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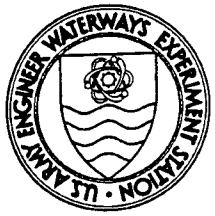
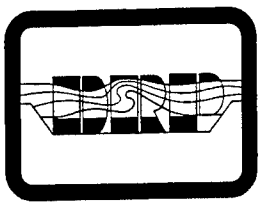


Dredging Research Technical Notes



Open-Water Placement of Dredged Sediment: A Framework for Site Management

Purpose

This technical note, the first in a series of technical notes on managing open-water sites for placement of dredged material, addresses the need for site management, outlines the benefits of an effective site management program, and presents a generalized framework for managing open-water sites.

Background

Section 103 of the Marine Protection, Research, and Sanctuaries Act of 1972 (MPRSA) and Section 404 of the Clean Water Act (CWA) of 1977 assign the Secretary of the Army responsibilities for regulating dredged material discharges. Managing open-water sites used for placement of dredged sediments is an essential and integral component of these responsibilities.

Open-water sites used for placement of dredged sediments are selected and managed to facilitate the necessary dredging and subsequent placement of dredged sediments, while minimizing potential adverse impact to human health and the aquatic environment. For many navigation projects that are vital to the Nation's economic health, placing dredged material in open-water sites is often the least costly alternative. However, as public awareness and concern with regard to the aquatic environment have increased, open-water placement of dredged sediments has become subject of increased environmental concern. Continued use of aquatic sites for placement of dredged sediments may depend on the Corps' ability to effectively manage dredged sediment placement sites, as well as the perception of how well the Corps' management policies and practices protect human health and the aquatic environment.

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Introduction

At present, placement of dredged material is highly regulated. Over 30 major environmental statutes, Executive Orders, and government regulations exist that may, on a case-by-case basis, govern the way that dredged material is managed (U.S. Environmental Protection Agency/U.S. Army Corps of Engineers (USEPA/USACE) 1992). Many of these statutes and regulations focus on limiting adverse environmental impacts. The principal statute governing the placement of dredged sediments in inland and estuarine waters (and in near-coastal waters for the purpose of fill) is the Clean Water Act. The Marine Protection, Research, and Sanctuaries Act, commonly called the Ocean Dumping Act, is the principal statute governing placement of dredged material in ocean waters. A more detailed discussion of the placement activities covered by each statute is provided in "Evaluating the Environmental Effects of Dredged Material Management Alternatives—A Technical Framework" (USEPA/USACE 1992).

In addition to compliance with the applicable statutes, several USACE policies guide site management. First, the Federal budgetary interest in construction and in continuing operation and maintenance of Federal projects is defined by the least cost plan for dredged material management that is consistent with sound engineering practices and Federal environmental laws (see Engler and others 1988). Accordingly, site management is partially shaped by cost considerations. Second, it is the policy of the USACE to undertake dredging and dredged material management activities to achieve maximum useful life for dredged material disposal sites (33 CFR 337) [Code of Federal Regulations]. Therefore, site management often focuses on maintaining continued use of existing placement sites. Third, District Engineers are urged to identify and develop long-term management plans for placement of dredged sediments from Federal projects (33 CFR 337.9). Likewise, the focus of site management is often long term.

Management efforts must also be tailored to the placement site itself. Conservatively, there are several thousand open-water placement sites in use nationwide. Site characteristics can be extremely diverse. A dispersive site, receiving sand-sized sediments, may require only minimal management to ensure that physical impacts, such as unacceptable mounding, do not occur. Conversely, multiple-user regional sites may likely require intensive management to ensure an adequate level of environmental protection.

Expanded guidance on managing open-water dredged material placement sites is being prepared by the USACE and the USEPA. Moreover, recent amendments to the MPRSA (Title V of the Water Resources Development Act of 1992), call for specific site management activities and preparation of site management plans for all ocean dredged material placement sites. Present Corps policy (May 1994) describing the funding and elements of studies for dredged material management associated with existing Federal navigation projects and feasibility studies for modifying Federal projects are found in Policy Guidance Letters Nos. 40 and 42, respectively (USACE 1993a, 1993b).

