenance dredging each year.[8] All dustpan types of dredges are owned by the Corps and are used for channel dredging of unconsolidated materials. Discharges are directed back into the water, outside the navigation channels, by floating pipelines. Cutterhead dredges are used for maintenance dredging and for new work projects. They can pick up consolidated and unconsolidated materials. Disposal for both cutterheads and dustpans are continuous and simultaneous with dredging operations. Consequently, spoils are usually found close to the dredging areas. When the slurries are discharged, without treatment by pipeline, they may be discharged into the water or sprayed out over a large area, or even under the water.

Hopper dredges are chiefly used in maintenance dredging and are involved in the removal of approximately 70 million cubic yards of spoils each year.[9] Similar in some respects to pipeline dredges, the hopper dredge operates by moving continuously, collecting the spoils in 'hoppers' or containers in the barge. When the hoppers are full, the barge travels to an open water site, opens the bottom doors, and releases the spoils to the water column. Approximately 8000 cubic yards can be released at any one time from a hopper dredge. Occasionally, spoils may be discharged at the dredging site when a method called "overflowing" is used. This is a procedure for concentrating the solids in the hopper by overflowing to the river or harbor waters any water that might flow into troughs located at the top of the hoppers. This is analagous to a landside dewatering procedure in a diked area despite its floating and migratory habit.

Sidecaster dredges are used for the removal of approximately one million cubic yards of material each year. This type of dredge is used primarily for maintenance dredging in the Gulf and East Coast waters.[10] These dredges operate while moving also, but they discharge their spoils simultaneously with dredging operations to the side of the navigation channel or onto beaches for beach nourishment projects.

Hydraulic dredges have been more frequently used because they are faster and accomplish the job quickly. However, they are more of a potential threat to the environment. Pumping methods allow 100-300% more contact of slurry water with potentially contaminated soils.[11] In addition, material disposed of hydraulically is put on top of the original bottom of an estuary or other area, and this results in the formation of large mounds of soil several feet wide for the entire length of the waterway. This restricts boating traffic, reduces water circulation, may alter salinity, and cause insidious effects on marine and aquatic communities. The hydraulic dredge is most economical to a user when it can dump its spoil nearby to the actual dredging site. However, in the past few years, the environmental problems of such disposal methods in inshore areas has resulted in ever increasing restrictions on dumping, and there has been a trend towards hauling spoils greater distances to dump in open waters. This has had the greatest economical impact on using hydraulic dredges because it reduces their potential productive capability.

The Future Modifications of Dredge Equipment

The dredging industry is concerned about environmental impacts caused by dredging activities. The industry has sought to mitigate environmental damage through equipment modification. While this discussion is not an in-depth, technical analysis of the equipment used in dredging operations, some of the methods presently being used and some of the methods considered for future dredging operations which minimally impact the environment have been investigated for this paper. They include the following types of equipment:

1) The impeller cutterhead dredge- This type of dredge has a cutterhead design where the blades act as an impeller. This type of dredge is useful for transporting soft materials. This type of dredge results in a greater concentration of solids, reduced turbidity in surrounding waters, and yields greater output.

2) The swivel cutterhead- This type of dredge results in reduced turbidity and greater output.

3) Automated ladder swing- Because this ladder is automated, there is a reduction in production costs. Environmentally, this ladder does not disturb sediments on the bottom, thus, nearby benthic communities are spared turbidity problems.

4) The Mud-Cat- Equiped with two horizontal cutting-screws, this small dredge can remove soft materials such as mud, silt, and plants with a minimum of turbidity.

5) Special dredges such as the walking dredge, are quite versatile. The walking dredge is mobile and it can also put down legs into the water. A walking dredge can have either a suction pipeline design or a swivel-head design. It has proven to be effective in minimizing the environmental effects of dredging.

6) A Closure Attachment for the Clamshell dredge- This hydraulic closing device is used to eliminate the upward pull when the jaws of the clamshell are closed (the normal operation). This attachment reduces bottom disturbances and turbidity and allows for larger volumes of materials to be dredged.

7) Endless chain or the Ladder-bucket Dredge- This type of dredge is used more in Europe than in the United States. This mechanical dredge does not dilute the bottom material as much as a hydraulic dredge. It requires less power for operation than another type of dredge, it requires a smaller disposal area, and it is more adaptable to long distance transport.

8) Short-range electronic equipment such as radar, sonar, and transponders, are being used for accurate control of all phases of dredging operations.

9) Chemical lubricants are being experimented with to reduce friction and increase solids concentration by as much as 15%. However, the environmental impact of these chemicals is unknown.

10) The 1984 Dredge proposed by Jantzen Engineering Company- This dredge is a modified conventional shallow water dredge. The hull has been altered and the ladder lengthened so the dredge can operate in 110 feet of water with a crew of only two persons. The dredge includes a conventional pumping system but it digs deeper and in rougher water. It would be suitable for ocean mining.[12] This design positively addresses the five problems currently facing the dredging industry:
    a) environmental restrictions
    b) the energy crisis
    c) development of ocean mining
    d) long-distance pumping through the water column to deeper depths
    e) deeper digging

Many engineering related steps can be taken to improve dredging operations. Different types of dredges can be modified by running them more slowly, adding shields, positioning the dredges more accurately, or automating the operation for greater economic efficiency and reduced environmental risk. The non-technical aspects of a social and economic nature can be changed to improve efficiency and reduce environmental risk. For instance, a change in method of payment from "quantity produced" criteria to payment on the basis of care and accuracy, better inspection and enforcement methods, and better personnel training will help to resolve economic and environmental conflicts. But there will be more on this subject later in the economic and social impact sections of this paper.

Present Disposal Methods and Equipment

During the past few years there have been several traditional ways to discharge dredged materials. These ways have not always been environmentally sound, and they are discussed in the next section. However, the equipment used for disposal has been under modification, and I will briefly mention present disposal practices and future disposal methods.

Present methods and equipment

1) Pipeline dredges discharge material to the side of the channel being worked on or into a confined or unconfined disposal area. Too much water comes in contact with soil particles using this method.

2) Hopper dredges and scows discharge by overflow, bottom-dump, or pump-out. The first is not environmentally desirable for reasons mentioned earlier. The second method is economically efficient and near-shore dumpsites are generally used. The third method is best environmentally because diked areas can be designated and prepared for dredged materials.

3) Silt curtains are vertical plastic screens which prevent the spread of suspended particles in the water column. They can be used only in calm waters with most efficiency.

Future Methods and Equipment

1) Bubble barriers- These pneumatic bubble screens create a barrier to floating or suspended materials. They are excellent in areas of low currents. They need a large power source for bubble generation. This method needs further testing.

2) Long distance pipeline transport- This method requires a large initial investment for pipe, and the system is inflexible. Feasibility for use depends upon location, type of material to be transported, existing facilities and equipment. Types of disposal sites include abandoned strip mine areas and open ocean sites.

3) Road and rail transport of dewatered or concentrated spoils involves high costs and requires dewatering sites and appropriate equipment.

4) Practices for the future include better monitoring and enforcement at disposal sites, better accuracy of disposal within the recommended location, and better spill controls.

5) Better treatment of spoils by aeration and chemical additions are needed to mitigate trace metal contamination, reduce anaerobic conditions at the spoil dumpsite, and to stabilize highly organic dredged materials.

6) Better knowledge of disposal treatments such as flocculation hydrocyclones which separate liquids from solids, vacuum filters, aeration, incineration, and other methods are needed which can transform the dredged spoils to a less environmentally harmful form.[13]

Combinations of the above methods have been suggested as viable methods for the future. They depend on the pollution status of the spoil and the physical and chemical characteristics of the dredged material as to selection of the appropriate method which is most cost-effective.

Problems facing the Dredging Industry today

The five problems currently plaguing the dredging industry include environmental restrictions, energy crises, the development of ocean mining, long distance pumping, and deeper digging. Of particular importance to the latter three problems is the needed modification for dredges to have greater stability and greater integrity between the site of dredging and that of disposal. Suggestions for dredge improvements will probably come from the oil industry and the designs from the semisubmersible rigs which have great stability and the platform rig which is similar to the "jack-up" rig, also quite stable. The more crucial problem is the pipeline by which the dredged materials are picked up and disposed of. The structural integrity of such a rig must be maintained, and it must be able to stand up to tremendous open-ocean wave action. Flexible floating pipelines must be used in these situations.[14]

The environmental problems effect the economic aspect of the dredging business. Since NEPA, there has been a slowdown of federal maintenance projects,[15] and the visible effect on business is reduced profits and idle equipment. At any one point in time, approximately, 25-50% of U.S. private equipment is idle.[16] This is the result of reduced new work and competition between private and government equipment for those projects which do exist. It appears that the best customer is also the chief competitor!

Between 1963 and 1970, there was a decline in new work projects and a reduction of $38 million dollars in government spending on dredging projects. But, in that period, government equipment received an increase of from 20% to 38% of available funds. In 1970, approximately $79 million dollars of funds for dredging projects were available.

During this period, actual private work declined, and there was a shift to government equipment, that is, Corps equipment, to accomplish the work.[17]

Increased, and often unrealistic, emotionalism about environmental concerns has helped reduce dredging operations over the past decade. And still another problem which creates idle equipment is an increased usage of foreign companies to do U.S. work.[18]

Opportunities to increase productivity in the dredging industry include projects such as superports, inland waterway and port development, beach and shoreline restoration, protection, and creation. In addition, projects such as offshore airports, ocean mining, and development of artificial islands would ease the economic problems in this industry. A potentially large future market exists for the dredging industry. Although the news media exploits the negative aspects of dredging, there are some extremely constructive uses for dredged spoils, and these will be explored later in this section.

Dredged Material Disposal

Section 123(i) of the 1970 River and Harbors Act authorized the Corps of Engineers to initiate a comprehensive nationwide study "to provide through research, more definitive information on the environmental impact of dredging and dredged material disposal operations and to develop technically satisfactory, environmentally compatible and economically feasible dredging and disposal alternatives"[19]. This four-phase program includes: 1) problem identification and assessment, 2) development of a research program, 3) accomplishment of needed research, and 4) field evaluation of new or improved disposal practices. The first two phases were completed in 1972, and phase three will be completed in 1978.

There are seven major research programs underway at the Corps of Engineers Waterways Experiment Station, Vicksburg, Mississippi, which constitute phase three of this program. This comprehensive program includes:

1) Environmental impacts and criteria development in aquatic disposal:
   A) Evaluation of disposal sites
   B) Fate of dredged materials discharged into different hydraulic regimes
   C) Effects of dredging and disposal on water quality (both short and long-term effects)
   D) Effects of dredging and disposal on aquatic organisms (both direct and indirect effects)
   E) Pollution evaluation and the development of techniques to determine pollution properties of dredged material on a regional basis.

2) The Environmental aspects and impacts of land disposal:
   A) Environmental impact studies, i.e, the identification, evaluation, and monitoring of short-term and long-term effects of confined and unconfined land disposal
   B) Marsh disposal research, i.e, the biological, ecological, water quality, and other problems relating to confined and unconfined disposal on marsh or other wetlands

C) Containment area operation research, or, the development of new methods for the operation and management of confined disposal areas.

3) New Disposal concepts which include:
A) Open water disposal research, or, the environmental/economic factors involved in deepwater disposal
B) Inland disposal research which includes the evaluation of new disposal possibilities such as utilizing abandoned mines and pits, long-distance transport to large inland disposal facilities, and other land-use concepts.
C) Coastal erosion control studies which expands dredged material use for beach nourishment and development of marsh erosion and subsidence control concepts.

4)Reuse of dredged materials in productive ways
A) Artificial habitat creation research- this includes the development, testing, and evaluation of marsh creation and island habitats.
B) Habitat enhancement research- an investigation of the feasibility of enhancing land and water habitats for sports and commercial fisheries.
C) Land improvement research- the development or enhancement of land for agriculture
D) Products research- the technical/economic aspects of marketing dredged spoils

5) Disposal area reuse and multiple utilization programs
A) Dredged material drainage/Quality improvement research- an investigation of in-place improvement techniques using physical and chemical and biological methods
B) Wildlife habitat program studies- the study of multiple-utilization concepts for confined disposal area.
C) Disposal area reuse research- studying the procedures which permit the removal of material from containment areas for landfill or other uses
D) Disposal area subsequent use research- the study of technical/ economic aspects of the development of disposal areas as landfill sites, and the development of recreation oriented and other public/ private land-use concepts
E) Disposal area enhancement- the evaluation of methods to improve the appearance and public acceptance of disposal areas through landscaping and related activities.

6) Dredged material treatment techniques and equipment programs
A) Dredged material dewatering and related research using chemical and mechanical densifying techniques
B) Pollutant constituent removal research which includes the evaluation of physical, chemical, biological methods such as aeration,

incineration, and coagulation for the removal and recycling of dredged material constituents

C) Turbidity control research- studying the nature and consequences of turbidity and the development of physical or chemical control methods for their employment in dredging and disposal activities.

7) Dredging and disposal equipment and techniques

A) Investigation of dredge equipment modifications and improvements and operational improvements to reduce environmental impacts

B) Development and application of disposal operation equipment such as barriers and bubble barriers to control turbidity and related problems

C) Dredged material transport concept research- an assessment of the technical and economic applicability of pipeline and vehicle transport concepts, particularly in regard to new disposal concepts. [20]

Over 150 projects are currently underway to evaluate these seven research areas, and there is coordination between the Corps and the Federal government, private, and academic laboratories to carry out the Research phase of the Dredged Material Research Program. After completion of the fourth phase of this program where prototype tests of new equipment and disposal techniques are developed, there will be a new national policy with respect to dredging and disposal operations.

Prior to the creation of this Dredged Material Research Program, dredged spoils were disposed of in the following places: a) open-water disposal which consisted of freshwater disposal (almost totally confined to rivers) and saltwater disposal which was limited primarily to the coastal zone, intracoastal waterways, and estuaries;[21] b) land disposal consisted of disposal in artificially confined areas or dikes, in upland areas which might have been partially confined, on marshes or other wetlands which were completely unconfined, to aid in beach nourishment,[22] or in containment areas or settling ponds[23].

Due, in part, to the Dredged Material Research Program, there are today nine possible methods for dredged material disposal. Some of these methods are present disposal techniques modified to reduce environmental impact, and some are new concepts in dredged spoil disposal. They comprise three major categories of disposal and include:

A. Land Disposal
   1) land disposal (coastal, lowland, or upland disposal)
   2) containerized disposal
   3) marketing dredged disposal as a product
   4) other methods (capping sanitary landfills, road development, construction fill, etc.)
   5) beach nourishment and erosion control

B. Artificial Habitat Creation
   6) island creation
   7) shoal creation
   8) marsh creation

C. Open Ocean Disposal
   9) Deepwater disposal

Land Disposal

Land disposal includes any dredged material that is placed in any quantity by any type of dredge in either a confined (naturally or artificially) or unconfined state on upland areas, coastal areas such as wetlands, or marshes and other lowland areas.

Historically, the major number of land disposal activities of an unconfined nature have been in marshes and in open waters. Disposal in confined areas or containment areas is a fairly new concept. Until the 1940's, most confined disposal areas were located near urban centers or congested areas to prevent the spread of spoil onto adjacent property. The increase in containment area construction in the last few decades is directly related to current concern over environmental impact on water quality. Most of the dredged spoils used in containment areas are fine-grained soils such as clays and muds, which have a particular affinity to adsorb and retain pollutants.

Some of the problems associated with containment areas is finding suitable sites for confined land disposal. They are scarce, and this condition will not improve in the future. The Corp's Dredged Material Research Program has attempted to resolve this problem indirectly by finding new uses for spoil, by revitalizing disposal areas, by reducing environmental damage caused by land disposal, and by trying to make confined spoil area more visually attractive.

Some containment areas are artificially closed natural depressions, but most are artificially diked facilities on almost flat ground. A bulkhead or dike is a characteristic feature of containment areas. Nearly all containment areas have spillways for water runoff and some have settling basins. They range in size from the large Craney Island disposal area in Virginia which totals 2500 acres, to very small impoundments. Some containment areas are built for a single project, others are built for multiple uses with life-expectancies of 100 years.

