4.0 ASSESSMENT OF OPEN-WATER DISPOSAL

This chapter describes the detailed assessment of open-water disposal including testing and management options and control measures. The portion of the framework for detailed assessment of open-water disposal alternatives is illustrated in Flowchart 3-2. The paragraph numbers in the text are shown as appropriate in the flowchart. The detailed assessment described in this chapter may be performed following a determination of the need for such an assessment as described in Chapter 3.

4.1 Determination of Characteristics of Open-water Sites

A knowledge of site characteristics is necessary for assessments of potential physical impacts and contaminant impacts. Information on site characteristics needed for assessments may include the following:

- Currents and wave climate.
- Water depth and bathymetry.
- Potential changes in circulation patterns or erosion patterns related to refraction of waves around the disposal mound.
- Bottom sediment physical characteristics including sediment grain-size differences.
- Sediment deposition versus erosion.
- Salinity and temperature distributions.
- Normal levels and fluctuations of background turbidity.
- Chemical and biological characterization of the site and environs (e.g., relative abundance of various habitat types in the vicinity, relative adaptability of the benthos to sediment deposition, presence of submerged aquatic vegetation, and presence of unique, rare or endangered, or isolated populations).
- Potential for recolonization of the site.
- Previous disposal operations.
- Availability of suitable equipment for disposal at the site.
- Ability to monitor the disposal site adequately for management decisions.
- Technical capability to implement management options should they appear desirable.
- Ability to control placement of the material.
- Volumetric capacity of the site.
- Other site uses and potential conflicts with other activities (e.g., sport or commercial fisheries, shipping lanes, and military use).
- Established site management or monitoring requirements.
- Public and regulatory acceptability to use of the site.

4.1.1 Site Selection under MPRSA

The intent of the criteria for site selection is to avoid unacceptable, adverse impacts on biota and other amenities. This requires that sufficient information be assembled such that reasonable assurance can be given that the criteria will be met. As a rule, the majority of amenities, such as fishing, shipping, mineral extraction, spawning, breeding, nursery grounds, and cultural or historical features, may be addressed with existing information. If so, primary concern is then directed to biological resources in and adjacent to the proposed disposal site. These concerns are addressed by ensuring that any geographically limited or especially significant living resources are not present within the site nor outside the site in such a location as to be adversely impacted by movement of material off the site if it is a dispersive site (USACE/USEPA 1984). Resources within the site may suffer physical impacts from the deposition of the dredged material, and sites should be designated/selected to ensure such impacts are acceptable.

The criteria provide that ocean dumping sites will be designated beyond the edge of the continental shelf, wherever feasible, and at other sites that have been historically used unless monitoring data or other information indicate the potential for significant adverse impacts.

If little is known concerning the resources or the characteristics of the site and its environs, appropriate investigations and studies must be performed. The USACE has prepared an ocean-site designation manual (Pequegnat, Gallaway, and Wright 1990), which provides useful guidance and procedures for conducting the appropriate investigations and studies. In addition, overview manuals for site designation have been developed (USACE/USEPA 1984; USEPA 1986). Procedures for application of risk assessment to the aquatic environment can be found in Cura et al. (2001).

4.1.2 Site Specification under CWA

The specification of disposal sites under the CWA is addressed specifically in the Section 404 (b)(1) Guidelines. The Guidelines establish a sequential review of a proposed project, the first step of which is avoidance of adverse impacts to the aquatic environment through an evaluation of practicable alternatives which would have less impact on that environment [40 CFR 230.10 (a)]. In general, the same concerns as given above for ocean-site designation are applied to site specification under CWA. These include potential impacts on physical and chemical characteristics of the aquatic ecosystem, potential impacts on biological characteristics of the aquatic ecosystem, potential effects on special aquatic sites, and potential effects on human-use characteristics (40 CFR 230 Subpart C-F).

The specification of an appropriate site under CWA takes into account that CWA disposal sites may be located in estuaries, rivers, and lakes that may have limited assimilative capacity. Geographic and operational constraints as well as site capacity may severely constrain potentially available sites.