This technical note provides a preview and summary of the site management concepts, philosophy, and approaches likely to be presented in the forthcoming guidance. Also, in conjunction with other technical notes in this series, this note outlines a philosophy and framework for management of all open-water placement sites that is consistent with the MPRSA and the CWA.

Benefits of Site Management

Effective site management can provide numerous benefits. The principal benefits are derived through ensuring the long-term availability of the placement site: potential project delays are avoided, the costs of identifying and designating/specifying alternative sites are saved, and potential increases in transportation costs or other costs relative to alternative sites are averted. Effective site management can also increase regulatory efficiency, ensure compliance with applicable Federal statutes and regulations, reduce conflicts with other uses of the aquatic environment, minimize adverse environmental impact, ensure maintenance of safe and efficient navigation, optimize site use, and ease public concerns regarding aquatic placement of dredged material.

In addition, in select cases, site management can facilitate placement of dredged materials requiring special handling, allow placement of dredged materials in special areas, or provide for other innovative alternatives for placement of dredged material.

Typical Components of Site Management

All sites are unique, and management responsibilities will vary from site to site. Typically, site management programs include the following basic elements:

- Developing and implementing a formal site management plan based on the types and quantities of dredged sediment, site-specific characteristics, dredging equipment, and issues of local or regional concern.
- Regulating time, rates, and methods of placement, as well as quantities and types of dredged material placed.
- Ensuring compliance of placement activities and enforcement of applicable regulations, permit conditions, and contract specifications.
- Developing and implementing effective monitoring programs for the open-water sites.
- Managing data, and reporting conditions and results.
- Coordinating site management actions and site use.
- Evaluating effects of continued use of the site for placement of dredged sediments.
- Recommending modifications in, or termination of, site use or designation/specification.

USACE Approach to Site Management

The USACE approach to managing open-water sites focuses on providing all necessary information for site managers to make informed decisions. All of the proposed components of management programs must be implementable, cost-effective, practical, enforceable, and clearly applicable to the decisionmaking process. The following management tools and techniques are directed toward achieving this goal.

Proactive Site Management

Proactive site management involves action in advance to avoid or minimize undesirable effects. For example, sites are selected to minimize impact to the aquatic environment and minimize interference with other uses of the Nation's waters. Critical resources near the disposal site are identified, the range of potential impacts from dredged material placement is evaluated, and management is focused on preventing unacceptable adverse impacts to these resources. Dredged material proposed for placement at open-water sites is carefully evaluated and screened before placement. When appropriate, the times, rates, and quantities of dredged material placement can be regulated to minimize adverse impacts or maximize site capacity.

Site Management Plans

A written, site-specific management plan can greatly facilitate management action over the extended use of the placement site. For some sites, the best

plan will be flexible and evolving, and written plans will need to be updated periodically. Site management plans can provide for continuity of management policy and procedures and can support consistent planning and decisionmaking. The plan can also define site management roles and responsibilities. Moreover, the management plan provides for a systematic approach to site management. Previous management decisions are clarified for present and future managers, and appropriate and adequate management actions can be delineated. The greatest advantage of a site management plan, however, may be that it can focus decisionmakers on the overall management issues associated with placement of dredged sediments that warrant further consideration or continuing evaluation.

Site Monitoring

Monitoring is an essential component in the overall management of the site. The feasibility and efficacy of monitoring often is considered when selecting placement sites, and monitoring studies can be used to confirm predictive determinations made in the site specification/designation and in issuing permits. Accordingly, monitoring studies should focus on providing useful compliance information to site managers.

Monitoring plans must be appropriate for the type and quantity of dredged material, the site characteristics, and the site environment. As with other management activities, the intensity of monitoring will increase with the volume of sediments, the rate of placement, the number of site users, the variance of sediments, the presence of man-made contaminants in the sediment, and resources of concern in the vicinity of the placement site. At a carefully selected site, under the best conditions, the appropriate level of monitoring is minimal. Results of monitoring studies conducted at other dredged material placement sites should be considered whenever appropriate.