Containment areas are economical in that they reduce maintenance dredging volumes by reducing the return of spoils to the channel areas. Over time, this saves in dredging costs. This cost saving is somewhat negated by the fact that 1) initial construction of these facilities often destroys wildlife habitats, and 2) few containment areas are well constructed. Most dikes are low budget construction jobs and often do not even perform their intended function of containing spoils effectively.[24]

Containment area problems have, in the past, been the result of faulty engineering and ignorance of subsurface conditions such as poor foundation soils which ultimately affect the engineering of the bulkheads. As a result, dikes have failed by sinking, spreading, allowing uncontrolled seepage, and erosion near the bulkheads. Dike failures result in environmental degradation and high costs for repair maintenance and redredging. Research is needed to improve dike construction and to treat dredged material within these contained areas to promote consolidation of the materials through better drainage methods. The latter depends on the intended subsequent use of the spoil or the spoil area. If the area is to be redeveloped, efforts must be made to improve soil conditions. Methods used for better drainage include ditching, vacuum wells, electro-osmosis, desiccation, and ground surface drains[25]. If the consolidated spoils are heavily polluted, additional treatment methods may be used to reduce this problem by utilizing chemical coagulants like alum, iron salts, or polyelectrolytes[26].

Uses of land disposal sites and consolidated dredged spoil

The potential for multiple use of containment areas is now recognized. Prior to the era of environmental concern, most land disposal sites were reclaimed for building development such as residential housing, commercial, and industrial sites. Today, however, these areas can be reclaimed and made suitable as wildlife habitats and hunting areas. Areas can be reclaimed for development into urban recreational areas.

Dr. Stephen Skjei at the University of Virginia, has been studying solutions to the problems of disposing of dredged material and satisfying demands for recreational facilities in urban areas. He has developed criteria for recreational uses based on the type of dredged material available, the intended location and use of the area, the costs of the project, and environmental quality objectives. The economic desirability is based on the population concentration in the area and the climate. In regions such as the Southwest, recreational boating or swimming could occur year-round and benefit a great number of people. A project might be more feasible under such conditions than in the Northeast where summer activities are limited to a few months of the year.

The Corps can sponsor projects for recreational areas because of their legal authority to control the uses of confined disposal areas under the River and Harbors Act of 1899 and 1970, the Federal Water Pollution Control Act of 1972, the Coastal Zone Management Act of 1972, the National Environmental Policy Act of 1969, and the U.S. Fish and Wildlife Control Act.

Skjei's conclusions are that the use of dredged material for urban recreational areas is particularly promising because 70% of the population in the U.S. lives in urban areas, and because substantial volumes of dredged material are generated annually in urban areas to maintain and improve navigable waters. Skjei found that larger parks are more economical to "build" than smaller sites, and he found that larger sites seem to encounter fewer legal and political problems. The one disadvantage to a larger site is that a longer period of time is needed to fill, settle, and otherwise prepare the area for recreational use.[27]

It is technically and economically feasible to transfer contained, slurried dredged materials by pipeline over long distances. It is realistic to propose abandoned strip mines as disposal sites for contaminated dredged materials although the unit cost is higher than present disposal procedures. Geographic availability of sites is the most significant restriction to this method of disposal. Because of shallow aquifers in the Gulf and Atlantic coast areas, pits and mine disposal might create groundwater contamination, although the Great Lakes area is considered an excellent site for **this** type of disposal.

Disposal of dredged spoils (clean spoils) over agricultural lands has been under investigation at Rutgers University in New Jersey. Some conclusions drawn from research there include: 1) definite beneficial effects have been demonstrated and yields from wheat, corn, and other crops were increased up to 100% over original soils; 2) up to 200 tons per acre of dredged spoils could be applied effectively to original soils; 3) soil characteristics included better percolation, aeration, textural characteristics, better water retention, and higher organic content.[28]

Another use of contained dredged spoil is its marketability as a product, to be bought and sold as a commodity for such purposes as sanitary landfill capping, improvement to road beds and highway shoulders, construction site fill, or for such future uses as raw materials for building bricks and other building materials, and as soil supplements which were discussed above. Wakeford and MacDonald's extensive report for the Dredged Material Research Program on the legal, policy, and institutional constraints associated with dredged material marketing and land enhancement has recommended the three most feasible ways to market this material: 1) reclamation of sand, gravel, and other materials such as shells with commercial value; 2) sale or donation of material as landfill for private or public developments; and 3) sale, or more likely, donation of material to public agencies for use in creating new recreational land, wildlife refuges, marshes, etc.[29]

The sale of dredged material can partially offset dredging costs to the extent that income might exceed processing and transportation costs. This marketing approach also seems feasible, because new uses for spoils must be found. It is estimated that 7000 acres of new land are required each year to confine newly dredged materials[30]. Costs and land requirements will increase over time and available sites will eventually become exhausted.

Increased shoreline erosion has become a significant problem in the United States. Twenty-five percent of the 82,240 miles of national shoreline is experiencing erosion, some at critical levels.[31] Beach nourishment consists of replenishing the coarse-grained sediments along the inner shelf zone through artificial fill with dredged, clean sand. Because erosion is seldom prevented, this is a recurring, periodic activity to prevent further and extensive damage to present beaches. Historical beach nourishment consisted of sand hauled from land sources or dredged from nearby estuaries and bays. Supplies of clean sand are becoming scarce in these areas as well as more expensive, and there has been evidence that sand removal from estuarine areas created ecological problems. The Inner Continental Shelf Sediment and Structure Program (ICONS) has, since 1964, located and surveyed exploitable resources for future beach nourishment activities along the Atlantic coast. It is reasonable to assume that offshore sand exploitation will become a significant activity in the future. Dredging material from tidal inlets and outer sandbar channels, particularly in the Middle Atlantic States, have provided a principle or sole source of material for some beach nourishment projects. It is a readily available resource and costs much less than offshore or landward operations. "In view of declining resources, accelerating erosion, and increasing exploitation and placement costs, it can only be concluded that optimum utilization must be made of dredged spoils for beach nourishment purposes."[32]

Shoaling is a condition caused by the introduction, through erosion by streams and banks, drainage outfalls, industrial discharges, and dredged sediments, which settle out and clog navigable waters in coastal areas. It is difficult to alleviate this problem completely, but some degree of prevention and control could reduce significantly the amount of dredging needed, the amount of spoil which would have to be moved, and reduction of all associated dredging and disposal costs. One effective method to alleviate shoaling is confined disposal. This method is definitely preferred to uncontained spoil disposal. Another effective method includes a less zealous approach to the "overflow" method used on hopper dredges, ie, the pumping beyond maximum capacity to achieve a higher payload. Other methods that reduce shoaling include bank stabilization, salinity intrusion control, channel depth control, and prudent use of jetties, reducing sidecasting (the dumping of unconfined spoils to the sides of the channel which is simultaneously being dredged) and other unconfined subaqueous disposal adjacent and parallel to channels. Future developments in computer models in estuarine areas and new remote sensing techniques may contribute to a better understanding of current patterns, spoil dispersal patterns, and the reoccurrence of shoaling.

Artificial Habitat Creation

The idea of habitat creation is a means of disposing of large quantities of dredged material with varying physical and chemical characteristics while, at the same time, creating an environment or modifying an existing environment to provide life-sustaining ingredients for waterfowl, deer, and many endangered wildlife species. The most promising areas of habitat creation are islands, shoals, and marshes.

Historically, man has dumped spoils on lands valuable as wildlife, habitats, and they have been destroyed. Spoil islands, shoals, and marshes have been successfully created along the Atlantic coast through proper techniques and careful management, and habitats have actually been created rather than destroyed by wanton, careless dumping. A great deal of research is presently underway to determine community succession patterns on these artificial lands. North Carolina is the location for many prototype studies of habitat creation. Investigators are analyzing the invasion and succession of vascular plants and vertebrates on known-age islands and trying to relate these findings to island stabilization, and the development of wildlife habitat management techniques.[33]

Spoil islands can be created from materials which are rejected for use elsewhere, that is, from soils which are structurally unstable and polluted. One method, referred to as the "sandwich" or inverted method, puts highly polluted materials on the original bottom, and the deeper, and more frequently cleaner soils on top of the polluted materials, in effect, sandwiching the contaminated soils away from a direct water interface and most aquatic life.

Planned disposal of dredged materials to intentionally create a wildlife habitat is clearly a desirable disposal alternative. The Dredged Material Research Program has addressed this possibility since 1975.[34] The results of a portion of their research are provided in a manual which provides information on disposal options for creating spoil islands, disposing materials on existing islands to minimize damage to existing colonies of shore birds, and procedures for managing single bird species or groups of species. Dredged islands are of primary significance as a breeding habitat for shorebirds and wading species, and so the Corps focused the development of guidelines for creating and managing spoil islands around these shorebirds. It is estimated that 30 species fo water birds use dredged spoil islands as a nesting and breeding habitat.[35] Islands created away from human access and predators have been successful for the Common Terns on Tern Island off Cape Cod[36] and Roseate Spoonbills in Texas.[37]

Spoil islands may also be created to replace coastal areas already modified and used for commercial and recreational developments. By periodic addition of dredged materials, it can be expected that Dredged spoil islands will be destroyed or critically altered by wave and current action within a few years, or normal community succession will take place and the habitat will be suitable for many other species.

The development of wildlife islands does not preclude further dumping to maintain suitable habitats for certain species of birds or other wildlife. Dumping must be coordinated and planned to avoid breeding seasons and nest destruction, and it is imperative that proper management techniques be taught to those directing such activities.

The ability to creat productive marshes by transplanting grasses on barren spoil mounds and in diked areas has been successfully demonstrated by Garbische and others.[38] Guidelines for planning marsh creation with dredged materials have been established in a comprehensive work by Johnson and McGuinness for the Dredged Material Research Program[39]. Despite an initially high start-up cost, a result of planned construction, highly regulated spoil deposition, and the manual labor needed for planting, marsh creation results in untangible benefits to society.

Marshes are an invaluable component of the estuarine ecosystem. They aid in 1) the synthesis of organic matter by submergent, emergent, and terrestrial vegetation, benthic algae, and phytoplankton, 2) nutrient cycle transport where constant tidal activity provides an abundance of nutrients to the estuary as a result of detrital breakdown and the flushing of this organic detritus into coastal waters, 3) trapping nutrients in the soil to continue the nutrient cycle and allow these organic and inorganic nutrients to be deposited for plant uptake and subsequent new growth, and 4) serving as a spawning ground and nursery for young fish and shellfish. During this critical part of the life cycle, the nutrient rich medium of an estuarine marsh serves as the base of the food chain for larval stages of marine forms.[40]

Boyd et al.,[41] described the utilization of marshlands as former spoil disposal sites and the disappearance of thousands of acres of highly productive marsh areas. Disposal has been curtailed on the remaining marsh acreage because of Federal legislation and the environmental awareness of concerned citizens. And so, an alternative to disposing on marshes was sought, and one approach has been to create new marsh areas along shallow coastal areas suitable for the appropriate spoil deposition, and preparation by settling, and grass planting. Marsh creation effectively solves two problems: 1) it provides a disposal area for spoils at a time when conventional disposal areas are becoming scarce, and 2) created marshes can replace those which have been destroyed carelessly by man or by natural processes such as erosion or the rise of sea levels. The Corps alone dredges 380 million cubic yards of spoil annually. If ten percent of this total was applied at an average depth of ten feet, approximately 2350 acres of marsh could be created each year.[42]

The study of marsh creation could become the subject of another major paper for it is complex and extremely interesting. To those persons interested in marsh processes, two excellent papers are recommended. Redfield (1972) discusses the natural processes of marsh creation and reconstructs the ontogeny of a New England marsh.[43] In another monograph, Nixon and Oviatt (1973) discuss the ecology of a New England marsh.[44]

Site selection is particularly critical to successful marsh creation. The following areas are of major concern: 1) Dredging considerations must address the purpose, frequency (incremental or a "one-time" dump) and volume of dredging, the type of material to be used, whether the spoils will be unconfined or confined, the sea state, currents, and tidal ranges at the selected location; 2) Fill-Site considerations include water chemistry, tidal range and depth, coastline configuration, climate, and geological history of the area; 3) Design construction considerations assess the equipment needed for dredging, transport and filling, proper surface preparations, confinement requirements, and elevation tolerances; 4) Environmental, economic and social considerations include the acceptability of alternate disposal methods, local importance of marshes, availability of suitable environments for creating new marshes, economic costs or impacts associated with a non-dredging decision, and public attitudes towards marsh creation, the evaluation of marsh grass seeding techniques, productivity studies of marsh grasses, ecological succession and physiological responses of marsh plants to environmental stress.

The guidelines for marsh creation established by Johnson and McGuinness are sevenfold:

1) Determine if marsh creation warrants significant consideration.
2) Determine which type of marsh would be most suitable.
3) Compare marsh creation with other disposal alternatives.
4) Address the properties of a marsh (elevation, shape, orientation, and settlement) and area of the proposed marsh.
5) Focus on any characteristics of the marsh special to the location (subsoil conditions, need for dikes, etc.)
6) Determine the best alternative disposal method.
7) Design and construct the marsh. This involves coordination in filling the area, planting the area, habitat enhancement, management of wildlife, and other biological concerns when the marsh is finally established.[45]

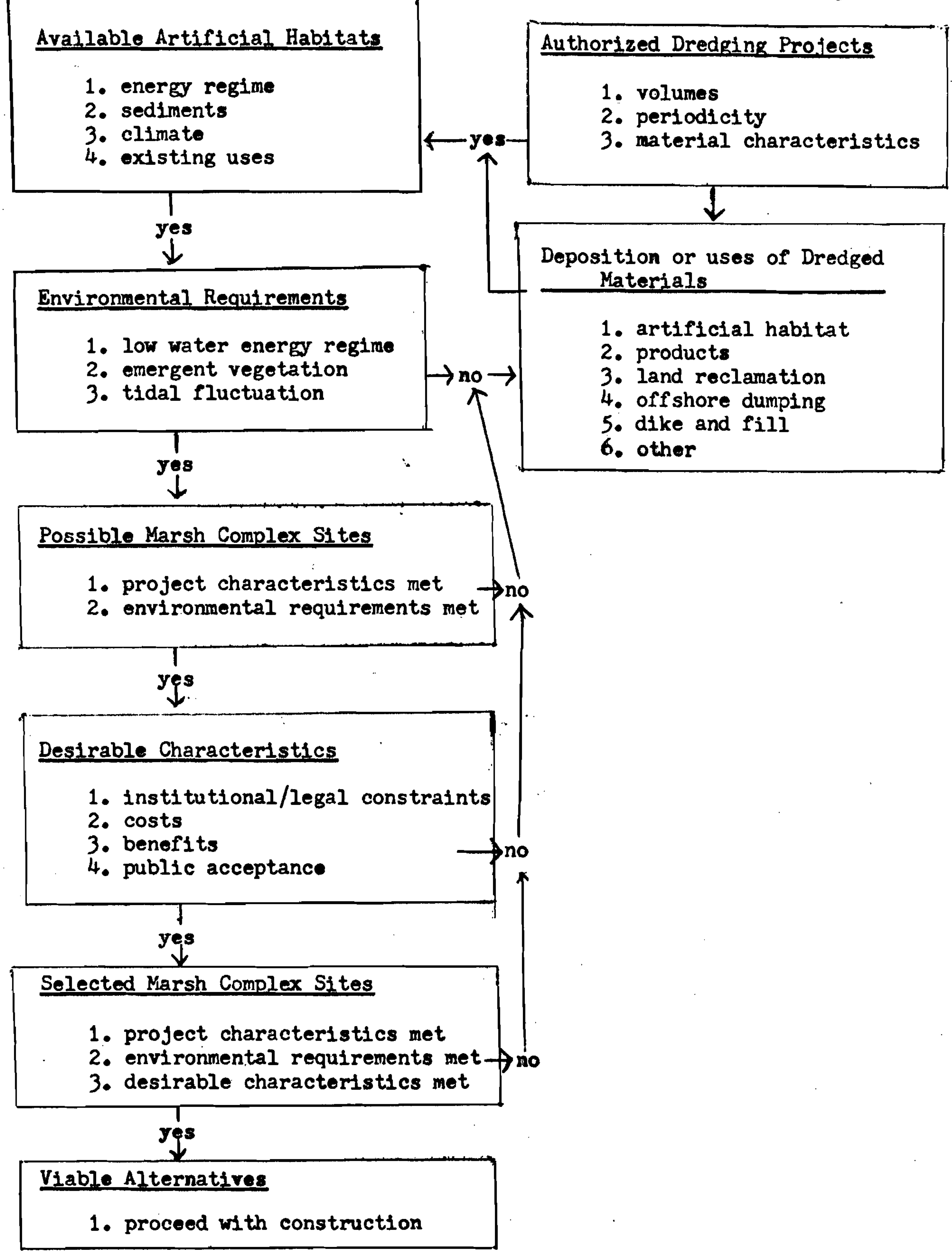
Physical impacts must be emphasized to insure long-term stability of a newly created marsh. Marsh creation guidelines call for locating new marshes in low water energy areas such as in the lee of barrier beaches, islands, and shoals, in shallow water where wave energies are dissipated, in river bends, in land extensions, bays and inlets where marshes already exist , and away from major tidal channels, headlands, or any area where wave energy is concentrated. The marsh should be planned so that exposure to erosion forces is minimal and coarse-grained soils should be used along exposed surfaces to protect against wave, current, or tidal erosion.Avoiding high wave energy areas will increase the likelihood of success of a marsh creation project.