There are also special concerns if the site is a special aquatic site (e.g., a wetland) as defined in Section 404 (40 CFR 230 Subpart E). For example, if the proposed disposal site is a special aquatic site and the activity for which disposal is required is not water-dependent, the Guidelines presume that nonaquatic alternatives are available [40 CFR 230.10 (a) (3)].

Physical compatibility between the characteristics of the dredged material and proposed disposal site is not the sole factor to be used in determining compliance with the Guidelines. Other requirements of the Guidelines, specifically Section 230.10, must also be considered in the evaluation of dredged materials. In addition, under Section 230.11(g), the Guidelines require that the cumulative impact of the individual discharges of dredged material on the aquatic ecosystem be included in the evaluation of individual permits. Therefore, dredged material disposal, like all other discharges of dredged or fill material into waters of the United States, cannot be permitted unless it has been demonstrated to comply with all requirements of the CWA Section 404(b)(1) Guidelines.

The USACE and USEPA may jointly identify, in advance, sites generally suitable or unsuitable for discharge of dredged material (40 CFR 230.80). The advanced identification of sites does not permit or prohibit the discharge of dredged or fill material, but does facilitate individual or general permit application and processing. Under the authority of Section 404(c), however, USEPA may prohibit, withdraw, or restrict the discharge of dredged or fill material if it determines that the discharge would have unacceptable adverse effects. As mentioned previously, procedures for application of risk assessment to the aquatic environment can also be found in Cura et al. (2001).

4.1.3 Site Monitoring

Site monitoring may be a requirement resulting from the site designation/specification process, or may be required as a part of an established site management plan. Detailed guidance on site-monitoring equipment and techniques and on development of monitoring plans is available (Marine Board 1990; Pequegnat, Gallaway, and Wright 1990; Fredette et al. 1990a, 1990b).

4.2 Evaluation of Direct Physical Effects and Site Capacity

An evaluation of direct physical impacts and site capacity should precede any evaluations of potential contaminant impacts, since elimination of alternatives or sites based on unacceptable physical impacts or inadequate site capacity is needed prior to testing for contaminant effects.

4.2.1 Direct Physical Impacts

Direct physical impacts will almost always result from the disposal of dredged material. Benthic organisms at the disposal site may be buried and may not be able to migrate through the material. If the substrate is changed from what was previously

present, the organisms which recolonize the site may be different from those present prior to disposal.

Suspended solids may also affect water column organisms, although these effects are uncommon because of the large dilution factor. Potential physical effects are addressed during the site designation/specification process. If at all possible, a site should not be located where significant undesirable effects will occur on or off the site. Prior to disposal, the physical characteristics of the material should be evaluated to determine if it is compatible with the use of a particular site. Models are frequently used to predict the behavior of the material during and after disposal, and, in some instances, monitoring may be needed to verify the model predictions. Both USACE and USEPA have generated a large database on potential physical effects through the large number of site-designation surveys performed nationwide.

If site conditions and uses are unchanged, collection of additional data to evaluate direct physical impacts would generally be unnecessary for evaluation of a proposed discharge of material under MPRSA because such impacts were evaluated as a part of the site-designation process as well as during the site monitoring and management activities. However, for Section 404 open-water disposal, direct physical impacts must be considered as a part of the site-specification process for the specific discharge. Under both MPRSA and CWA, appropriate site management and monitoring concerns must be addressed.

4.2.2 Site Capacity

The physical capacity of predominantly nondispersive sites to hold the dredged material without (1) resuspension and transport of disposed material by surface waves or (2) interference with navigation traffic or other operational conflicts, must also be evaluated. This may involve (1) setting a maximum height for mounds of disposed dredged material or (2) estimating mounding rates over the long term, taking into account erosion and consolidation of the mound (Dortch et al. 1990; Scheffner 1991; Poindexter-Rollings 1990). Site capacity of predominantly dispersive sites is not normally a concern.