Well-designed monitoring can be a powerful management tool. Monitoring can provide specific evidence to support or modify site management plans and practices. Decisions that were made when the site was specified/designated or when permits were issued can be confirmed or shown to need modification. Results of monitoring studies can be used to verify assumptions and predictions or to provide a basis for modifying the decision process (that is, developing more or less stringent decision guidance) (Fredette and others 1990a; National Research Council 1990).

Defining Unacceptable Impact

To effectively use monitoring as a management tool, site managers need to define in quantitative terms the unreasonable or unacceptable effects that dredged material may have on resources of concern.

In the same manner, early-warning action levels should be determined in advance of monitoring studies. The action levels should represent a level of effects well below those effects defined as unreasonable or unacceptable. This

allows the site managers to take corrective measures if action-level effects are observed and thus prevent unreasonable and unacceptable effects.

Prospective Versus Retrospective Monitoring

Where practicable, monitoring programs should be prospective, that is, consisting of repeated observations or measurement to determine if site conditions conform to a predetermined and quantifiable standard or baseline. Unreasonable degradation and unacceptable adverse effects are defined, and resources that might be at risk, both nearfield and farfield, are identified before sampling or field studies begin. Additionally, specific early-warning thresholds of physical, chemical, and biological conditions that should not be exceeded are established, and impacts of the dredged material placement are predicted. If impacts approach these specific early-warning thresholds, operations can be modified or terminated long before unacceptable impacts occur.

Tiered Approach/Hypothesis Testing

A strategy for developing and implementing monitoring programs for disposal sites has been designed to provide site managers with reliable, cost-effective information on the effects of disposal of dredged material into the aquatic environment (Fredette and others 1986, 1990a, 1990b; Zeller and Wastler 1986). This strategy follows a tiered approach driven by several key principles. In general, a tiered monitoring program will proceed through the development of a series of predictions regarding the transport, fate, and impact of disposed dredged material. Many of these predictions will be shaped by the site selection and site designation process.

Each tier should have defined unacceptable thresholds, null hypotheses, and sampling/data collection plans, plus predetermined management options if the threshold is exceeded. A proper design can be obtained by following Green's (1984) systematic approach.

In a tiered approach, each defined objective is monitored by testing a series of null hypotheses. Results that indicate the acceptance of the null hypothesis at any tier would prevent further, often more costly, monitoring at a more complex level. Results that indicate rejection of the null hypothesis will trigger monitoring in higher tiers and provide early indication to managers that a predetermined adverse effect may occur. This approach allows managers to take corrective actions and modify disposal activity before unacceptable impact occurs.

Multi-User Sites

Multi-user sites (those used by multiple Federal projects and private permittees) often create additional management challenges. Multi-user sites are becoming more widespread as a result of the environmental and economic difficulties in designating new sites. Because the Corps issues the

permits, it controls and has ultimate responsibility for the sites, and therefore should be responsible for site management. However, as proponents for permit projects are asked to cost-share in monitoring and other aspects, they demand a greater role in the management process, thus making the job of the site manager more complicated. Some of the obvious problems include less control of the timing and volumes of material that go into the site and increased requirements for inspection, monitoring, and data management. Often, innovative methods must be developed to fund the increased monitoring that is required. Probably the only universal truth is to get those involved together early and often, both to educate and to seek input. An additional technical note dealing specifically with multi-user sites is planned to allow others to benefit from experience gained in the New England Division and the New York and Seattle Districts.

Prescribed Management Tools and Alternatives

For all sites, managers should strive to determine in advance the complete range of management tools and actions that are to be employed when triggered by specified impacts or conditions. Careful analysis is required to ensure that all management tools are implementable and to identify and ensure the availability of the resources necessary for implementing these alternatives, including closure of the site.

Data Management and Reporting

The extent to which a site management plan succeeds will depend on how closely the generated data fit the needs of the site managers and how quickly the information reaches managers for decisionmaking. If the information provided is not linked to specific concerns or management decisions, it may be of little value. In addition, data must be in a format and of sufficient quality to be useful to site managers.