If the selected site is deemed physically acceptable for marsh development, the location is further analyzed for sedimentation processes, environmental requirements, and institutional, economic, and social factors . This graphic representation simplifies the general approach to marsh site selection.(Figure 2). It is general procedure to mirror as closely as possible the processes and structure of the natural ecosystem when creating new marsh. Those that best approximate natural conditions will have a better chance for survival.

Kadlec and Wentz[46] have evaluated the state-of-the-art techniques for marsh plant establishment. Plant colonization depends for its success on compatability of the grass species with the soil substrate, the ecological requirements of the grasses chosen to imitate the local marsh systems in the area, a rapid rate of colonization on the new soil, and soil treatment prior to planting. It is necessary to choose local species because they survive better than introduced species. One must also know which species are more tolerant of polluted waters or low

Marsh Creation Site Selection

Figure 2.
Source: Reference DMRP Notes
Misc. Paper D-74-10
Dec. 1974 p. 1



water quality conditions, for instance, wild celery or Common cattail. One must also distinguish between freshwater and saltwater species, proper salinity, tidal conditions, aeration, rainfall requirements, water depth, temperature, proper soil mixtures, light penetration, and the type of current and wave action which will directly affect the grass plantings and ultimately determine its successful colonization or its demise.

Propagation materials consist of cuttings, vegetative structures, such as root systems, seeds, or transplanting entire plants. Seeds are the least expensive, but transplants have a higher rate of success. Seneca[47], Woodhouse, Seneca, and Broome,[48] and Broome[49] have examined the propagation techniques of seeding and establishing one species of hardy marsh plant, Spartina alterniflora. This species stabilizes dredge spoil mounds for subsequent plant colonization.

Marsh creation projects are one of the few viable alternatives to effective dredge spoil disposal in New England, and this is the reason for the thorough discussion on the past few pages. However, while the physical characteristics are better documented than socio-economic considerations today, actual methodologies for marsh creation are still in their infancy and must always be coordinated with integration of environmental values in final management decisions.

Open Water Disposal

Generally defined as dumping spoil materials into the open ocean, bays, estuaries, and inland rivers and lakes, open water disposal concepts have recently been expanded to include those materials placed on beaches, marshes, river edges, or any unconfined disposal where the spoil materials are subject to tidal and river fluctuation or erosion.

Boyd et al., in 1972, reported that over 250 million cubic yards of spoil materials were disposed of in open waters.[50] The tonnage of dredge spoil disposal into open waters is five times that of all other wastes combined.[51]

To ascertain the effects of disposal in the open water environment, physical and chemical properties of the spoils must be analyzed. Determinations of spoil density, for example, will show how the materials will disperse and settle or resuspend in the water column under specific current and wave conditions. Fine-grained silts and clay materials will settle slowly, while larger grained soils and sands will settle quickly. The chemical constituents of the dredged spoils should also be determined, since excesses of trace elements and toxic chemicals are known to have adverse impacts on biological systems.

At the disposal site, the biological processes must be known so that organisms most likely to be affected and pathways of transport and possible bioaccumulation of toxic materials can be identified. Quantitative and qualitative assessment of the community structure is essential for establishing effective management programs for open water disposal. For example, it is important to establish breeding and nursery grounds, areas of endangered or rare species, commercial species of economic importance, and migratory pathways of species using the disposal area at certain times of the year, to minimize both acute and chronic effects of disposal on the biota.

The National Academy of Sciences assessed disposal in the marine environment in 1976 for the Environmental Protection Agency. Their report described parameters to be analyzed at the disposal site, the selection of the disposal site, the types of materials to be disposed of, effective monitoring, and recommendations for future study.[52] Their conclusions were general in nature: 1) an ocean disposal site should be confined to as small an area as possible; 2) toxic wastes be characterized with respect to environmental impact prior to disposal; 3) irreversible dependence of society on ocean disposal be avoided; 4) toxic materials that may accumulate in the food chain, and ultimately, be detrimental to man, not be disposed of; 5) management strategy of disposal should be continually evaluated with respect to its continued effectiveness, and 6) further investigations be initiated to develop the knowledge necessary for desired levels of confidence in management decisions. Recent legislation has addressed the Academy's judgements on ocean disposal with the passage of the Toxic Substances Act (TSCA) and the Resource Conservation and Recovery Act (RECRA).

Dump sites are regionally specific. It is impossible to produce generalized criteria on how and what to dump, because local conditions must always be taken into account when dumping projects are proposed. However, the primary concern should always be the biological implications, and the secondary concern should be dispersion tendencies. The third concern is economics.

The physical parameters which influence dispersion and dilution of dredged spoils also affect the cost of ocean dumping. These include discharge rate, water depth, barge capacity, and distance to the disposal area. Associated with these parameters are three major cost categories:

1) capital costs, 2) maintenance costs, and 3) towing costs.

Capital costs represent the initial purchase of new barges with radio-controlled, rapid discharge systems (discharge time of approximately 90 minutes). The service life of a barge is 10-20 years at a cost of \$170 per ton. Annual costs are calculated by using an 8% interest rate, equal replacement cost, and negligible salvage value or benefits from depreciation.[53]

Maintenance costs are estimated at \$800 per trip and includes one annual dry docking for repairs. Capital and maintenance costs are combined to provide one yearly operating cost.

Towing costs are the most variable because they are proportional to a barge's discharge rate, tow speed, distance travelled, and existing weather conditions. As a general rule, it costs approximately \$80 per hour to tow a 5000 ton capacity barge moving at a speed of 6 knots. The following relationship determines tow costs on a per trip basis:

$$C_t = Tc \left\{ \frac{x}{v} + t \right\} \qquad (54)$$

where

C_t = total towing cost in \$/trip

Tc = towing charge in dollars/hour

x = round trip distance traveled in miles (point to point)

v = tug speed in miles/hour

t = unloading time in hours

Socio-economic Effects of Dredged Spoil Disposal

The social costs of a dredged spoil project are often a forgotten portion of a cost/benefit analysis. These costs include all uncompensated adverse effects, tangible or intangible, caused by the construction and operation of a project. Economic considerations do not normally take into account the advantages of a project, but only the costs of actually disposing of dredged materials. The social values of wetlands destroyed by dredging operations are generally not computed. These evaluations can be figured and used to increase the value of a project. For example, marsh creation projects may render spoil disposal costs negative, and thus, additional benefits are created from the project. These social costs which must be taken into account have been defined as "those costs which result from an action, which is not paid by the agency, and which affects a segment of society rather than identifiable individuals."[55]

A Case Study- The value of a tidal marsh to society

The tidal marsh is generally regarded as a wetland which is not conducive to residential or industrial development. Conventional real estate value of such lands are low. This is an erroneous evaluation. Their cumulative value to society must be considered, and this value is high. A marsh is valuable because it is 1) a natural tertiary sewage treatment system, 2) a stormwater "sponge" preventing floods, 3) a habitat to precious wildlife, and 4) a nursery for fish, and ultimately essential for profit from commercial fisheries.

Functionally, the marsh is important as a link in the food web. Serving as a nursery area for young fish and crustaceans, calm, nearshore waters are essential to the future existence of these immature forms which support a multi-million dollar fishing industry. The marsh can be used for aquaculture of shrimp and oysters which utilize the detrital cycle of estuarine-marsh regimes. Such industry adds to the value of the marsh.

The marsh is efficient as a sewage treatment system. A typical sewage treatment system consists of several phases. Primary treatment consists of adding chemicals to water to cause precipitation, thereby creating a sludge. Secondary treatment involves the addition of oxygen to the sludge to increase the efficiency of the bacteria which decompose the organic materials into harmless compounds such as carbon dioxide and water. Once completed, nitrogen and phosphorus are the only compounds remaining in high concentration. Removing them is expensive. Here is where a marsh can be of value to man, for marsh grasses require both nitrogen and phosphorus as nutrients for growth. As the grass grows, both nutrients will be removed from the soil and converted into food for marine organisms further up the food chain. Thus, treated sewage can benefit the marsh as fertilizer and relieve man of an expensive chore in cleaning up sludge pollutants.

Marshes are storm buffers. They absorb the energy of storm waves and prevent inshore damage. They function as reservoir for stormwaters and prevent inland flooding and erosion.

In 1974, Odum, Pope, and Gosselink[56] attempted to evaluate the natural functions of a marsh in economic terms. The dollar figure arrived at was $82,000 per acre, a reflection of the social value of a tidal marsh. This is a conservative estimate, because the value can only increase with continued encroachment by man and declining marsh acreage.

Dredged spoil disposal may be an opportunity for social gain rather than social cost. As positive applications of dredged spoil are explored, for example, beach nourishment, marsh creation, soil enrichment additives, and landfill, the social benefits may outweigh the economic costs of transportation of spoil for those purposes in addition to outweighing the social costs of destroying a wetland now assessed at $82,000 per acre.

Additional considerations of a social nature which are not generally assessed in the economics of dredged spoil disposal include 1) the long-term effects of spoil disposal, or, how will disposal affect the surrounding land, its drainage characteristics, property values of adjacent lands, 2) long and short-term effects of disposal on local business, that is, helping or hindering local fishing industries, local recreational activities, navigation, alteration of land-use patterns, and 3) long and short-term health care costs and water treatment costs if the spoils are found to be contaminated.

Pope suggested several ways of handling external costs of disposal within present day capabilities.[57] The first includes the social costs/benefits in a project evaluation. Those topics included in the evaluation might include a) decreased or increased fisheries production, b) increased pollutional loading, c) increased or reduced recreational areas and opportunities, and d) increased or reduced natural system aesthetics and amenities. The second suggestion is a scientific comparative analysis of all possible alternatives to dumping. Alternative sites and methods for disposal should be compared in terms of economic costs before a final site is selected. The cost/benefit ratio may shift slightly by approaching the project with social cost considerations as well as economic requirements.

Socio-economic decisions must be made at the State and local government levels. Dredge and fill operations extend beyond the individual property owner, and perhaps, even beyond the political limits of a city or county or state. It is difficult to measure and define the nature of the public interest and public impact that any one dredging operation may have upon the public welfare. Cost/benefit analysis should systematically be used to evaluate the economic and social considerations to disposal projects, for, it is particularly essential for intelligent and imaginative management of dredge and fill operations especially at the State and Federal levels. The local level tends toward the myopic on occasion. With this approach, economic analysis may turn a liability into an asset.

Environmental Impacts

Dredge and fill practices effect the environment at several levels. There may be acute and chronic impacts on the biological, physical, and chemical regimes at a dredge and fill site.

A. Acute impacts are primarily biological in nature. The most direct acute impact, acute being defined as a short-term, immediate impact, is the physical removal of organisms. Studies have concluded that this effect is not as significant as was once thought, because there is rapid recolonization of a dredged or filled area.[58,59,60,61,62,63]

Burial of organisms at a disposal site is of concern for two reasons. The amount of damage to the biota is dependent on the volume of material deposited on the bottom and the type of organisms found at the site. The covering or smothering of benthic animals at the disposal site is an anticipated effect. Sediments with a low oxygen content may provide anoxic conditions, and animals not capable of physiologically alternating from an aerobic environment to an anaerobic condition may smother before they reach the surface. Crustaceans are particularly vulnerable because, under stress, they increase ventilation and, so, need more oxygen instead of less. Some polychaete species (worms) can lower their physiological activity and, thus, decrease their oxygen requirements.[64] A change in community structure may result from substrate changes, and new animals may colonize a disposal site. Studies by Sherk,[65] Windom et al.,[66,67] indicate minimal effects on test sites and little stress on animals, a small change in species diversity, negligible change in water quality, and succession and recolonization at a steady state at disposal sites. Saila, Pratt, and Polgar,[68] however, showed only gradual succession and recolonization in Rhode Island Sound. Leathem et al.[69] and Maurer et al.[70] have documented low animal density and low oxygen concentrations in disposal areas, and recruitment to the area after cessation of disposal operations.

Turbidity and siltation problems from suspended solids in the water column are the most common and more reported effect of dredging, primarily because of high visibility and unaesthetic qualities.[71] This is not a significant problem in estuarine and nearshore areas because natural turbidity levels are normally high due to wave turbulence, storms, and tidal scours. Most nearshore organisms are highly adapted to these high turbidity levels and would be able to survive intermittent turbidity due to dumping at localized dumpsite locations.

There are direct and indirect effects of turbidity and siltation. Direct effects include suffocation and impairment of respiratory exchange mechanisms for benthic animals and fish, reduced survival and growth of larval stages of shellfish, fish, and water column dwellers. Indirect effects include: 1) reduction in light penetration and subsequent reduced photosynthesis by algal species, 2) reduction of visibility for feeding organisms, 3) destruction of spawning areas, 4) reduction of food supplies, 5) reduction of vegetational cover, 6) trapping of organic matter which results in the depletion of oxygen at the sediment surface and the creation of anaerobic bottom conditions, 7) flocculation of planktonic algae, and 8) the absorption of oil and the adsorption or absorption of organic matter or inorganic ions.

Studies at the University of Rhode Island [72] and Scripps[73] have shown that dredged particles are not distinguishable from food particles for water column crustaceans, specifically copepods. By diluting the water column with non-food particles, the filter feeding animals ingest them and experience rather drastic results in the form of impaired nutrition which results in slower growth, a loss in weight, and a higher mortality rate. Mortality rates were due, in part, to sluggish movements because animals became heavy with particles they had eaten, rendering them easy prey to carnivorous animals. Reproductive capability was also impaired because of this effect on feeding habits. Female sterility was a direct result of starvation, because an insufficient quantity of energy producing food was ingested along with soil particles, and the oil droplets that serve as energy reserves became depleted and reproductive organs did not develop.[74]

Impairments to the nutrition, survival, and reproduction of planktonic copepods, a basic element in the food web, results in an inherent weakening in the rest of the food chain. If the unicellular plants are incapable of photosynthesizing and the small crustaceans die of "malnutrition", and these are the basic food elements for all other levels of the marine food web, what are the long-term effects on the larger animals, assuming they survive the dumping themselves, and is the inherent stability of the food web and ecosystem weakened?

The answers to these questions are complex. Generally speaking, disposal is considered a localized situation. Plants and animals of the water column are known to recover quickly from a "one-time" dump.

However, O'Connor and Sherk[75] have documented that phytoplankton subjected to various concentrations of suspended particles have a carbon fixation rate which is inversely proportional to particle concentration. Gustafson[76] noted that sediments which have metals adsorbed to them are ingested and, in turn, accumulated in these filter feeding organisms and ultimately passed along the food chain. It has also been documented that in areas where heavy metal concentrations are high, the substrate is devoid of bottom dwelling animals.[77]

Heavy metals are known to be highly toxic, but neither their physical chemical bonding within sediments nor their release into the water column is well understood. Metals can be 1) dissolved in the water, 2) adsorbed to particle surfaces, 3) associated with hydrous iron and manganese oxides and hydroxides, 4) associated with sediment organic matter and sulphides, and 5) bound within the lattice of crystalline minerals and in clay. Studies done at USC indicate that the release of metals from fresh water sediments into a saltwater environment is greater than the release of metals from marine sediments. Gustafson[78] noted that resuspended sediments resulted in increased adsorption of heavy metals to the sediment particles in addition to those metals in the sediments which also became resuspended and adsorbed. Much work needs to be initiated to determine the relationship between metals and biological effects. Some work has already begun on establishing relationships between metals and their uptake by marsh plants.