4.2.3 Need for Management Actions

If the evaluation of direct physical impacts and evaluation of site capacity indicate that the site is adequate, the evaluation of contaminant pathways can be initiated. If the evaluations of direct physical impacts and site capacity indicate unacceptable impacts will result, or that site capacity is inadequate, management actions are required to reduce physical impacts. Management actions to reduce physical impacts to acceptable levels may include operational modification, submerged discharge, lateral confinement, or thin-layer placement. These same management approaches can be considered to extend the physical capacity of the site. Management actions are described in paragraph 4.4. If the management actions are determined to be effective, the evaluation of contaminant pathways can be initiated. If not, then the open-water disposal alternative at the site under consideration should be eliminated.

4.3 Evaluation of Contaminant Pathways of Concern

The main emphasis of contaminant pathway testing for open-water disposal is aimed at determining if a given dredged material is acceptable for open-water disposal from the standpoint of contamination. If dredged material is found to be environmentally unacceptable for disposal in the ocean, it also would probably be environmentally unacceptable for disposal in Section 404 waters.

As shown in Figure 4-1, the potential contaminant pathways for open-water disposal are water column and benthic. Water-column contaminant impacts must be considered from the standpoint of water quality (chemical) and toxicity (biological). Benthic impacts must be considered from the standpoint of toxicity and bioaccumulation. A tiered approach to contaminant testing and assessments is described in detail in the dredged material testing manuals for MPRSA and CWA (USEPA/USACE 1991; USEPA/USACE 1998; USACE 2003).

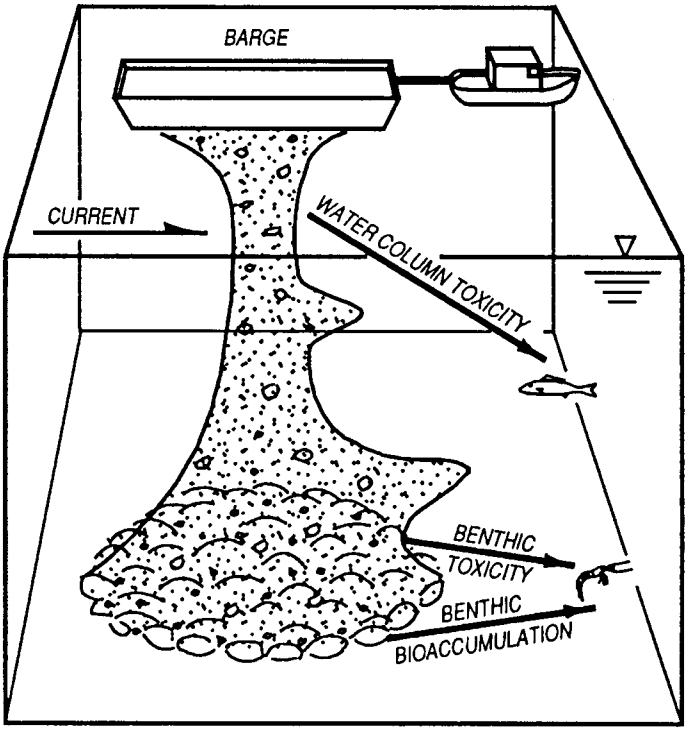

Figure 4-1. Contaminant Pathways for Open-water Disposal

4.3.1 Water-Column Impacts

Potential water-column contaminant effects are evaluated by comparing contaminant release in an elutriate of the material to be disposed with applicable water-quality criteria or standards as appropriate. In addition, acute water-column toxicity bioassays considering initial mixing may be needed. The procedures to be used in elutriate or water-column bioassays are provided in the MPRSA and CWA testing manuals (USEPA/USACE 1991; USEPA/USACE 1998; USACE 2003). For disposal operations under the MPRSA, specific criteria for water quality and water-column toxicity must be met, and specific allowances are specified for initial mixing (USEPA/USACE 1991). For disposal operations under CWA, water quality and water-column toxicity standards and allowances for initial mixing are specified by the States as a part of the Section 401 water-quality certification requirements. Models are available for mixing calculations (USEPA/USACE 1991; USEPA/USACE 1998; USACE 2003).