Regulating Use of Placement Sites

The site selection process or the site management plan may set limits or restrictions on the type of dredged material and the quantity of dredged material that may be disposed at the site. Applicable limits and conditions should be made provisions of projects that require the transportation and placement of dredged material. Some typical limits and restrictions include quantity limits, rate of dredged material placement, and seasonal restrictions.

Sediment Evaluation/Testing Requirements

The primary purpose of sediment testing and evaluation is to determine whether the sediment is suitable for open-water disposal. Data generated during this process are useful for the management plan as it will indicate the quantity and nature of sediment that may be placed at an open-water site as

well as its subsequent behavior, such as erosion, transport, and consolidation. These behavioral characteristics are important in determining site capacity and in protecting resources outside the boundaries of the site, and are frequently useful in the design of monitoring activities. National guidance is provided in "Evaluation of Dredged Material Proposed for Ocean Disposal; Testing Manual" (USEPA/USACE 1991), with regard to proposed placement at ocean sites, and in "Evaluation of Dredged Material Proposed for Discharge in Waters of the U.S. (Draft); Inland Testing Manual" (USEPA/ USACE 1994) for proposed placement at inland or near-coastal sites.

History of Dredged Material Disposal at the Site

The site management plan can be updated periodically to provide a summary description of the dredged material disposal activity that has taken place at the site. Information that may be of benefit includes

- Known historical uses of the proposed disposal site. Site plans may include a comprehensive listing or a summary of recent activity. The dates of dredged material disposal, the volume of dredged material, and a concise description of the grain size, chemical characteristics, and bioassay and bioaccumulation test results may be included.
- Review of transportation and disposal methods, conditions experienced, observations, lessons learned, difficulties, and similar information.
- Findings of monitoring studies that have been conducted at the site (that is, documented effects of other authorized placements that have been made in the disposal area).

Project Conditions

The District Engineer may impose specific conditions on projects requiring placement of dredged material at open-water sites. These conditions may range from specifying the type of equipment to be used to requiring participation in or sponsorship of specific monitoring studies. Those project conditions relative to the management of the site, specifically those conditions that site managers wish to have applied to all projects, may be itemized in the site management plan. In addition to the topics mentioned above, subjects of such conditions may include

- Equipment requirements (equipment for dredging, transportation and disposal, and navigation and positioning).
- Disposal methods (for example, only bottom dumps are allowed).
- Positioning of discharge and allowable tolerances in position (for example, position may be specified to localize areas of greatest benthic impact within the site).
- Debris removal.

- Overflow.
- Spillage, leakage of dredged material, and misplacement of dredged material.
- Record-keeping and reporting requirements.
- Inspection and surveillance.
- Quality assurance/quality control.
- Special study or monitoring requirements.
- Other miscellaneous provisions.

Specialized Procedures to Manage Open-Water Placement of Dredged Material

Material that is not suitable for unrestricted open-water disposal can sometimes be disposed at open-water sites by using specialized procedures such as time, location, and volume modifications; submerged discharge; lateral containment; thin-layer placement; capping; or treatment. The site management plan should identify the specialized tools and management practices appropriate for the site and specify the criteria leading to the use of such practices. Additional guidance on the process of evaluating these specialized procedures is provided in USEPA/USACE (1992). A brief overview of selected practices is provided below.

Time, Location, and Volume Modifications

Considerations for meeting water quality standards or criteria or toxicity criteria may require modifications of the discharge regime. The management plan should incorporate such modifications. Examples include siting of the discharge within the disposal site so as not to exceed constraints outside the boundary of the site, discharge at times when currents are minimal or maximal, or reducing the volume of sediment in each discharge. Of necessity, these will be site and sediment specific, and the management plan should, if necessary, address these on a case-by-case basis.

Submerged Discharge

Submerged discharge is a technique that may be considered to reduce or limit water column impacts. The use of a submerged point of discharge reduces the area of exposure in the water column and the amount of material suspended in the water column and susceptible to dispersion. The use of submerged diffusers can also reduce the exit velocities for hydraulic placement, allowing more precise placement and reducing both resuspension and spread of the discharged material. Considerations in evaluating the feasibility of a submerged discharge or use of a diffuser include water depth, bottom topography, currents, type of dredge, and site capacity. Further

discussion of these methods can be found in Neal, Henry, and Greene (1978) and Palermo and others (in preparation).