A previous section has explained that marsh creation is a viable alternative to dredge spoil disposal. Pilot programs for studying marsh creation specific to different regions of the country are developing techniques for the rapid establishment of plants in dredged materials. Certain species of marsh plants are easier to grow and establish than others. Spartina alterniflora is one example. Spartina also serves as a nitrogen and phosphorus pump in the marsh. Scientists at the University of Georgia marine laboratory at Sapelo Island have shown that Spartina exports significant quantities of phosphorus from the sediments, up the plant, out through the leaves, and out into the water through the cyclic process of tidal inundation.[79]

One question of considerable importance is whether or not heavy metals are taken up by marsh plants, accumulated in plant tissues, and passed through the food chain in plant detrital material. The scientists at Sapelo Island have found that some species accumulate metals more than others. For example, Spartina alterniflora and Spartina foliosa accumulate metals in or on their roots but do not rapidly move them up the stem through translocation or into the leaves. Lead and chromium were found to remain near the root systems. S. alterniflora will, however, accumulate mercury in the roots and translocate 5% up through the leaves and back into the water in a similar manner as phosphorus is carried through the plant system. Two species which prefer less saline soils and inhabit the higher ground of a marsh, Spartina patens and Distichlis sp., rapidly accumulate and translocate zinc, cadmium, and nickel through the stem and leaves.[80] At present, it remains unclear whether heavy metal uptake by marsh plants is significant, and what 'significant' really means. This depends to a large extent on what happens to metals as they are accumulated and passed along the food chain.

Odum has observed that, except for mercury, there are decreasing levels of heavy metals with increasing trophic level in estuarine systems. If heavy metals do not pose a significant problem, the study of Somers _et al._[81] gives food for thought on the subject of marsh creation from dredged spoils for economic benefit. If one colonizes spoils with edible seed-bearing plants, such as rice, that are metabolically adapted to survive saline conditions, such crops can be raised to meet food needs locally or abroad for man or animals.

In summary, then, acute impacts on the environment due to dredge and fill operations are biological in nature. They include:

1) Community disruption by physical removal of organisms
2) Loss of habitat by burial of organisms and destruction of spawning areas
3) Reduction of depth of euphotic zone with a decline in primary production (photosynthesis) by algae
4) Reduction of food supplies to organisms
5) Reduction of feeding and subsequent higher mortality of organisms
6) Creation of oxygen demand, anaerobic conditions, and potential suffocation of benthic animals on the bottom
7) Reduction in reproductive capability of plankton
8) Increased metal toxicity due to adsorption and release from soil particles

B. _Chronic impacts_ of dredge and fill operations are fundamentally physical-chemical in nature. Chronic biological effects are due to physical alteration and subsequent hydrological and ecological changes which result from spoil removal and deposition.

Circulation patterns may be altered by the physical removal or deposition of large quantities of material. This can result in changes in salinity and temperature regimes in a localized area. Many organisms are adversely effected by temperature and salinity changes, and these characteristics can cause permanent changes in the ecology of the area.

Dredging has a significant impact on substrate quality, particle size distribution, and the associated biological communities. Studies have shown that spoil sites may slowly be recolonized after dumping, but the new community which develops is compatible with the new substrate and may not duplicate the original community. Rates of repopulation vary according to abundance of planktonic larvae, the mobility of non-planktonic species, patchiness and type of substrate, rate of setting larvae, competitive success of organisms, and prior colonization.[82]

Filling may change the hydrography of an area permanently in open water and in coastal and wetland situations. Filling lowland areas may effect nutrient and mineral recycling, groundwater recharge, and may destroy areas, such as the marshes described previously, which naturally detoxify the soil and water.

The chronic effects of disposal on benthic communities have been more widely studied than effects on water column organisms for several reasons. First, water column organisms are difficult to evaluate, and they have a certain mobility, whether it is voluntary or not. Second, a dump effects the benthic community for a longer period of time. The bioassessment of benthic animals is, however, more difficult, than the bioassessment of water column animals. The bioevaluation of benthic organisms takes two forms, both of which are explained in the July 1977 recommended procedures published jointly by EPA and the Corps.[83]

The first is the bioassay which tests the potency or activity of a material through a response or specific endpoint, such as death, within a certain time period. The response may not be readily measurable except over the long-term. This type of response is referred to as a sub-lethal effect, and, although a toxic element may not kill the organism, there may be substantial impairment physiologically or morphologically so that future generations do not survive. There may be behavioral anomalies produced which render the animal more vulnerable to predation.

The second form of bioevaluation of benthic animals may be the insidious accumulation of metals and other contaminants which may effect the organism itself, its progeny, or serve to pass the accumulated toxicants further along the food chain to effect non-target organisms higher up the food chain.

The rate of benthic community recovery from a dump depends on several factors: 1) initial ecological conditions, 2) time of year, 3) nature of the biota, and 4) duration, frequency, and scope of dredge and fill activities. If all conditions are favorable, the effect on biota will only be acute, and recolonization may begin as soon as the next spawning season.[84] If conditions are not favorable, recolonization will be slower, and the potential for an increase in chronic effects may become apparent.

In summary, the chronic impacts of dredge and fill activities are physical and biological in nature. Physical impacts include:

1) Alteration of circulation patterns which may result in -
2) Potential changes in temperature and salinity
3) Alteration in ecology of benthic biota
4) Change in substrate quality and particle size distribution which effect recolonization of benthic communities
5) Effect on nutrient and mineral recycling and groundwater recharge

Biological impacts include lethal and sub-lethal effects on benthic animals as measured by bioassay and bioaccumulation studies and substrate changes which result from physical-chemical alterations that ultimately affect the biological community.

Chapter 3

Disposal Practices, Legislation, and the Southern New England States

To date, no comprehensive analysis of New England dredge spoil disposal practices exist on a regional or sub-regional level. Within any one State, information is fragmentary. Of the eighty people interviewed and contacted during the information gathering stage of this project, not even members of a single State government were totally certain of the State laws governing dredge and fill practices, whether permits were needed, or what, in fact, the permit procedures might be.

The information contained in this Chapter is a compilation of existing State legislation and permitting procedures governing dredge and fill practices in the States of Massachusetts, Rhode Island, and Connecticut. A case study of a regional project currently being considered for Long Island Sound is examined in some detail in the final section of the chapter.

Massachusetts

Legislation and Permitting Procedures

The Commonwealth of Massachusetts initiated legislation to protect its remaining wetlands earlier than most States. Irreparable damage had been done to wetland areas as a result of dredge and fill operations, the most notable example being the filling of Boston's low-lying areas in the 1850's. Of the many laws passed in Massachusetts to protect against continuation of further wetland damage, the earliest was the Conservation Commission Act of 1957.

The Conservation Commission Act was a response to prohibit a dredge and fill project on an Ipswich marsh. The State passed legislation to allow any town to take action to prevent environmental deterioration. Conservation commissions were established to coordinate conservation activities of local agencies, to promote and develop natural resources and protect watershed resources, to make recommendations to local governments for improved development and utilization of these areas, and to publish pertinent materials on the subject of local conservation. Each Commission consists of three to seven people appointed by the Mayor or town selectmen. This Act laid the basic foundation for local involvement in environmental matters by approving direct citizen involvement in conservation planning and by providing a continuing coordination and review at the local level for environmental issues. These commissions have provided a valuable link as a citizens group-local government-State government liaison where dissemination of information pertaining to environmental programs and State legislation is effectively handled.

The Jones Act of 1963 requires that, thirty days prior to beginning any dredging project, notice must be given to local authorities, the Director of the Division of Marine Fisheries of the Department of Natural Resources, and the Director of Public Works. Notices must describe the project, the intent, what is to be altered, who will do the work, and a map must be included which shows the area and drainage patterns. After a notice is received by these people, a public hearing is held within two weeks by city selectmen or a licensing agency. After the hearing, the recommendations of the committee must be forwarded within seven days to the State Department of Natural Resources. The Department of Public Works determines if a dredging project would be harmful to harbors, navigable waters, or adjacent areas. The Director of this Department can obtain an injunction prohibiting a project for adverse effects to harbor and water areas. The Director of Marine Fisheries may impose certain modifications to a project in order to protect marine life, but he can not prohibit a project on these grounds.

The Hatch Act of 1965 protects inland waters and wetlands in the way that the Jones Act seeks to protect coastal wetlands. Both are invaluable as natural flood protection areas and fresh water reserves. The Department of Natural Resources can prohibit and fine violators who dredge and fill such wetland areas. Fines range from $1000-$5000 with a 2-year jail sentence. As with the Jones Act, the Hatch Act also requires a permit. A potential land developer who wishes to dredge and fill inland wetlands must file a notice of intent with the Department of

Natural Resources and the local Conservation Commission. After a public hearing, the Department of Natural Resources issues an order of the conditions to be met specifying certain wetland protections which must be obeyed.

The Coastal Wetlands Protection Act of 1965 and the Inland Wetlands Protection Act of 1968 were passed to protect wetlands even more. These laws allowed for restriction of development on wetlands before a developer filed a notice of intent and/or bought the land. Although a deterrent to development, these laws were never adequately enforced. Understaffed offices and underfunding have resulted in massive delays and little action by the Department of Natural Resources.

The Coastal Wetlands Protection Act of 1965 authorizes the Commissioner of the Department of Natural Resources to "adopt, amend, modify, or repeal orders regulating, restricting, or prohibiting dredging, filling, removing, or otherwise altering or polluting ocastal wetlands."[1] In this instance, a coastal wetland is defined as any bank, marsh, swamp, meadow, flat, or low land subject to tidal action or storm flow. The Commissioner can enforce easements to prevent any wetland alteration, and these orders are required to be recorded at the local registry of deeds. Public hearings are held three weeks prior to records being registered. Appeals by affected land owners may be heard by the Supreme Court within a ninety day period of receipt of notice to determine whether such an order " restricts the use of a land owner's property so as to deprive him of the practical uses thereof and may constitute an unreasonable exercise of a taking without compensation."[2] Landowners must prove clear ownership to the land before the court will consider such an appeal. If such a finding is found, the law allows the state to replace the order by negotiated purchase of the full title to the land and its easements.

This law gives the State strong powers to protect coastal wetlands. Under this law, proposed wetland areas to be protected have their boundaries determined on a Coast and Geodetic Survey Map, and meetings are held at the local level to discuss the proposed protected wetland and answer questions pertaining to its boundaries. Revisions, if necessary, are then made, and the entire order is sent to the Division of Natural Resources for final approval. This entire process takes nearly a year to execute. Such actions have been well received by the local governments and landowners, because it provides a means of protecting wetland resources without destroying the tax base, and it compares favorably to State acquisition of the property. The lands affected remain in private ownership with restrictions imposed by the State regarding certain developments and activities in those areas.

The Inland Wetlands Protection Act of 1968 covers all areas subject to fresh water flooding and permanent wetlands. It includes many of the same provisions as the Coastal Wetlands Protection Act. This law is weak, however, for several reasons. First, the State can not enforce orders on a landowner if he can show clear title to the land and if they object to such orders within ninety days. The Department of Natural Resources can negotiate for purchase of the land and easements or use its eminent domain powers to achieve the purpose of the Act. Second, if the local authorities do not approve the Department of Natural Resources' order, the order can not be adopted for a period of one year. Third, land excluded from this Act includes agricultural lands, and agencies excluded from involvement in this Act are the Department of Public Works, the State Reclamation Board, Department of Public Health, the Metropolitan District Commission, the Division of Fisheries and Game, the Massachusetts Aeronautics Commission, and various mosquito control projects. The Act seeks to protect 300,000 acres of inland wetland compared to the Coastal Protection Act which governs 45,000 acres..

The Wetlands Protection Act was passed in 1972. Its main purpose was to improve the permiting process. The Act considers coastal and inland wetlands together for the first time instead of separately, because,in many cases, distinctions were difficult to determine. The power to issue permits was removed from the Department of Natural Resources and given to local Conservation Commissions. Developers and citizens groups could, however, appeal a Conservation Commission decision to the Department of Natural Resources.

A series of amendments to this Act were passed in 1973 and went into effect in 1974. They included a detailed definition of a wetland as 100 feet horizontally inland from the bank of any beach, dune, wetland or 100 feet horizontally landward from the water elevation of a 100 year storm. Amendments also included comprehensive vegetation lists in addition to requesting a ten day period after an order is given for the Department of Natural Resources to have time to act on an appeal, and the requirement that permits and variances be obtained before an order is given to the Conservation Commissions to request such a permit.

Other amendments were considered in 1974, and they were passed and took effect in 1975. The most important amendment passed at this time states that citizen's groups have up to three years to sue a landowner who has illegally filled land. If, after three years, no one sues, the landowner is no longer liable.

The Wetlands Protection Act has enforcement powers. Conservation Commissions have the power to impose conditions on a developer when they issue permits for wetlands development. Conditions may include protecting public/private water supplies, groundwater supplies, control flooding, protecting stormwater drainage areas, and protecting fisheries interests.

Although the Act is implemented on the State and local levels, the Conservation Commissions may be inherently weak as an enforcement authority for several reasons. First, most Conservation Commissions are voluntary. Second, most members work part-time at this job, their full-time jobs getting top priority. Third, most members are lay-people who do not have the legal or engineering expertize to properly evaluate technical reports. When questions in technical areas arise, the Conservation Commissions use city engineers and city lawyers. These experts may have biased opinions, particularly if the town planning boards are pro-development. Fourth, Commission members may have conflicts of interest which may work to the advantage or disadvantage of the Commission. Fifth, Commissions are often under pressure to respond to local town sentiments which is more of a socially subjective response than an objective, legal and scientifically oriented response. Sixth, Commissions do not use uniform standards to evaluate permit applications.

Seventh, Commissions can not take action on violators until an illegal dredge and fill project is reported. Small activities may go unnoticed and this insidious development wastes many acres of wetland areas. Eighth, Conservation groups do not have a procedure for cumulative review, and there is no way to estimate or predict overall effects of these small incremental changes. And finally, enforcement of the law is at the local police level. This is the weak link. It is to the developer's advantage that enforcement is weak at the local level, because Conservation Commissions will often make compromises with developers to alleviate any fear of litigation. This type of action also eats away wetland areas.

At the State level, the Department of Environmental Management is responsible for wetlands, but the Department is understaffed and the process of permit application review proceeds slowly. The State encourages compromise to cut down extensive time delays. Legal appeals also slow the permit process down and these are discouraged. Most compromises favor the developer. The Department can overturn rulings made by the Conservation Commissions, and this action causes additional delays and creates internal communication problems.

In summary, the Wetlands Protection Act is an inherently good law, but the administration of the Act and the legal mechanisms are somewhat unrealistic. The Conservation Commissions, under their present mode of operation, are not terribly competent in evaluating technical reports and permit applications, and this puts the developer at an advantage. The State is basically pro-development and strong communications exist between the State and the developers, so, often, developers are advised of "loopholes" for complying with the law. The State groups are underfunded and understaffed, and their actions can often cause communication and coordination problems between local and state agencies.

The Ocean Sanctuary Act of 1970 provides for the protection of the Cape Cod Bay, and the Cape and Island, and North Shore Sanctuaries. The Act gives the Division of Environmental Quality Engineering (formerly the Department of Natural Resources) responsibility to care for and control these areas and list prohibited activities in those waters. Prohibited activities include removing sand and gravel, drilling, and dredging. The Act is limited in its enforcement value because it does not explicitly authorize regulations.

The Massachusetts Environmental Policy Act of 1972 (MEPA) requires all State agencies to assess the impact of their proposed activities on the environment and to take all practicable means to minimize and prevent environmental damage. It is a critical environmental disclosure law and it presents a useful set of criteria. While it exempts the Massachusett's Port Authority, it includes all municipal projects, and it gives the Office of Environmental Affairs (OEA) varying degrees of administrative authority. The law essentially creates a miniature NEPA and requires environmental impact reports which must explain the potential for environmental damage, how the damage can be mitigated, and a discussion of project alternatives. MEPA was designed to address some of the inadequacies of the National Environmental Policy Act. NEPA did not directly address non-compliance or evasion by some groups. NEPA failed to circulate draft impact statements to the public. NEPA lacked authority on the part of reviewers to reject an impact statement. NEPA enforced by EPA, lacked control over its sister agencies. MEPA is not as strong as the Wetlands Protection Act. MEPA can only delay, not prohibit, development. Its purpose is to motivate public and private sector groups to become aware of how their activities affect the environment.