4.3.2 Benthic Impacts

In assessing potential benthic effects of contaminants under MPRSA, if the exclusion criteria of 40 CFR 227.13 (b) are met, biological testing of the dredged material is not necessary. If the exclusion criteria are not met, toxicity and bioaccumulation information is required to evaluate the suitability of the material for disposal. If disposal is under the authority of the CWA, a chemical comparison of the material to be disposed and a reference sediment may be conducted. If contaminant concentrations in the dredged material and an adjacent disposal site are substantially similar and contaminants will not leave the adjacent disposal site or if controls are available to reduce contamination to acceptable levels within the disposal site, no further evaluation may be required [40 CFR 230.60(c) and (d)]. If this is not the case, bioassays and bioaccumulation tests are required to complete the evaluation.

Contaminants may affect benthic organisms through acute toxicity or by the uptake of the contaminants (bioaccumulation). The evaluations compare acute toxicity and/or bioaccumulation in benthic organisms exposed to the material to be disposed with organisms exposed to a reference sediment. Procedures for conducting and interpreting the acute toxicity and bioaccumulation evaluations are described in detail in the MPRSA Ocean Testing Manual (USEPA/USACE 1991) and CWA Inland Testing Manual (USEPA/USACE 1998). The Upland Testing Manual (USACE 2003) provides detailed procedures for evaluation of dredged material proposed for disposal at CDFs.

4.3.3 Need for Contaminant Controls

If the contaminant pathway testing indicates that the impact Criteria or Guidelines are met, the open-water disposal alternative is environmentally acceptable from the standpoint of contaminant effects. If the impact Criteria or Guidelines are not met, contaminant control measures must be considered to reduce impacts to acceptable levels if the open-water alternative is to be further considered.

Control measures to minimize contaminant impacts may include operational modification, submerged discharge, lateral confinement, treatment, and capping. These control measures are described in paragraph 4.4. If the control measures are determined to be effective, then the alternative is environmentally acceptable from the standpoint of contaminants. If not, then the open-water disposal alternative at the site under consideration should be eliminated.

4.4 Evaluation of Management Actions and Controls for Open-water Disposal

In cases where evaluations of direct physical impacts, site capacity, or contaminant pathways indicate the Criteria or Guidelines will not be met when conventional open-water disposal techniques are used, a variety of management actions and contaminant control measures may be considered. Such techniques include operational modifications, use of subaqueous discharge points, use of diffusers, subaqueous lateral confinement of material, thin-layer placement, or capping of contaminated material with clean material.

Descriptions of the commonly used management actions and contaminant controls are given in the following paragraphs. Additional guidance on selection of contaminant controls for open-water disposal is found in Francingues et al. (1985), Cullinane et al. (1986), and Truitt (1987a and 1987b).

The primary consideration in selecting management or control options is to identify the impacts to be addressed by the management or control options and choose an option that best addresses the issue(s) of concern. The management and contaminant controls discussed in this section are to be considered and implemented on both a site-specific and case-specific basis. General considerations for each option are presented within each section below. It is important to note that not all options work under all situations or in all cases. Before any option is selected for implementation, a complete review of the material-specific and site-specific conditions and circumstances should be completed.

4.4.1 Modification of Dredging and Disposal Operations

Modifications of dredging and disposal operations can be an effective control for both physical effects and water-column or benthic contaminant pathways. The purpose of operational modification as a control is to reduce water-column dispersion and/or spread of material on the bottom. The most obvious control measure for open-water disposal is a modification in the technique or equipment used for placement. For example, if water-column concentrations of dredged material exceed water-quality criteria or toxicity criteria for a proposed hopper dredge discharge, an operational modification to clamshell dredging with discharge from barges would reduce the water-column release. Discharge of mechanically dredged material from barges also results in less spread of material as compared with hopper discharge. Other operational modifications include constraints on location of disposal, rate of disposal, and timing of disposal.