Lateral Containment

Lateral containment is a control measure that can be considered to reduce the area of benthic impact or the potential release of contaminants. The use of subaqueous depressions or borrow pits or the construction of subaqueous dikes can provide lateral containment of material reaching the bottom. Considerations in evaluating the feasibility of lateral confinement include type of dredge, water depth, bottom topography, bottom sediment type, and site capacity. Simply selecting a site amenable to lateral confinement, such as an existing bottom depression or valley, can be effective. Placement of material in constructed depressions such as abandoned borrow pits has also been proposed. Submerged dikes or berms for purposes of lateral confinement have been constructed or proposed at several sites. Such a proposal would not necessarily involve significant added expense to the project if the material used for the berm comes from the same or another dredging project.

Thin-Layer Placement

Placement of dredged material in a thin layer over wide areas is a management action that may be considered to offset physical effects due to burial (Nester and Rees 1988, Wilber 1993). Thin-layer placement allows benthic organisms to more easily burrow up through newly placed material and also increases the rate of recolonization of the disposal site.

Capping and Contained Aquatic Disposal

Capping is the controlled placement of a sediment at an open-water site followed by a covering or cap of sediment to isolate the original material from the adjacent environment. Capping is a control measure for the benthic contaminant pathway. Level bottom capping is a term used for capping without means of lateral confinement. If some form of lateral confinement is used in conjunction with the cap, the term "contained aquatic disposal" is used. Considerations in evaluating the feasibility of capping include site bathymetry, water depth, currents, potential for storm-induced erosion, physical characteristics of contaminated sediment and capping sediment, and placement equipment and techniques. Capping is generally preferred to be conducted in lower energy environments. However, if lower energy sites are unavailable, capping can be conducted in higher energy sites. For capping at higher energy sites, studies to determine the additional thickness of the outer layer for erosion protection are needed, along with more frequent monitoring.

Precise placement of material is necessary for effective capping, and the use of other control measures such as submerged discharge and lateral containment increases the effectiveness of capping. Guidelines for the planning and design of capping projects are available in Palermo (1991a,

1991b, 1991c); Palermo, Fredette, and Randall (1992); Palermo and others (in preparation); Sturgis and Gunnison (1988); and Truitt (1987a, 1987b).

Treatment

Treatment of discharges into open water may be considered to reduce certain water column or benthic impacts. For example, the Japanese have used an effective in-line dredged material treatment scheme for highly contaminated harbor sediments (Barnard and Hand 1978). However, this strategy has not been widely applied, and its effectiveness has not been demonstrated for solution of the problem of contaminant release during open-water disposal.

Summary

Management of open-water sites used for dredged material disposal is an integral and essential component of the Corps' regulatory responsibilities. Nationwide, several thousand such sites are required for dredged material disposal each year. These sites represent a wide range of physical, environmental, and regulatory conditions and challenges, and management requirements are as varied as the sites themselves.

This technical note provides field guidance on management tools and techniques for effective open-water site management and is based on the collective experiences and input of senior Corps professionals in this area. This guidance stresses a proactive approach to site management, wherein site management goals are clearly established initially, and site management objectives and actions are aimed at the prevention of adverse environmental impacts well in advance of their potential occurrence.

Specific management tools that are stressed include tiered management strategies, in which the complete range of management tools and actions that are to be employed (when triggered by specific impacts or conditions) are determined in advance; prospective monitoring protocols and strategies; and effective data management and reporting.

This guidance further stresses the need for all components of a site management plan to be implementable, cost-effective, practical, enforceable, and clearly applicable to the decisionmaking process.

Effective site management provides numerous benefits. The principal benefits are derived through ensuring the long-term availability of the disposal site, avoiding potential project delays, saving the cost of identifying/specifying an alternative site(s), and averting potential increases in transportation costs or other costs relative to alternative sites.

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