Section 62 of the Act directs all authorities and agencies of Massachusetts to publish and circulate environmental impact reports before any project can begin. Reports must include a statement of measures taken to minimize environmental damage, the environmental impacts of the project, and a discussion of project alternatives. A "project" is defined as any work or activity of any agency which may have environmental impact, and which is a) directly undertaken by the agency, b) supported by any form of financial assistance from an agency, or c) involves the issuance of a lease, permit, license, certificate, or any entitlement for use by an agency.[3]

Impact reports are reviewed by several staff of the Office of the Secretary of Environmental Affairs. They are circulated to other agencies and groups for review and comment. Comments are not legally binding. The purpose of these reviews is to assess full disclosure of environmental impact. Other agencies reviewing and evaluating permit applications may use these comments in decision making, but the OEA's recommendations are not binding to those agencies which issue permits.

The OEA is severely underfunded. As a result, the OEA depends upon students majoring in environmental management to review impact reports. Major reports are often approved without a thorough review. In addition to the staffing problem, limited funding also prohibits the OEA from obtaining independent data on particular projects. The OEA relies heavily on the information provided by those groups seeking project application approval.

There are no organized groups at the local level to evaluate environmental impact reports. Environmental reports are circulated to the public, but there is little opportunity for citizen participation early in the planning process when project alternatives are being chosen. At the present time, there is almost complete dependence on the State to evaluate these reports.

MEPA lacks enforcement power, and the law may be thought of more as a planning tool than a legal tool. As a planning tool, MEPA seeks full disclosure but this does not preclude the assumption that the alternative which minimizes environmental impact will always be chosen. Because requiring full disclosure does not provide enough incentive to concern and activate agencies during the planning process, MEPA may not be effective in environmental protection. And since the OEA's recommendations are not binding on permitting agency's final decisions, the Secretary of the OEA can only override a permitting agency's authority by taking the case to court.

Federal agencies must, of course, adhere to NEPA and other pieces of Federal legislation discussed in Chapter I. Federal permitting procedures are regimented and bureaucratic. The schematic flow-chart in Figure 3 briefly explains how a dredge and fill permit application must proceed through the Massachusetts State structure.

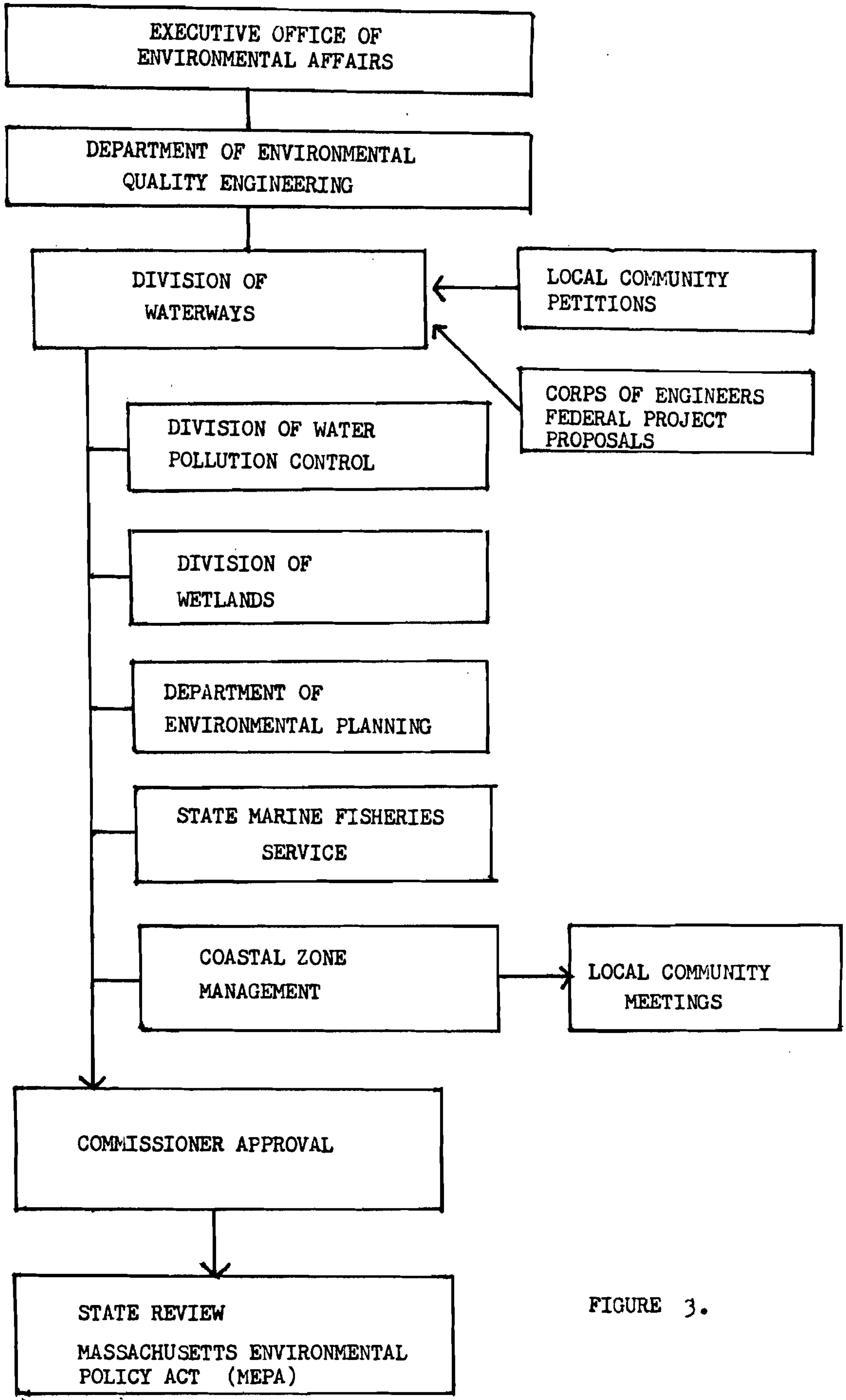

EXECUTIVE OFFICE OF ENVIRONMENTAL AFFAIRS
DEPARTMENT OF ENVIRONMENTAL QUALITY ENGINEERING
DIVISION OF WATERWAYS
LOCAL COMMUNITY PETITIONS
CORPS OF ENGINEERS FEDERAL PROJECT PROPOSALS
DIVISION OF WATER POLLUTION CONTROL
DIVISION OF WETLANDS
DEPARTMENT OF ENVIRONMENTAL PLANNING
STATE MARINE FISHERIES SERVICE
COASTAL ZONE MANAGEMENT
LOCAL COMMUNITY MEETINGS
COMMISSIONER APPROVAL
STATE REVIEW
MASSACHUSETTS ENVIRONMENTAL POLICY ACT (MEPA)

FIGURE 3.

In Massachusetts, the lead agency is the Division of Waterways. This division receives dredging permits from local communities and federal permit proposals from the Army Corps of Engineers. There is a public hearing to whether local attitudes are favorable for the project. Following this meeting, the permit application goes to the Division of Water Pollution Control. This agency decides if the dredged spoil, based on the elutriate test and bulk analysis tests and other tests, if required, is polluted. If the material is not polluted, a Water Pollution certificate is issued for the dredge and fill sites.

If a Wetlands Permit is required, the proposal is circulated to the Division of Wetlands. The permit application must also be approved by the State Division of Marine Fisheries. If the proposal is for an open water disposal site, the Department of Environmental Planning is consulted. There are presently seven sites for dredged material disposal off the Massachusetts coast. They include:

1) Foul Area- 22 nautical miles east of Boston (the only site approved, so far, for polluted spoil disposal)
2) Clean Spoil Disposal Area- 42°21'14"N, 70°40'12"W (1 mile in diameter)
3) North Shore at 42°46'N, 70°46'W (1 mile diameter circle)
4) Cape Cod at 41°49'N, 70°25'W (1 mile diameter circle)
5) Nantucket Sound at Great Point- 41°26' N, 70°01' W. (1 mile circle)
6) Nantucket Sound at Cross Rip Shoal 41°27' N, 70°22' W (1 mile circle)
7) Buzzards Bay off West Falmouth- 41°36' N, 70°41' W (1 mile circle)

The Office of Coastal Zone Management reviews all environmental impact statements of disposal and dredging for recreational, land-use, socio-economic effects, or any aspect that has not yet been reviewed and examined. This group meets with interested local citizens at public meetings to discuss proposed projects. The OCZM also acts as an agent of the Army Corps of

Engineers for State projects.

The Commissioner of the Department of Environmental Quality Engineering reviews the permit application after all other appropriate State groups have reviewed it. If approved, the permit application is forwarded to the MEPA review board to see if an Environmental Impact Report is required. If not, the permit is approved. If an EIR is needed, further investigations are needed before a permit can be ultimately approved or denied.

The Federal Corps of Engineers projects must proceed through this same review process in the Commonwealth of Massachusetts.

Massachusetts Dredging Practices

Spencer has reviewed dredging practices in Massachusetts.[4] Mechanical dredging is predominant, because of the unavailability of sites close to a dredging site for utilizing an hydraulic dredge with its accompanying offside spoil deposition. Hydraulic dredges were once used in the State prior to environmental awareness that coastal wetlands were a valuable resource that needed to be preserved rather than destroyed. Today, hydraulic dredges are used only to transport clean sand on beaches for beach replenishment projects. Most dredged materials in the Cape Cod area are utilized for beach replenishment activities.

Maintenance dredging is performed in and around Boston harbor to remove silt from the channels. This material is generally quite polluted and must be disposed of in ocean disposal areas. The Massachusetts North Shore Site combines onshore and offshore disposal depending upon the type of material dredged.

The offshore disposal sites previously mentioned for unpolluted disposal are easily accessible by boat. The "foul area" for polluted materials is relatively unaccessible for small, shallow scows which are unable to maneuver in severe sea conditions. The foul area is located in exposed, open sea. Larger, deeper draft vessels which can operate under extreme sea conditions are unable to maneuver in the shallow harbors and coastal areas that are usually the sites for dredging.

Because Massachusetts is densely populated along the coast, some onshore disposal alternatives are unfeasible. Those methods commonly used and those which have development potential include beach replenishment, small, onshore fill projects, marsh creation, island creation, and offshore dumping. The economics of dredging in Massachusetts rests primarily with the State. The State funds up to 75% of dredge and fill costs. The affected town or municipality must provide a minimum of 25% of the total project cost.

Rhode Island

Legislation and Permitting Procedures

The Office of Statewide Planning is the official coastal zone management agency in Rhode Island. All official monies for coastal programs are dispersed through this agency. The Coastal Resources Management Council (CRMC), established in July of 1971 under P.L. 1971, Ch. 279; H 2440 B, is the lead agency under the Office of Statewide Planning for handling dredged spoil disposal problems. The Council has planning, management, implementation, and coordination and operational authority over the State's coastal resources. The Council contributes heavily to the development of management policies and priorities in coastal management out to the three-mile limit and up to the mean high water mark. The Council makes all final determinations on coastal management issues.

There is only one salaried member of the CRMC, the Director. All other members of the Council are volunteers. Seventeen persons make up the Council: two State Senators, each representing coastal communities and appointed by the Lieutenant Governor, two State Representatives, two local town councilmen, and eleven coastal community citizens. In addition, there are two ex-officio members: the Director of the Department of Health and the Director of Natural Resources. The primary goal of this group is advisory in nature: to help manage the State's coastal resources and preserve and restore the ecology of Rhode Island.

The research and planning arm of the CRMC is the Coastal Resources Center (CRC) which is located at the University of Rhode Island. This group does extensive research on all aspects of coastal development, inventories of coastal resources, and recommends appropriate comprehensive management options to the CRMC. The Council then considers these recommendations as part of a Statewide Administrative Policy. A citizen's advisory committee reviews each proposed management project and can make alterations before the recommendations on coastal policy are presented to the CRMC. The Council may further alter the program if necessary. After a public hearing, the policy is included in the comprehensive coastal management plan for the State.

The Director of the CRMC also maintains a salaried staff which make up the Coastal Resources Division of the Department of Natural Resources. There are, then, three groups which work on coastal programs within the State under the umbrella of the Office of Statewide Planning: 1) the Coastal Resources Management Council, 2) the Coastal Resources Center, and 3) the Coastal Resources Division of the Department of Natural Resources.

Other State agencies which are also involved in the permitting procedures for dredge and fill operations in Rhode Island are: 1) Division of Fish and Wildlife, 2) Division of Water Supply and Pollution Control (housed within the Department of Health), 3) Division of Wetlands and 4) Department of Transportation. In addition, the State Historical Preservation Commission, town officials and local planning boards and citizen's groups are active in dredge and fill projects in the State. Figure 4 illustrates the permitting procedures for dredge and fill projects in Rhode Island. The CRMC requires a permit for all dredge and fill activities in the tidal waters of the State. This is the State's only dredging policy and requirement.[5]

RHODE ISLAND

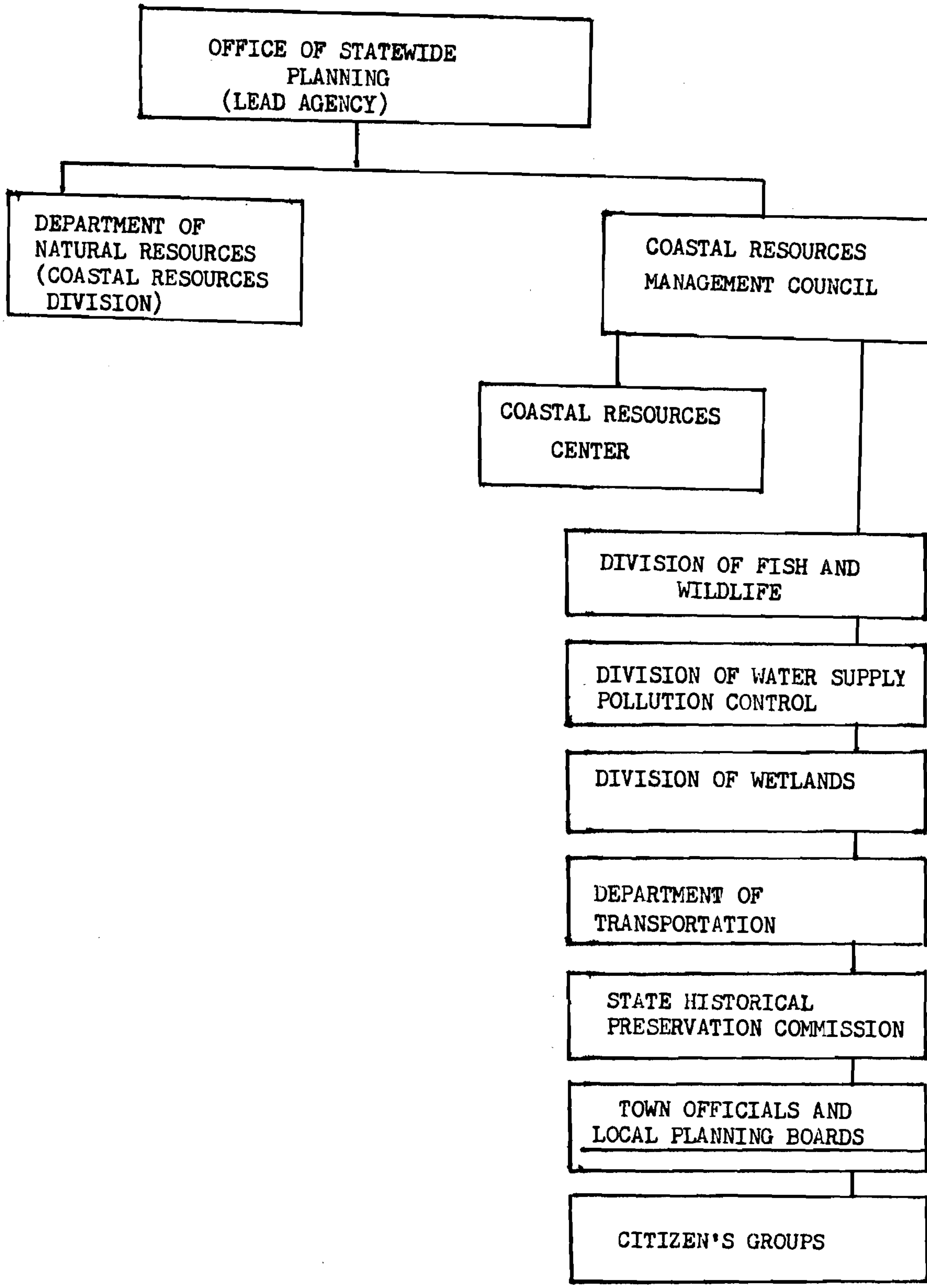


FIGURE 4.