4.4.2 Submerged Discharge

Submerged discharge is a control measure which may be considered to reduce 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 susceptible to dispersion. The use of submerged diffusers also reduces the exit velocities for hydraulic placement, allowing more precise placement and reducing both resuspension and spread of the discharged material. Considerations in evaluating feasibility of a submerged discharge and/or use of a diffuser include water depth, bottom topography, currents, type of dredge, and site capacity. Design specifications for submerged diffusers are available, and the diffusers have been successfully used for disposal operations (Neal, Henry, and Green 1978, Palermo 1994).

4.4.3 Lateral Containment

Lateral containment is a control measure which may be considered to reduce benthic impacts. The use of subaqueous depressions or borrow pits or the construction of subaqueous dikes can provide containment of material reaching the bottom during open-water disposal, resulting in a reduced bottom area being affected by the placement. Such techniques reduce the areal extent of a given disposal operation, thereby reducing both physical benthic effects and the potential for release of contaminants. Considerations in evaluating feasibility of lateral containment include type of dredge, water depth, bottom topography, bottom sediment type, and site capacity.

Simply selecting a site amenable to lateral containment 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 containment have been constructed or proposed at several sites. Such a proposal would not necessarily involve added expense to the project if the material used for the berm comes from the same or another dredging project.

4.4.4 Thin-Layer Placement

The intentional spreading of hydraulically pumped dredged material over broad areas to achieve overburdens less than 12 inches thick has been termed “thin-layer” placement. The objective of thin-layer placement is to minimize impacts on benthic fauna and to speed their recovery, particularly in estuarine environments. This strategy is based upon knowledge that a portion of the benthos can migrate upward through the dredged material overburden, usually present as a fluid mud layer. This concept has been developed and demonstrated in Mississippi Sound by the Mobile District. Results of monitoring studies indicated that recovery was enhanced in shallow, turbid Gulf coast estuaries. A distinction should be made between thin-layer placement in open-water applications and high-pressure spray disposal on marsh surfaces. Although sometimes referred to as thin-layer placement, the latter case involves different equipment requirements and generally is suitable for relatively small volumes of dredged material, whereas open-water thin-layer placement uses conventional hydraulic equipment (with

modification of the discharge terminus for mobility) and is potentially suitable for large quantities of dredged material. There are few references in the literature on this topic. A brief discussion can be found in Nester and Rees (1988).

4.4.5 Capping and Contained Aquatic Disposal

Capping is the controlled placement of contaminated material at an open-water site followed by a covering or cap of clean isolating material. Capping is a control measure for the benthic contaminant pathway. Level bottom capping is a term used for capping without means of lateral containment. If some form of lateral containment 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, wave climate, physical characteristics of contaminated sediment and capping sediment, and placement equipment and techniques. Because long-term stability of the cap is of concern, capping is generally considered to be more technically feasible in low-energy environments. Precise placement of material is necessary for effective capping, and use of other control measures such as submerged discharge and lateral containment increase the effectiveness of capping. Guidelines and recommendations are available for planning and design of capping projects (Palermo et al. 1998a and 1998b; Fredette et al. 2000).

4.4.6 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.

4.4.7 Monitoring

Monitoring is a management action which may be used to establish the effectiveness of other specific management actions and the need for modification of such actions, the necessity of which is a case-by-case decision. Technical guidance for monitoring open-water disposal sites (physical and biological) is available (Marine Board 1990; Fredette et al. 1990a, 1990b).

4.5 Retention of Environmentally Acceptable Open-water Alternatives

Once appropriate open-water assessments are complete, a determination of environmental acceptability is made. This determination must ensure that all applicable standards or criteria are met. If control measures were considered, a determination of the effectiveness of the control measure in meeting the standards or criteria must be made. If all standards or criteria are met, the open-water alternative can be considered environmentally acceptable. At this point in the framework, other factors can be considered in the selection of an alternative as described in paragraph 3.6 and Chapter 7.