The policy of the CRMC is

> "to preserve, protect, develop, and restore the coastal resources of this State for this and succeeding generations through comprehensive and coordinated long-range planning and management designed to produce the maximum benefit for society from such coastal resources; and that preservation and restoration of ecological systems shall be the primary guiding principles upon which environmental alteration of coastal resources will be measured, judged, and regulated."[6]

The primary responsibility of the CRMC is to plan and manage the resources of the State's coastal region. The original intent was to study the coastal resources in several phases: first, identify all of the State's coastal resources, water, submerged land, etc; second, evaluate these resources in terms of quality, quantity, utilization potential, etc; third, determine current and potential uses of these resources as well as current and potential problems of each resource; fourth, formulate plans and programs for the management of each resource, identify permitted uses, locations, protection measures, etc; fifth, carry out these resource management programs through implementing authority and coordination with State, Federal, local and private activities; sixth, formulate standards on a continuous re-evaluation basis for all resources. The basic standards and criteria included: 1) the need and demand for various activities and their impact upon ecological systems, 2) the degree of compatability of various activities, 3) capability of coastal resources to support various activities, 4) water quality standards set by the Dept of Health, 5) consideration of plans, studies, surveys, inventories, etcetera, prepared by other public and private sources, 6) considerations of contiguous land uses and transportation facilities, and 7) consistency with the State guide plan.[7]

The establishment of the CRMC was an attempt to deal with pressing coastal problems. Rhode Island was one of the first states to begin comprehensive coastal zone planning, and one of the first to receive a grant from the Federal Office of Coastal Zone Management to aid in the further development of their program under the Coastal Zone Management Act of 1972.

It has been essential for Rhode Island to develop a coastal program. Its small size and its dense population create pressures for residential and commercial expansion of coastal lands. This was felt in the 1960's. By 1971, the State General Assembly passed the Act which created the CRMC. Since that time, The council has been quite successful. The authority of the CRMC is widely recognized, and rapport between local and State agencies is well established. Although the Council has two weaknesses, and they are 1) the the Council lacks direct authority over most coastal residential and commercial development, and these are widespread activities, and 2) the 17 appointed, unpaid members of the Council may not always be as well-versed in coastal issues as some would like and this may lead some people to believe that the group is not as effective as it could be, the Council is generally considered to have made a valuable contribution to management policy of coastal resources in Rhode Island.

Prior to the passage of the Coastal Management Council Act of 1971 which created the Coastal Resources Management Council, Rhode Island had passed two pieces of wetland preservation legislation. Both were passed in 1965. One was the Intertidal Salt Marsh Act (Act 26-1965) and the second was the Coastal Wetlands Act (Act 140-1965). The State Constitution guarantees the "free right of fishery,"[8] and these laws were based on this right and the environmental awareness that coastal wetlands contribute to the sustenance of the State's fisheries.

The Intertidal Salt Marsh Act "prohibited the dumping of dirt, mud, or rubbish in salt marshes or excavating a marsh without a permit."[9] Permits were obtainable through the Dept. of Natural Resources. A salt marsh was defined by an inventory of certain species of grasses, other marsh vegetation, and the presence of salt marsh peat. The Director of the Department of Natural Resources determined whether a project would adversely effect the ecology of the marsh, and denied or approved dredge and fill permit applications.

The Coastal Wetlands Act defined coastal marshes somewhat more loosely than the Intertidal Salt Marsh Act. A coastal marsh consisted of the salt marsh and contiguous lands up to fifty yards from the salt marsh, but not as many species of marsh vegetation were included in the definition. The Director of Natural Resources implemented this Act. He could restrict the uses allowed on these coastal wetlands. Unfortunately, a provision where any landowner who believed he had suffered damages by the issuance of such an order could receive compensation by filing at Superior Court within two years of the issuance of an order and the recording of the order on his property deed. Since this provision seriously inhibited implementation of this Act, and the Intertidal Act referred specifically only to salt marshes, much of the State's coastal lands remained inadequately protected from further development. This awareness created a pressure to develop more comprehensive legislation. The Council Management Council Act was enacted several years later as a result of this need.

Rhode Island Dredging Practices

At the time of this investigation, the State of Rhode Island had no effective dredge and spoil disposal policy. In addition, there was a moratorium on dumping in any coastal waters in the State. The dumpsite at Brenton Reef had been closed by the Governor, because of public opposition and an injunction against the Army Corps of Engineers by local commercial fishermen who feared the loss of valuable fishing areas. A disposal site at Brown's Ledge was proposed by the Department of Natural Resources of Rhode Island and the OEA of Massachusetts. It is located on the border between Rhode Island and Massachusetts, and the site is 120 feet deep and quite rocky. It is also beyond the three mile limit. Shallow-water scows can not maneuver in the rough seas encountered at the site, so it would be difficult to dispose of dredged materials at Brown's Ledge from shallow coastal and harbor areas. There has also been opposition to this site by a number of communities and fishing groups, for example, citizen's of Cuttihunk, Westport, and Martha's Vineyard, and the City Council of New Bedford and the Atlantic Offshore Lobster Association.[10]

Rhode Island's alternatives for disposing of dredged materials are threefold: 1) ocean dumping, 2) landfill, and 3) marsh creation. At present, no ocean dumping is allowed. Landfill area in the State is scarce because of high density and small size of the State. Landfill would be costly because spoil treatment and dike construction would be required. In addition, local communities must bear the major portion of all landfill costs.

Marsh creation is a viable alternative to dredged material disposal. A salt-marsh creation project at Watchemoket Cove in East Providence was proposed by the Coastal Resources Center. Spoils from the Port of Providence were to be used to enhance this sheltered area and make it ecologically productive, help to attract wildlife to the area, and improve water quality. It would also have enhanced the area's property values. Functionally, the project would allow the City of Providence to develop additional docking facilities at the Port. New facilities would economically benefit the entire State, and the cost of disposing of the spoils nearby as opposed to transporting them for disposal would be considerably less.

Unfortunately, the project received adverse publicity in the newspapers and on television. Environmental protests caused intense public disapproval which resulted in denial of project approval. The State continued to abstain from ocean dumping. The harbors which bring economic vitality to the State continue to silt-in and become a hindrance to shipping.

Connecticut

Legislation and Permitting Procedures

At the present time, Connecticut does not have a comprehensive dredge and fill program. All dredge spoil disposal is dealt with on a case by case basis. There is little State legislation which deals with dredged material removal and disposal. Under the State of Connecticut Statutes (Title 25, Ch. 473: Water Resources, Sec. 25-10), the Department of Environmental Protection (DEP) Commissioner regulates the removal of

> "sand, gravel, and other materials from lands under tidal and coastal waters with due regard for the preservation or alleviation of shore erosion, protection of necessary shellfish grounds and fin-fish habitats, the preservation of necessary wildlife habitats, the development of adjoining uplands... the creation and improvement of channels and boat basins, the improvement of coastal and inland navigation..."[11]

In Connecticut, the DEP is the lead agency for dredge and fill activities. The Coastal Area Management Group is lodged within the DEP, and the Deputy Commissioner of this Department is a liaison officer between DEP and the Water Quality Compliance Division, the Department of Planning and Energy Policy, Department of Commerce, Department of Water Resources, Department of Transportation, and regional planning agencies.[12] The Deputy Commissioner is also the Board Chairman of a central planning advisory group whose members include representatives from various State agencies, the six coastal regional planning agencies, and ten citizens who are members-at-large. Figure 5 shows the permit application pathway through the State Government for dredge and fill projects.

CONNECTICUT

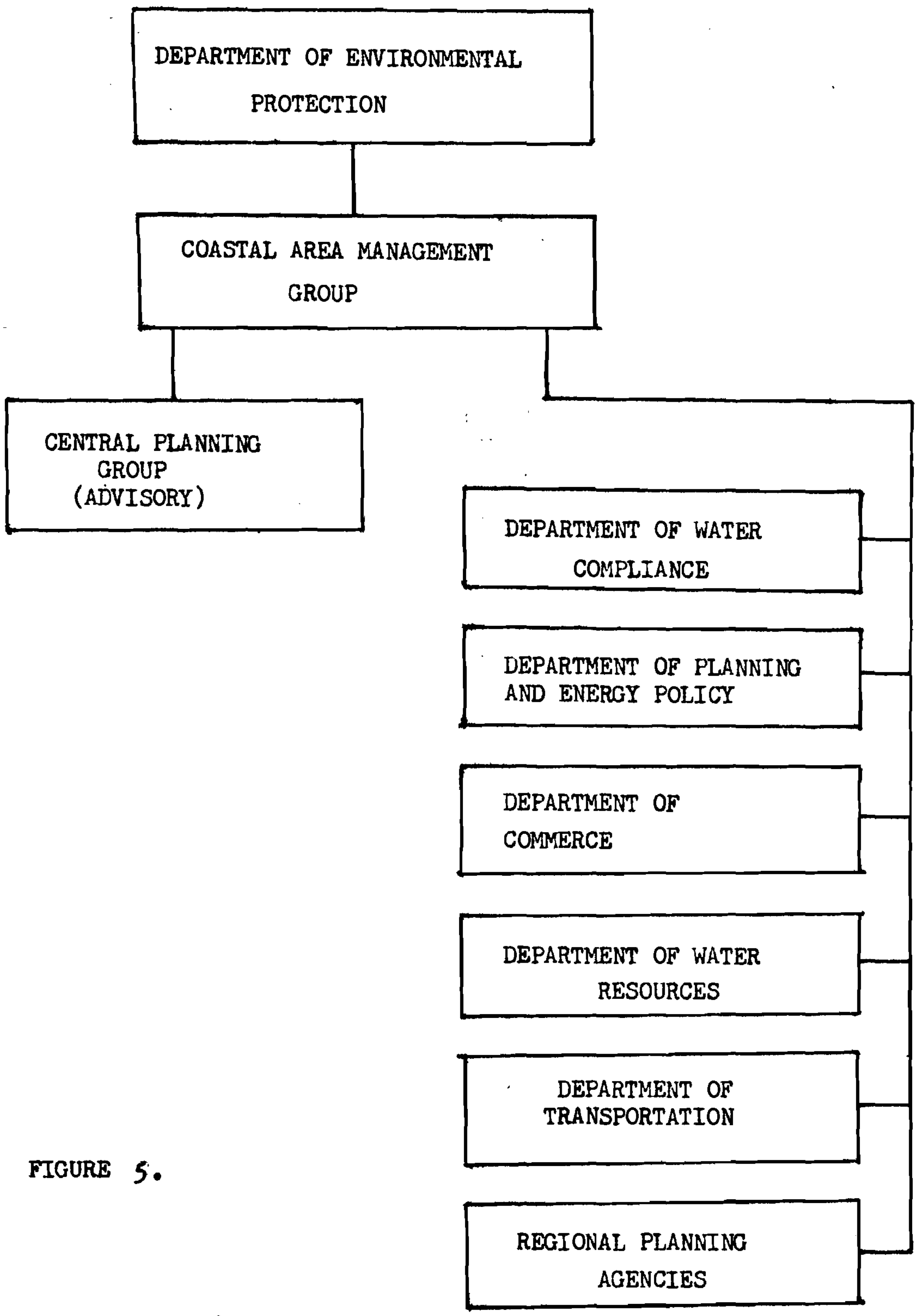


FIGURE 5.

A dredging permit must be obtained from the Commissioner of the DEP. The Commissioner or a hearing examiner designated by the Commissioner must hold a public hearing on the proposed project. Notice of the hearing is published in local newspapers ten days in advance of the meeting. The permit application then proceeds through the State agencies as illustrated on the previous page, and, if the permit application is approved, the Commissioner, if necessary, can set conditions for regulating the removal and disposal of dredged materials. He can also revoke or suspend a permit if conditions are violated.

The Commissioner also has the authority to designate and lay-out channels across State lands to provide access to and from deeper waters to uplands adjacent to or bordering State lands. Such plans are subject to public hearings and Army Corps of Engineers approval. The purpose of such a project is enhancement of coastal and inland navigation by recreational and commercial vessels.

The Department of Environmental Protection, operating under the Wetlands Preservation Act of 1969, has authority over all wetlands, and activities on wetlands must go through the permit procedure, because it is "declared to be the public policy of this State to preserve the wetlands and to prevent the despoliation and destruction thereof."[13] Under this Act, all wetlands areas are to be inventoried and mapped. Once an area has been designated a wetland, no draining, dredging, excavation, soil or gravel removal, or filling, or construction of pilings or any structures is allowed without a permit.

The permit must include a detailed description of the project, a map of the wetland area affected, and names of all adjacent landowners. The Commissioner notifies local town administrators, the State Board of Fish and Game, the Shellfish Commission, and the Soil and Water Conservation Division of the proposed work after he receives the application. A hearing is held on the project. In the course of deciding on the permit, the Commissioner must consider the effect of the proposed work on public health and welfare, marine fisheries, shellfisheries, and wildlife. An application is automatically denied if the Division of Fish and Game is in the process of acquiring any of the tidal lands in question. Fines are imposed on violators, and persons are liable for the cost of restoring the affected wetland to its original condition insofar as that is possible.[14]

<u>Connecticut Dredging Practices</u>

Dredged material in Connecticut is normally disposed of on land or in Long Island Sound. The Tidal Wetlands Act of 1975[15] eliminated the possibility of dredged material disposal on tidal wetlands. Because of high transportation costs, land disposal sites are usually close to the harbor dredging sites. However, land disposal is becoming increasingly more difficult and expensive with the growth and development of coastal communities. As a result, landfill sites are small in size and very scarce. Long Island Sound has become the primary disposal place for dredged materials. Spoil disposal in the Sound is jointly regulated by the Army Corps of Engineers, the U.S. Environmental Protection Agency, and the States of Connecticut and New York.

In 1973, Connecticut, New York, and the Federal Agencies agreed to limit dredged material disposal to four dumpsites. Originally, there were 19 dumpsites. The four sites were: Eaton's Neck, New Haven, Cornfield Shoals, and New London. They were chosen because of their proximity to major Corps projects, distance from shore, and water depth. More concentrated sites would facilitate environmental monitoring at each site and allow for greater control of dumping. Because of ongoing or planned research at New Haven and Eaton's Neck locations, these sites were subsequently closed, and a site at Bridgeport was opened for "clean" dredged materials only. This was to be determined on a case-by-case basis.

It was proposed that the continuation of spoil dumping be critically examined with respect to many environmental questions, such as chemical and biological composition of the spoil material and the community at the dumpsite, and the suitability of dredged materials to disposal in Long Island Sound. It was proposed that a comprehensive Dredge Spoil Management Plan be developed for Long Island Sound. Research studies had estimated that, over the next ten years, proposed dredging of navigation channels, harbors, boat slips, and basins, would result in 8.5 million cubic yards of dredged material which would require disposal. Existing landfill sites were either already committed to other projects, no longer usable due to adjacent residential or commercial development, or of insignificant holding capacity to warrant use. It would be economically unfeasible to dewater and haul dredged material over long distances. Marsh development, habitat creation, and island development were viable solutions for small private projects and as a short-term alternative, but there were few sites along the shoreline which would be acceptable environmentally, socially, and economically to landfilling. Disposal in Long Island Sound, the Atlantic, or a no-dredging option were the only suitable alternatives in 1973.[16]

Ocean barging was soon found to be expensive. An economic study done on the dumpsite at New London estimated that 1,800,000 cubic yards of material could be barged to the New London dumpsite in Long Island Sound at a cost of $3,000,000 ($1.70 a cubic yard, four miles to the dumpsite). To dump the same volume of material in the Atlantic "Easthole" Dumpsite, a distance of 16 miles, the total cost was $4,130,000 ($2.30 a cubic yard).[17]

Since the initiation of the Long Island Sound Disposal Plan in 1975 by the Connecticut Department of Environmental Protection, the program has gone through several revisions and many public hearings. The following section is a discussion of the reasons for developing such a program, and a description of the management program as it is currently proposed.

A Case Study - Long Island Sound Dredged Material Disposal Plan

Background Information

Long Island Sound is 930 square miles of coastal water. It supplies adjacent states with an active commercial and sport fishery, recreational resource, and a transportation artery. The harbors and channels along the coastline are continually being filled in with silt, sand, and organic materials, the result of erosion, upland watershed runoff, and wastewater discharge by municipalities and industry, as well as natural tidal movement and current action. These areas must be periodically dredged to maintain viable transportation. Between 1954 and 1976, 35 million cubic yards of dredged material were deposited randomly at 19 locations throughout Long Island Sound. These locations may be found on the Map in Figure 6. During the next ten years, an estimated 15-20 million cubic yards of dredged spoils must be disposed of from maintenance and new-project dredging. These estimates are listed in Table 1.[18] Until recently, all disposal activities were decided upon on a case-by-case basis. No thought was given to a comprehensive management plan, environmental effects and ecological damage to Long Island Sound, how the material was to be disposed of in an environmentally safe manner, or what the consequences might be economically, socially, and politically, if the environmental factors were neglected and/or if dredging was prohibited for lack of a suitable dumping area.

Long Island Sound is an area where the coastal activities of one adjacent state may influence the coastal uses of another state. Separate activities in New York, Connecticut, and Rhode Island, if

Dredged Spoil Disposal Sites in Long Island Sound

Figure 6

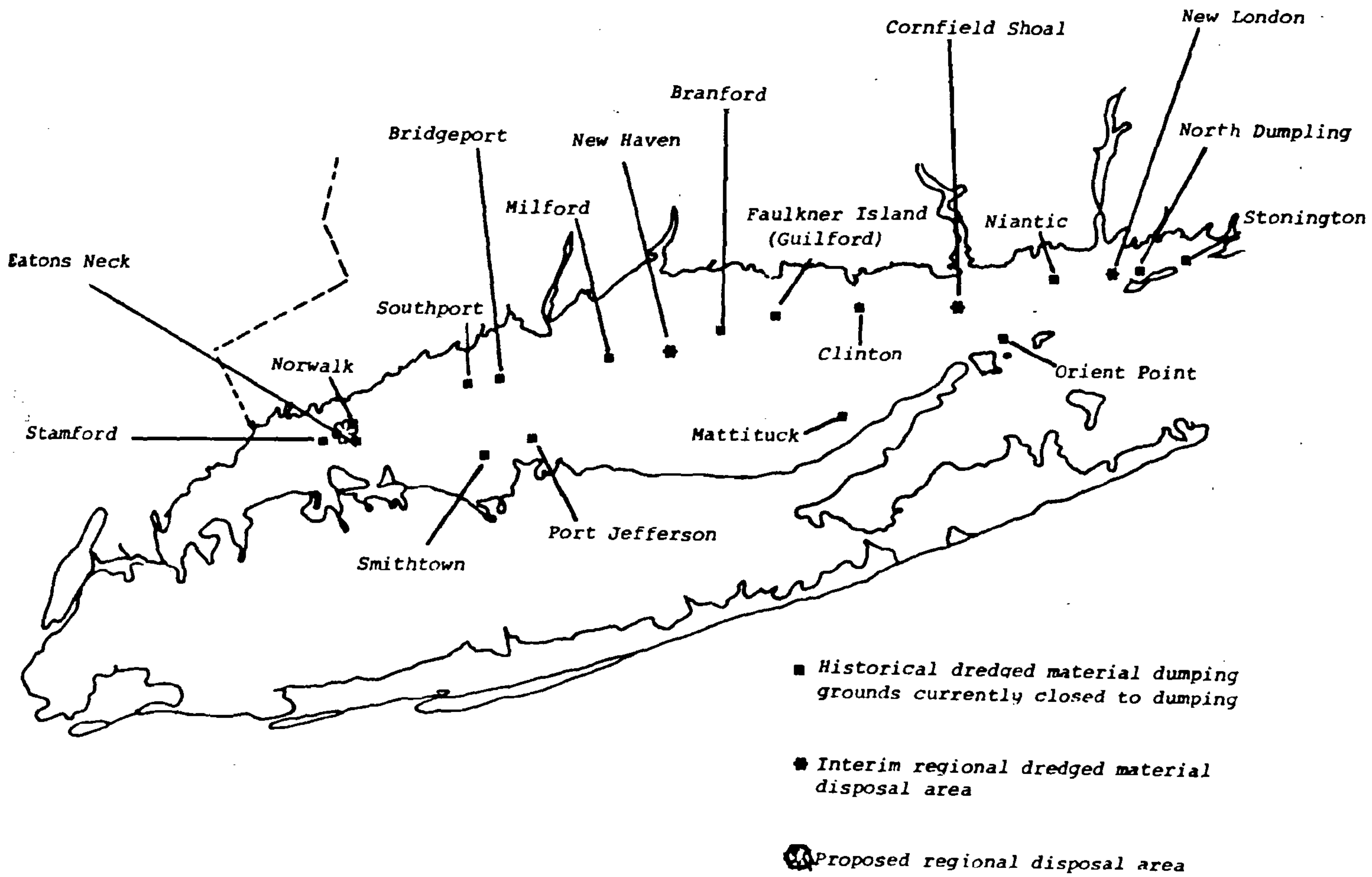


TABLE I

Ten year forecast of dredging and disposal requirements for ports and harbors bordering Long Island Sound. Anticipated volumes presented below are estimates which may vary as much as ± 25% from actual pre-dredge soundings. Disposal options need to be developed for between 15 and 20 million cubic yards of sediment for federal, state, municipal and private dredging projects projected over the next decade.

A. FEDERAL MAINTENANCE DREDGING PROJECTS

Project	Est. Vol. (cubic yds.)	Yr. last dredged	Previous Disposal	Scheduled Maintenance
Branford Hbr.	70,000	1965	Long Island Sound	1977 (land)
Bridgeport Hbr.	400,000	-	Long Island Sound	1979-80
Clinton Hbr.	125,000	1972	Land	1981
Eastchester Cr.	150,000	1974	Sea	1981
Five Mile River Hbr.	70,000	1968	-	1980
Glen Cove Cr.	100,000	1965	Long Island Sound	1979
Greenwich Hbr.	50,000	1968	-	1979
Guilford Hbr.	70,000	1974	Long Island Sound	1984
Housatonic R.	200,000	1975	Land	1987
Little Neck Bay	150,000	1968	Long Island Sound	1978
Mamaroneck Hbr.	165,000	1966	Long Island Sound	1978
Mianus Riv.	25,000	1964	Long Island Sound	1977
Milford Hbr.	60,000	1967	Long Island Sound	1977
West River	90,000	1977	Land	-
New Haven Hbr.	800,000	1974	Long Island Sound	1987
New Rochelle Hbr.	25,000	1971	Long Island Sound	1982
Niantic R.	40,000	1971	Long Island Sound	1981
Norwalk Hbr.	200,000	1969	Long Island Sound	1980
Patchogue R.	100,000	1972	Land	1977 (land)
Pawcatuck R.	60,000	1962	Long Island Sound	1978
Portchester Hbr.	200,000	1966	Long Island Sound	1978
Stamford Hbr.	200,000	1963	Long Island Sound	1979

Project	Est. Vol. (cubic yds.)	Yr. last dredged	Previous Disposal	Scheduled Maintenance
Stony Creek	28,000	-	Long Island Sound	1977
Southport Hbr.	40,000	1962	-	1980
Thames R.	200,000	1966	Long Island Sound	(see below)
Westcott Cove	40,000	1963	-	1982
Westport Hbr.	80,000	1970	Land	1981
TOTAL:	3,738,000			

B. FEDERAL HARBOR IMPROVEMENTS - New Work Dredging (volume in cubic yards)

Thames River	2,779,000 (ongoing)	disposal in L.I.S.
Thames River	1,844,000 (proposed)	*1980
New Haven Hbr.	6,500,000 (proposed	*1980-1982
TOTAL	11,123,000	

* Disposal options being developed

C. STATE,MUNICIPAL AND PRIVATE DREDGING - Estimates for next ten years (volume in cubic yards)

New London Co.	1,000,000
Middlesex Co.	350,000
New Haven Co.	170,000
Fairfield Co.	750,000
Westchester Co.	500,000
Nassau Co.	100,000
Suffolk Co.	750,000
TOTAL	3,620,000

Source: Connecticut State Department of Environmental Protection. 1975 Dredging and Dredge Spoil Disposal in Long Island Sound: A Discussion Paper. October 27, 1975.

decided upon unilaterally, have the potential to limit adjacent state uses by altering the water quality of the coastal area. State boundary delimitations are arbitrary, man-made political decisions, and each state, as we have seen in the preceding section , has promulgated dredge spoil disposal guidelines, wetlands legislation, and designed permitting procedures on a unilateral basis. There has been negligible effort to coordinate coastal environmental regulations and design an environmental program that shows environmental consistency.

The environment does not respect political boundaries as they have been arbitrarily designated. The Long Island Sound is a region which must be discussed as a totality. Long Island Sound extends east to Nantucket Island and receives waters from many estuaries which may be classified as naturally stressed temperate zone estuaries.[19] They are valuable as fish nursery areas which stock the offshore waters. The Sound is relatively protected from dominant wave forces, and this, in addition to warmer temperatures, when compared to offshore waters, contributes to the high natural productivity of the coastal area. Flounder, hake, scallops, lobsters, oysters, and clams are economically profitable species.[20]

The physical features of the Long Island Sound area, particularly water circulation and flow, reflect the homogeneity of the region. Circulation in the western portion of the Sound exchanges waters from the drowned river valleys along the northern shores with the East River. The East River waters tend to travel via net surface transport into the Sound and disperse over the more dense Central Basin waters.[21]

Because of limited mixing, most of this water remains in the western portion of the Sound.

The entire area of Long Island Sound is a shallow extension of the Continental Shelf. The physical, biological, and chemical character of the Sound is determined by its proximity to the Atlantic Ocean, the geomorphology of the basin, and upland physiography. The Mattituck Sill is a submarine ridge at the eastern end of the Sound. The Hempstead Sill is found west of Norwalk. These sills partition the Sound into three basins. The Central basin is the deepest portion of the Sound. The Central and Western basins are characterized by 65% silt and clay and 35% sand, while the Eastern basin is 75% sand and 25% silt and clay. This reflects a high energy regime in the eastern basin and a lower energy regime in the Central and Western basins of the Sound.

Circulation of water is controlled by the shape of the basins, and currents are modified by temperature gradients, winds, atmospheric pressure, and fresh water intrusion from inland. The Sills prevent bottom water circulation between the basins, although there are occasional overflows into an adjoining basin. Tidal currents generally run east to west, and the waters flow in an ellipsoidal counter-clockwise gyre. Bottom and surface waters are generally well mixed throughout the year, but they do not necessarily flow in the same direction at the same time. Below the 60 foot contour, water transport of suspended materials is to the west. Above the 60 foot contour, net transport is toward land and into ports and estuaries.

Outflowing tidal currents are stronger at the surface than at the bottom. Inflowing tidal currents are stronger at the bottom than at the surface, so there is a net transport of oceanic water and suspended particles into the Sound with bottom waters.[22]

At the present time, Long Island Sound contains huge reservoirs of contaminated sediments, particularly along the northwest and western shores. These sediments are frequently resuspended by tidal action. If these sediments are removed and dumped in relatively clean areas, the biosystem at the dumpsite may ultimately deteriorate, and the polluted sediments will become more evenly distributed over the entire basin. It is essential that these contaminated sediments be properly characterized and disposed of in a manner that minimizes exposure of dredged sediments to the aquatic environment. For example, site selection must be based on biological and physical features, distance from the dredging site, distance from known environmentally sensitive areas, and dispersion characteristics.

Marine sediments tend to adsorb pollutants to suspended particles which then settle out and are not readily released back into the water column. Fine grained sediments are usually more contaminated than sands. Fine grained sediments usually have a high organic content, and these organic materials have an affinity for hydrocarbons and metals. Some of these chemicals are biologically inert, but some can be transformed into toxic substances through biological action. Since toxicity is concentration dependent, overall concentrations would be reduced if polluted sediments were confined to a few disposal sites. While it is unrealistic to characterize all the pollutants in bottom sediments, bioassay methods to determine toxicity, bioaccumulation, and mobility of toxic compounds through the food chain are of paramount interest with respect to ensuring environmental safety, especially if disposal sites are located near nursery or breeding grounds.

Studies have shown that spoil mounds are recolonized over time. Spoil mounds consolidate and attain a character similar to the surrounding sea-floor. This is partially due to capping spoil mounds in Long Island Sound with clean sediments. Depending on how clean these sediments are, the biological community may imitate the natural Long Island Sound community or vary distinctly from the natural bottom. Spoil mounds attract burrowing crustaceans and finfish, and the four sites selected in the Sound are away from breeding areas.

Broadly speaking, the Sound is characterized by a homogeneous biological community. Problems of a biological nature might be most effectively addressed at a regional level. Already, the Sound is recognized as a region by the Federal government through such agencies as the Corps and the EPA, and groups such as the New England River Basins Commission and the New England regional commissions regard the area as a totality. The proposed Long Island Sound Management Plan is the most recent reflection of a growing sense of regionalism. The politics, however, have yet to be used as a regional indicator, because each State has its own very separate system for dealing with common problems.

Within the context of a regional system for Long Island Sound, the disposal of dredged spoils can be compatibly coordinated with other uses of coastal waters, and a balence of conflicting uses can be achieved. Dredged spoil disposal, for example, has the potential to significantly alter water quality for biological communities and cause health problems for man. Aesthetic pollution problems may also result. Any alteration of circulation patterns may potentially affect the efficiency of pollutant dispersal in a water system, affect shipping traffic, affect recreational craft, and produce adverse economic impact to the fishing industry.

Long Island Sound Management Plan

The program was initiated in 1975 by Connecticut's DEP. Efforts were made to coordinate the study with the State of New York, but New York has not taken an active role in its formulation. New York has received little policy direction from the State office in Albany. New York's environmental staff keeps informed of the progress of this program through Connecticut's environmental personnel. There has been no interaction between Connecticut's Coastal Management Group and the New York Coastal Area Management Group with respect to the technical content of the proposed plan.[23]

Rhode Island borders the eastern portion of the Sound, but negligible effort was made to contact appropriate parties, because the state systems between Rhode Island and Connecticut are not able to agree, apparently, on appropriate procedures. Rhode Island has taken no part in the formulation of the program.

Public workshops have been held since 1976 to review, comment, and revise the Long Island Sound Management Program before formal publication of the plan. The program consists of two parts. The first is historical background on Long Island Sound and justification for developing such a program. The second section consists of the actual program. The program strictly proposes a regional plan. It is not an environmental impact statement.

The program as stated is designated as an interim program to last for a period of three years. This will allow time for the formulation of a long-term comprehensive management program. The major elements of the program are summarized below:

"A) Controlled disposal at specified disposal points with four designated disposal areas in Long Island Sound.

B) Establishment of a technical advisory committee on disposal composed of research scientists and cognizant State and Federal interests.

C) Establishment of operational guidelines for the evaluation of the potential polluting characteristics of materials to be dredged and proposed to be disposed of in the Sound.

D) Application of these operational guidelines case-by-case, to determine when alternatives to open water disposal in Long Island Sound should be mandated.

E) Establishment of a long-term Long Island Sound disposal-area monitoring network.

F) Development of a dynamic long-term management program and environmental assessment of both dredging and disposal."[24]

The accomplishment of this program depends upon the prioritizing and completion of a number of tasks. The proposed study is based primarily on existing data on dredging and on Long Island Sound's chemical, physical, and biological characteristics. New research will be undertaken only when questions can not be answered adequately with existing data. One of the first tasks to be completed is to compile, interpret, and summarize data already available. Data of importance include circulation patterns, topography, sediments, physical-chemical properties, distribution of biological organisms, particularly benthic and demersal fish.

Another task is to compile historical data on dumping activities. This includes information on the source and characterization of the dredged materials, quantity, texture, heavy metals content, concentration of other potential contaminants, the location of dump sites and types of disposal, and comparisons with previous environmental studies.

Another component of the program is to project future demands on spoil disposal sites. This includes a listing and evaluation of future projects for which permits have been requested, assessment of the volumes and character of the spoil with respect to the proposed dumpsite, and evaluation of environmental impact statements, if available. The assessment of dumping locations should include a ranking in terms of desirability for capacity, the class of spoils to be dumped without inflicting acute and/or chronic ecological damage, and economic considerations, such as transport costs to the dumpsite as opposed to landfill or open ocean disposal. Socio-political considerations, such as proximity to recreational areas, shellfish and finfish operations, mining operations, and proximity to political "governmental" boundaries must also be assessed.

One final consideration in the development of this regional plan is evaluation of the possible creative uses for dredge spoil in Long Island Sound. These uses might include beach nourishment, construction of recreational islands, marshes, and wildlife habitats, and perhaps using dredge spoils to alter circulation patterns to enhance the productivity of the waters.

The interim management program is based on available information to date. There is a lack of environmental data, social and economic cost data, and cost-benefit information. The program as developed maintains flexibility to respond to changes as gaps in the information are filled in.

The Management Plan applies to all public and private dredged material disposal activities in Long Island Sound's navigable waters. The program will be implemented by the establishment of a disposal area monitoring program funded by the Army Corps of Engineers. A comprehensive management plan and Environmental Impact Statement are being initiated by the Corps with the cooperation of the State of New York's and Connecticut's Departments of Environmental Protection. Public hearings will be held in late 1980 on the Environmental Impact Statement and the Long Range Management Program. It is proposed that the Impact Statement and the Management Program be updated every five years to include evaluations of past, present, and future dredging operations. It is also proposed that a technical advisory committee be established to review and recommend modifications in project monitoring, the management program, and make evaluations on proposed alternatives to Long Island Sound disposal. The committee will probably be composed of representatives from National Marine Fisheries Service, U.S. Fish and Wildlife, EPA, Army Corps of Engineers, States of Connecticut and New York, and ad hoc representation from the academic and research community. The advisory committee will evaluate all federal dredging projects and the significant private dredging proposals. The States of Connecticut and New York's environmental protection groups will evaluate and coordinate these projects according to specific guidelines.

Local communities will be encouraged to become involved. They will have an obligation to provide disposal areas for materials dredged from their ports and harbors. Alternative disposal methods will be encouraged, and State and Federal staff will assist local communities in strategy planning for disposal. Environmentally acceptable impacts of a temporary and shortlived nature must be evaluated. Examples include temporary release of chemicals that do not violate State water quality standards, reductions in dissolved oxygen, turbidity, color, pH, nutrient level, increases in suspended solids, and so forth.

The four areas in Long Island Sound designated for dumping have been evaluated by specific selection criteria in "Interim Guidance: Ecological Evaluation of Proposed Discharge of Dredged or Fill Material into Navigible Waters."[25] All except the Cornfield Shoals site are natural containment sites. Cornfield Shoals is a dispersal site. These locations provide for regional and sub-regional allocation plans. They do not conflict with commercial shellfish or fishing industries. Each site is to be marked with buoys and disposal activity is to be restricted to within 200 meters of each buoy. Disposal of great quantities of spoil will be controlled to prevent the buildup of large mounds of material. After disposal of 500,000-600,000 cubic yards of material, the buoys will be relocated to immediately adjacent areas within the dumpsite. This will minimize potential losses and exposure of high mounds of sediment to current transport, and will create depressions or pockets which can then be used for subsequent disposal and capping of questionable toxic or potentially toxic materials.

The New England Division of the Army Corps of Engineers is to assume management coordination and recordkeeping responsibility for all Long Island Sound disposal activities within their jurisdiction under Section 404 of the Federal Water Pollution Control Act. The New York Division will be responsible for local disposal projects within its jurisdiction. All coordination will be the job of the representatives on the advisory committee. Toxic or potentially hazardous substances will be evaluated on a case-by-case basis, and if no other alternative exists, be dumped in natural or artificially created depressions and adequately capped with clean fill.

Monitoring the dumping grounds will be coordinated through the advisory committee. Monitoring will be funded by the Corps under Section 404 of the Water Act. The program must include a minimum of 2 "blocks" or mounds, one of which is a reference or control mound; All data collected must be standardized with monitoring programs at the other locations. Parameters should be sampled biannually, once in early summer and once in late fall. General parameters to be evaluated include: chemical-physical data, analysis of sediments, bathymetric profiles of the spoil mounds, reproductive and succession of macrobenthic communities, visual inspection by scuba, bioaccumulation of toxicants by sessile or infaunal benthic species.

Evaluation of the material to be disposed of includes such data as the source of the sediment, chemical spill history, historical industrial and municipal discharges in the vicinity, chronic pollutant loading, sediment analysis, the volume to be dredged, and site-specific ecological information. This information will be used to determine the specific chemical, physical, or biological testing which may be required further along in the program. Bulk analysis tests will be required and elutriate tests will be run only if water column impacts are of concern.

The dredged materials must be characterized to provide a means to evaluate biological impact. Sediments will be classified by grain size and water content in addition to volatile solids and oil and grease. Class I sediments are considered "clean" and suitable for capping materials, habitat recreation projects, landfill, and beach nourishment. These are usually coarse grained sands with high solids content and low oil and grease and volatile solids content. Class II sediments are 60-90% clay and silt with moderate solids content. They are considered questionable spoils and may be suitable for habitat creation projects. They may also require capping. Class III sediments are 90% silt and clay, 60% water and 10% volatile solids. They are usually enriched with heavy metals. They are considered potentially hazardous and will not be dumped unless they can be capped. Land disposal and containment is considered more desirable for these soils.

Studies on the feasibility of dumping in Long Island Sound have previously been concerned with establishing one major open-ocean dump site south of Long Island or south of the presently proposed dumping areas.[26] Attention was given to sport and commercial fishing, shipping, military uses, research and recreational uses as opposed to economic benefits derived from dumping nearshore versus the open ocean. No recommendations or management programs were developed based on these studies.

Summary and Conclusions

This is the Long Island Sound Dredge Spoil Disposal Program as it has been proposed. A cooperative effort has been made by the Environmental Protection Departments of both Connecticut and New York as well as the U.S. Environmental Protection Agency and the Army Corps of Engineers to develop, implement, and enforce a sound dredged materials disposal program. Particularly in a body of water the size of Long Island Sound, there is a critical need for policies concerning wetlands protection, dredging and filling, and water quality which are consistent on a regional basis. While engineering solutions predict physical and tangible results of change to a disposal area, they predict only to a limited degree the impacts of such activities on the natural environment. It is unwise to base public policy on uncertain and imperfect scientific data, and the lack of environmental data renders environmental factors difficult to quantify and relate to other information.

Perhaps the most critical element to the success of this program is cooperation and coordination between the State and Federal agencies and State and Local governments. During my survey of dredge spoil disposal activities in southern New England, the lack of communication and awareness of state and local groups, and even between departments of the same state agency, were astounding. The need to educate these people who are heavily involved in these environmental projects is most critical. There is also a need to educate local citizens about the problems associated with dredge and fill activities and make them aware of permitting procedures and potential environmental hazards from dumping.

The success of the Long Island Sound Program depends upon an educated citizenry who has learned that there are sound reasons geologically, hydrographically, and ecologically for developing an effectively managed regional program for dredged spoil disposal in Long Island Sound. The social issues, the economic issues, and the political issues surrounding this program must be considered objectively. Those involved in implementing this program must remain flexible to better scientific technology as it develops and future standardization of procedures. Consideration of these ideas will produce a realistic management policy towards dredged material disposal, promote better interstate and interagency communication and cooperation, and serve to mitigate environmental problems through increased ecological understanding.

Appendix A

Seven additional pieces of Federal legislation have been annexed to this report because they help to regulate the activities of dredging and spoil disposal in the United States. The sections of each Act that applies to dredging and dumping activities have been set forth or summarized, but there is no in-depth analysis of the implications of each law. This appendix has been included to supplement Chapter 1 and to make the discussion of Federal legislation on the subject of dredging and filling as comprehensive as possible.

Excerpts of the following legislation appear in this Appendix:

1) Convention on the Prevention of Marine Pollution by Dumping (The Ocean Dumping Convention)
2) Coastal Zone Management Act
3) Fish and Wildlife Coordination Act
4) Flood Control Act
5) River and Harbors Act of 1970
6) Submerged Lands Act

The Ocean Dumping Convention

The Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (The Ocean Dumping Convention) was signed by 92 nations in November 1972. The United States became a party in 1975.

It is the first international treaty whose aim is to protect the ocean from a large number of pollutants on a global basis. Its preamble states that it recognizes "the marine environment and the living organisms which it supports are of vital importance to humanity." Parties are required to prohibit the dumping of wastes or other matter except in accordance with a permit system.(Article IV(1)).

It seeks to control deliberate dumping at sea but does not cover pollutants coming from the atmosphere, rivers, outfalls, land run-off, exploration and exploitation, or normal aircraft and vessel operations. The Convention, therefore, misses major sources of marine pollution.

The Convention separates matter into three categories. Each category has specific permit requirements. Annex I lists materials which can not be dumped except in emergencies. This is the black list. Annex 2 materials require special permits for dumping. This is the grey list. A permit system is to be established by each national government to control materials in their waters. All matter not included in Annex 2 can be given a general permit.

The black list includes the following chamicals and compounds:

organohalogen compounds (pesticides and PCB'S)
mercury, cadmium, and their compounds
persistent plastics
oil
high level radioactive matter
chemical and biological warfare agents

The black lists fails to prohibit the bulk of materials generally dumped in the oceans.

The grey list covers the following chemicals and compounds:

trace amounts of arsenic, lead, zinc, copper, and their compounds
organosilicon compounds
cyanides
fluorides
pesticides and by-products not mentioned in the black list
bulky waste liable to sink and cause hazards to navigation and fishing
medium and low level radioactive materials

The Convention focuses for the most part on characteristics of the material to be dumped and little attention is given to characteristics of the dump site. The signatories to the Convention are required only to "give careful consideration" to: characteristics at the dumping site, possible effects on amenities, marine life, other uses of the sea, land based alternate dump sites, and methods of treatment (Article IV(2), Annex III(B),(C)). The United Kingdom administers the Convention until an appropriate organization is designated to execute it.

The Convention relies heavily on national enforcement. The signatories will administer the permit system and establish standards. New ideas and modifications at the international level must be generated by national parties to the Convention. If U.S. standards are any model (see Chapter 1), the level of competence by which this Convention is administered and enforced is dubious. More meaningful regulation would result if an international organization regulated and administered this Convention. Until this is accomplished, there will be inadequate surveillance, and no uniform penalties, no procedures for enforcement, no interpretation, nor any settlement of disputes.

The Convention has weaknesses, as all international efforts do, but it stands symbolically as a first attempt to unite the world and attack the problem of pollution of the world's oceans. It encourages regional arrangements in the field of pollution abatement and international cooperation (Articles IV(3), VIII, XIV(4)(d)).

Coastal Zone Management Act (P.L.92-583)

Signed into law on October 28, 1972, as an amendment to the Sea Grant Colleges and Marine Sciences Development Act of 1966 (33USC. Sect. 1101-1124.), the Coastal Zone Management Act is an attempt to establish a Federal protection program although it created few legally enforceable standards. The Act states that it is the national policy to encourage and assist the states in coastal zone protection and improvement. Participation of public, federal, state and local governments is encouraged to "help preserve, protect, develop, and where possible, to restore or enhance the resources of the coastal zone for this and succeeding generations," (Sect. 303(a)).

Section 302(h) encourages the states to exercise authority over the lands and waters in the coastal zone. The encouragement comes in two forms of grants of Federal monies (Sections 305 and 306 of the Act). These sections set forth the requirements with which the states must comply prior to receiving grant money.

Every Federal agency conducting or supporting activities which directly affect coastal zone areas shall conduct these activities to the maximum extent practicable and consistent with state programs. Any applicant for a federal license or permit to conduct activities affecting land or water uses in a coastal zone area of a state which has an approved program, must certify that the proposed activity complies with the state program. Public notice procedures and public hearings should be provided for by each coastal state. The State has six months from receipt of an application to approve or deny a permit. The Secretary of Commerce administers this Act.

Fish and Wildlife Coordination Act (16 USC 661 et seq.)

Concern for the destruction of fish and wildlife and their nursery grounds due to dredging, filling and diking operations for navigational improvement and maintenance resulted in the passage of this Act.

> "The dredging of bays and estuaries along the coastlines to aid navigation and provide land fills for real estate and similar development, by Federal and other agencies under Corps permits has increased tremendously in the past 5 years. Dredging activities of this sort have a profoundly disturbing effect on aquatic life.[1]"

The Act provides that whenever the waters of any stream, or other body of water otherwise controlled or modified for any purpose by any department or agency of the United States, or any public or private agency under a Federal permit or license, the agency must consult with the U.S. Fish and Wildlife Service, the Department of the Interior, as well as any applicable state agency to review the conservation of wildlife resources to prevent the loss of and damage to these resources (Sect. 662(a) and 663(b)).[2]

Flood Control Act (33 USC 701 et seq.)

The Flood Control Act defines flood control projects to include channel improvement. It integrates all laws dealing with channel improvement with this Act. This puts dredging operations and disposal of spoils under this Act.

Section 701 integrates laws for improvement and flood control. It requires a report by the Office of the Chief of Engineers of the Corps to the House of Representatives to provide details "to the extent and character of the area to be affected by the proposed improvement" including land use for disposal.

In the case of West Inc. v. U.S. (C.A. Miss. 1967, 374 F 2d. 218), the Corps doesn't need State approval to condemn property for fish and wildlife habitats to offset damage done to same by flood control projects. However, the use for navigation of State waters is not to conflict with any beneficial State use of the same waters. The Secretary of the Army may acquire lands for specific projects (these are mentioned in the Act) without prior application (Sect. 701(c)). Section 701 was not modified or repealed by the Submerged Lands Act (43 USC. Sect. 1303).

Submerged Lands Act (43 USC 1301 et seq.)

This Act gave coastal states all offshore lands lying three miles seaward from their coasts, but reserved to the coastal states of the Gulf of Mexico a right to historical boundaries not in excess of three leagues. Although the lands have been vested to the coastal states, the Federal government continues to retain control over these lands for navigation, flood control, national defense, commerce, and hydroelectric power production. The government retains the constitutional power to regulate their use without compensation to the owners pursuant to the powers of the Commerce Clause and the doctrine of navigational servitude. These powers are paramount to the rights of the states but do not include "proprietary rights of ownership or the rights of management, administration, leasing, use and development" (Sect. 1314).

If ownership of dredged material were ever to become a disputed issue, final resolution of the question will probably come from a judicial interpretation of the Act.

River and Harbor Act of 1970 (84 Stat. 1818, P.L. 91-611)

This Act authorizes the construction, repair, and preservation of certain public works on rivers and harbors for navigation, flood control, and for other purposes. It authorizes work on specified Corps projects throughout the country, but of particular interest is Section 123 which describes contained spoil disposal sites and facilities.

Section 123(a) The Secretary of the Army,... is authorized to construct, operate, and maintain, subject to Subsection (c), contained spoil disposal facilities of sufficient capacity for a period not to exceed 10 years. Before establishing such a facility, the Secretary of the Army shall obtain the concurrence of appropriate local governments and shall consider the views and recommendations of the Administrator of the EPA and shall comply with the requirements of Section 21 of the Federal Water Pollution Control Act and of the National Environmental Policy Act. Section 9 of the 1899 River and Harbors Act shall not apply to any facility authorized by this Section.

(c) Prior to the construction of any such facility, the appropriate State, interstate agency, municipality, or appropriate political subdivision of the State shall agree in writing to:

1) furnish all lands, easements, and rights-of-way necessary for the construction and maintenance of the facility
2) contribute 25% of the construction costs
3) hold the U.S. free from damages due to construction, operation, and maintenance of the facility
4) maintain the facility after completion of its use...in a manner satisfactory to the Secretary of the Army.

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